PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE

May 14, 2019

Advice Letter 5302-E-B
5302-E-C

Erik Jacobson
Director, Regulatory Relations
Pacific Gas and Electric Company
77 Beale Street, Mail Code B10C
P.O. Box 770000
San Francisco, CA 94177

SUBJECT: Additional Modifications to the Electric Rule 21 Changes made in PG&E AL 5129-E for Phase 3 Smart Inverters Pursuant to Resolution E-4898.

Dear Mr. Jacobson:

Supplemental Advice Letter 5302-E-B and Supplemental Advice Letter 5302-E-C is effective as of February 20, 2019.

Sincerely,

Edward Randolph

Edward Randolph
Deputy Executive Director for Energy and Climate Policy/
Director, Energy Division

Erik Jacobson
Director
Regulatory Relations

Pacific Gas and Electric Company
77 Beale St., Mail Code B13U
P.O. Box 770000
San Francisco, CA 94177

Fax: 415-973-3585

February 20, 2019

Advice 5302-E-C
(Pacific Gas and Electric Company ID U 39 E)

Public Utilities Commission of the State of California

Subject: **Third Supplemental: Additional Modifications to the Electric Rule 21 Changes made in PG&E Advice Letter 5129-E for Phase 2 and 3 Smart Inverters Pursuant to Resolution E-4898**

Purpose

The purpose of this supplemental advice letter is to make additional modifications to Electric Rule 21, *Generating Facility Interconnections*, to incorporate a six month extension of time (until August 22, 2019) to comply with the deadline for Smart Inverter Phase II communication requirements, pursuant to (i) Resolution E-4832[1], Ordering Paragraph (OP) 2 and 4, and for Phase III Functions 1 and 8, (ii) Resolution E-4898[2], OP 2.a. and (iii) the January 2, 2019, letter from the California Public Utilities Commission (CPUC or Commission) modifying the timelines. While this advice letter supplements but does not entirely superseded Advice Letter 5302-E-B, the tariffs in attachment 2 entirely supersede the tariffs in Advice 5302-E-B.

Background

On August 18, 2017, Pacific Gas and Electric Company (PG&E) submitted Advice Letter (AL) 5129-E[3] ("Modifications to PG&E's Electric Rule 21 Tariff and Interconnection Agreements and Forms to Incorporate Smart Inverter Phase 3 Modifications") in compliance the CPUC Decisions (D.) 14-12-0351 and 16-06-0522 that addresses Phase 2 and 3 recommendations of the Smart Inverter Working Group (SIWG), (PG&E to update Electric Rule 21 Tariff in order to facilitate smart inverter deployment.

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1 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*.

2 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.

3 AL5129-E *Modifications to PG&E's Electric Rule 21 Tariff and Interconnection Agreements and Forms to Incorporate Smart Inverter Phase 3 Modifications*

Resolution E-4832 was issued April 6, 2018. E-4832 approved with modification PG&E's AL 4982-E making revisions to PG&E's Electric Tariff Rule 21 to incorporate the Smart Inverter Working Group (SIWG) Phase 2 Communications Recommendations in Compliance with D. 16-06-052. E-4832 set a deadline to comply with the Smart Inverter Phase II communications requirements. OP 2[4] requires:

> 2. For the three IOUs, the new subsection will become mandatory for generating facilities utilizing inverter-based technologies for which an interconnection request is submitted on or after the effective date which is 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.** (emphasis added)

Following up on AL 5129-E, Resolution E-4898 was issued a few weeks after E-4832 on April 26, 2018. E-4898 approved, with modifications PG&E's Advice Letter 5129-E, *Request for Modifications to Electric Rule 21 Tariff to Incorporate Smart Inverter Phase 3 Advanced Functions in Compliance with Decision 16-06-052*. E-4898 modified, among other things, the effective date of the Phase III Functions 1 and 8 capability requirements to February 22, 2019.[5] OP2.a requires:

> 2. Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric shall each file a supplemental Tier 1 compliance Advice Letter within 30 days to modify Electric Rule 21 Tariff to incorporate the changes as ordered herein:
>
> a. The IOUs shall incorporate the consensus-based effective dates in Table 2 of this Resolution;

Table 2:

Table 2: Final Effective Dates Function	**Effective Date**
Function 1 Monitor Key DER Data	9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 2 DER Disconnect and Reconnect Command (Cease to	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE

[4] OP 4 pertains specifically to San Diego Gas and Electric's advice letter, and is not germane to PG&E.

[5] The final date was based on the July 1, 2018 letter sent by the Executive Director of the Energy Division, based on the Sunspec effective date.

Energize and Return to Service)	1547.1 standard revision.
Function 3 Limit Maximum Active Power Mode	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
Function 4 Set Active Power Mode	12 months after approval of a nationally recognized standard that includes the function.
Function 5 Frequency Watt Mode	9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 6 Volt Watt Mode	9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 7 Dynamic Reactive Support	12 months after approval of a nationally recognized standard that includes the function.
Function 8 Scheduling Power Values and Modes	9 months following SunSpec Alliance Communication Protocol Certification Test Standard.

Since AL 5129-E and was no longer pending but is approved by E-4898 OP 1, PG&E submitted a new Advice Letter rather than a supplement.

Pursuant to Resolution E-4898 OP 2, **AL 5302-E**[6] was submitted May 25, 2018. AL 5302-E among other changes, set the effective date for Functions 1, 5, 6, and 8 along with the communications requirements to February 22, 2019.

Parties IREC and CALSSA[7] protested AL 5302-E on June 14, 2018, on 11 issues.

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[6] AL 5302-E *Additional Modifications to the Electric Rule 21 Changes made in PG&E Advice Letter 5129-E for Phase 3 Smart Inverters Pursuant to Resolution E-4898*

[7] IREC is the Interstate Renewable Energy Council
CALSSA is the California Solar and Storage Association

On July 11, 2018, while the above changes to AL 5302-E were going on, the Director of the Energy Division sent out a letter "Clarification of deadlines for adoption of smart inverter Phase 2 requirements and Functions 1, 5, 6, and 8 of Phase 3" effectively established the effective date as February 22, 2019. Based on the SunSpec Alliance approval of the SunSpec Common Smart Inverter Profile (CSIP) Conformance Test Procedures on May 22, 2018, "Phase 2 and Functions 1, 5, 6, and 8 of Phase 3 will become mandatory for generating facilities using inverter-based technologies for which an interconnection request is submitted on or after February 22, 2019.

Advice Letter 5302-E-A[8] was submitted on September 19, 2018, as a supplement to AL 5302-E in response to the protest submitted. It replaced AL 5302-E in its entirety11[9].

On September 25, 2018, IREC submitted additions changes to AL 5302-E-A. On October 16, 2018, PG&E addressed those additional changes in supplemental AL 5302-B[10].

Separately, due to the complex technical and procedural nature of the rollout of the Smart Inverter capabilities, on November 19, 2018, CALSSA submitted a petition-for-modification requesting a six-month extension of the deadline (from February 22, 2019, to **August 22, 2019**) to comply with both the Smart Inverter Phase II communications and Phase III, Functions 1 and 8, as established by E-4898.

Subsequently, on January 2, 2019, CALSSA's request was approved in a letter issued by the Executive Director of the CPUC (Attachment 1). Specifically, the letter stated:

> "In conclusion, the compliance deadline for Smart Inverter Phase II communications requirements, pursuant to Resolution E4832, OP2 and 4, and Phase III **Function1 and 8**, pursuant to Resolution E-4898, OP2.a is extended to August 22, 2019."

The new effective date of these requirements is now August 22, 2019.

Accordingly, in this Tier 1[11] advice letter PG&E updates the associated communications, Function 1 and 8 date references in Rule 21 from February 22, 2019 to August 22, 2019.

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[8] AL 5302-E- A *Supplemental: Additional Modifications to the Electric Rule 21 Changes made in PG&E Advice Letter 5129-E for Phase 3 Smart Inverters Pursuant to Resolution E-489*8

[9] In an email from Energy Division sent: Monday, July 30, 2018 6:23 PM with subject: RE: Rule 21: IOU's interpretation of "default settings" as referenced in Resolution E-4898, it was stated: "…IOUs, please remember to file the supplemental replacing the original in its entirety…"

[10] AL 5302-E-B *Second Supplemental: Additional Modifications to the Electric Rule 21 Changes made in PG&E Advice Letter 5129-E for Phase 3 Smart Inverters Pursuant to Resolution E-4898*

[11] AL 5302-E, -A, -B were all Tier 1 per E-4898 OP 2.

Tariff Revisions

Smart Inverter Timeline Changes

1) On Rule 21 Sheet 201, in Section:

Hh.Smart Inverter Generating Facility Design And Operating Requirements
2. Prevention Of Interference
p. Phase 3 Function
Table of Phase 3 Effective Dates Pursuant to Resolution E-4898

- Function1 – Monitor Key DER Data – in the Effective Date column, replaced "February 22, 2019" with "August 22, 2019."

- Function 8 – Scheduling Power values and Modes - in the Effective Date column, replaced "February 22, 2019" with "August 22, 2019."

2) Communications - On Rule 21 Sheet 204, in Section:

Hh.Smart Inverter Generating Facility Design And Operating Requirements
5. Communication Requirements
a. The communication protocol requirements…

- In the first paragraph, replaced "February 22, 2019" with "August 22, 2019."

3) Scheduling - On Rule 21 Sheet 207, in Section:

Hh.Smart Inverter Generating Facility Design And Operating Requirements
6.Scheduling Capability Requirements
a. Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities …

- In the first paragraph, replaced "February 22, 2019" with "August 22, 2019."

4) Monitoring - On Rule 21 Sheet 209, in Section:

Hh.Smart Inverter Generating Facility Design And Operating Requirements
7. Monitoring And Telemetry Requirements
a. The capability for this requirement will be mandatory…

- In the first paragraph, replaced "February 22, 2019" with "August 22, 2019."

Protests

Anyone wishing to protest this filing may do so by letter sent via U.S. mail, facsimile or E-mail, no later than March 12, 2019, which is 20 days after the date of this filing. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
505 Van Ness Avenue, 4th Floor
San Francisco, California 94102

Facsimile: (415) 703-2200
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

Erik Jacobson
Director, Regulatory Relations
c/o Megan Lawson
Pacific Gas and Electric Company
77 Beale Street, Mail Code B13U
P.O. Box 770000
San Francisco, California 94177

Facsimile: (415) 973-3582
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, telephone number, postal address, and (where appropriate) 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

PG&E requests that this Tier 1 advice letter become effective upon date of submittal, which is February 20, 2019.

Notice

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the parties on the service lists for R.11-09-011 and R.17-07-007. 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 filings can also be accessed electronically at: http://www.pge.com/tariffs/.

/S/
Erik Jacobson
Director, Regulatory Relations

Attachments
Attachment 1: Jan 2, 2019 letter from Exec Dir of CPUC – Alice Stebbins
Attachment 2: Clean Tariffs
Attachment 3: Redline Tariffs

cc: Service Lists R.11-09-011 and R.17-07-007

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: Yvonne Yang
Phone #: (415) 973-2094
E-mail: PGETariffs@pge.com
E-mail Disposition Notice to: QXY1@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) #: 5302-E-C

Tier Designation: 1

Subject of AL: Third Supplemental: Additional Modifications to the Electric Rule 21 Changes made in PG&E Advice Letter 5129-E for Phase 2 and 3 Smart Inverters Pursuant to Resolution E-4898

Keywords (choose from CPUC listing): Compliance, Rules

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

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #: E-4898

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: N/A

Confidential treatment requested? ☐ Yes ☑ No

If yes, specification of confidential information: N/A
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: N/A

Resolution required? ☐ Yes ☑ No

Requested effective date: 2/20/19 No. of tariff sheets: 16

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: Electric Rule 21

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

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102
Email: EDTariffUnit@cpuc.ca.gov

Name: Erik Jacobson, c/o Megan Lawson
Title: Director, Regulatory Relations
Utility Name: Pacific Gas and Electric Company
Address: 77 Beale Street, Mail Code B13U
City: San Francisco
State: California Zip: 94177
Telephone (xxx) xxx-xxxx: (415) 973-1877
Facsimile (xxx) xxx-xxxx: (415) 973-3582
Email: PGETariffs@pge.com

Name:
Title:
Utility Name:
Address:
City:
State: District of Columbia Zip:
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email:

Clear Form

Advice 5302-E-C
February 20, 2019

Attachment 1

Jan 2, 2019 letter from Exec Dir of CPUC – Alice Stebbins

STATE OF CALIFORNIA Edmund G. Brown Jr., Governor

PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298

January 2, 2019

Erik Jacobson
Director, Regulatory Relations
Pacific Gas & Electric Company
77 Beale Street, Mail Code B13U
P.O. Box 770000
San Francisco, CA 94177

Gary A Stern
Managing Director, State Regulatory Operations
Southern California Edison Company
8631 Rush Street
Rosemead, CA 91770

Clay Faber
Director, Federal & CA Regulatory
San Diego Gas & Electric
8330 Century Park Court
San Diego, CA 92123

RE: Request of the California Solar & Storage Association for Extension of Time to Comply with Rule 21 Smart Inverter Communications Requirements

Dear Mr. Jacobson, Mr. Stern, and Mr. Faber:

Under the authority provided for in the Commission's Rules of Practice and Procedure, Section 16.6, the compliance deadline for Smart Inverter Phase II communications requirements, pursuant to Resolution E-4832, OP 2 and 4, and for Phase III Functions 1 and 8, pursuant to Resolution E-4898, OP 2.a, is extended to August 22, 2019.

This deadline extension letter is in response to the letter of November 19, 2018 from the California Solar & Storage Association (CALSSA). CALSSA requested a six-month extension of the deadline to comply with the Smart Inverter Phase II communications requirements ordered in Resolution E-4832 and an equivalent delay in the deadline for compliance with Phase III Functions 1 and 8, as established by Resolution E-4898 (the "deadline extension request" or "CALSSA request"). This request would extend the deadline from February 22, 2019 to August 22, 2019.

CALSSA served its request on the service list of Rulemaking (R.) 11-09-011 and of R.17-07-007. Southern California Edison and Pacific Gas & Electric responded to the CALSSA request affirming their non-opposition to the deadline extension request.

Due to the complex technical and procedural nature of the rollout of Rule 21 smart inverter capabilities, the complete background and discussion of the CALSSA request have been appended to this letter; see Appendix A.

We find that the extension requested by CALSSA is necessary. Additional time will provide both industry and the utilities more opportunity to smoothly roll of this rule change.

This deadline extension request applies only to the Smart Inverter Phase II communications requirements and to Functions 1 and 8 of the Smart Inverter Phase III requirements. It does not affect Smart Inverter Phase III Functions 5 or 6, which, pursuant to Resolution E-4898, OP 2.a, will be required for all inverter-based generating facilities as of February 22, 2019.

In conclusion, the compliance deadline for Smart Inverter Phase II communications requirements, pursuant to Resolution E-4832, OP 2 and 4, and for Phase III Functions 1 and 8, pursuant to Resolution E-4898, OP 2.a, is extended to August 22, 2019.

Sincerely,

Alice Stebbins
Executive Director

cc: Brad Heavner, Policy Director, California Solar & Storage Association
Service Lists of R.17-07-007 and R.11-09-011
Kelly Hymes, Administrative Law Judge
Michael Picker, Commissioner
Forest Kaser, Advisor, Office of President Michael Picker
Geoffrey Dryvynsyde, Assistant Chief Counsel
Elizabeth Dorman, Principal Counsel

APPENDIX A: Background and Discussion of the California Solar & Storage Association's (CALSSA) Request for Extension of Time to Comply with Smart Inverter Phase II Communications Requirements and Phase III Functions 1 and 8

The California Public Utilities Commission (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 the California investor-owned utilities (IOUs). In early 2013, the Smart Inverter Working Group was formed by parties of R.11-09-011 to develop proposals to take advantage of the new, rapidly advancing technical capabilities of inverters. The Smart Inverter Working Group (SIWG) submitted recommendations for Smart Inverter Phase II communications requirements in February 2015 and for Smart Inverter Phase III advanced functions in March 2016.

In June 2016, the Commission incorporated those recommendations into D.16-06-052, which directed the IOUs to file implementing advice letters within six months.

On December 20, 2016, the IOUs proposed Rule 21 revisions to incorporate the Phase II recommendations with a deadline of "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." Resolution E-4832 approved these revisions.

In August 2017, the IOUs proposed Rule 21 revisions to incorporate the Phase III recommendations. Resolution E-4898 approved the proposed revisions and adopted a deadline of the "[l]ater of March 1, 2018 or 9 months after the release of SunSpec Alliance Approved Test Procedure (or another industry-recognized protocol standard)."

The SunSpec Alliance released its Common Smart Inverter Profile (CSIP) on May 22, 2018, which established February 22, 2019 as the compliance date for generating facilities to have the functions described above.

Following the release of the CSIP, the SIWG recognized gaps in the certification regime. For example, while the Rule 21 tariff allows for communications between a generating facility and a utility to be mediated through an aggregator or energy management system (EMS), the CSIP procedures do not provide for end-to-end testing and consider communications between a generating facility and an aggregator or EMS to be out of scope. In August 2018, the SIWG began weekly meetings to address these implementation issues. On October 26, 2018, at the request of the Commission's Energy Division Staff and the parties of the SIWG, the IOUs released implementation plans describing their approaches to meeting the February 22 deadline ("implementation plans"). Subsequent discussion of the implementation plans indicated to Energy Division Staff that the plans needed more work to address the implementation challenges associated with both the deadline and other unforeseeable practical issues.

Given the need to continue discussions and seek greater clarity on how to proceed, the California Solar & Storage Association (CALSSA) determined that a deadline extension would be

beneficial to its members who construct generating facilities. On November 19, 2018, CALSSA requested a six-month extension of the deadline to comply with the Smart Inverter Phase II communications requirements ordered in Resolution E-4832 and an equivalent delay in the deadlines for compliance with Phase III Functions 1 and 8 contained in Resolution E-4898. CALSSA did not request a delay of other deadlines in Resolution E-4898.

On December 6, 2018 and December 10, 2018, respectively, Southern California Edison (SCE) and Pacific Gas & Electric (PG&E) noticed the service lists for R.11-09-011 and R.17-07-007 of their non-opposition to the CALSSA extension request. San Diego Gas & Electric (SDG&E) staff stated in a R.17-07-007 working group meeting on December 12, 2018 that SDG&E also intended to notice the service lists of their non-opposition.

In the same working group meeting, CALSSA stated an intention to submit a Proposal for Modification (PFM) of Resolutions E-4832 and E-4898. According to CALSSA's verbal statement, it plans to request that the Commission address specific implementation parameters of the Phase II and III functions under discussion in the CALSSA deadline extension request.

The deadline extension is necessary due to a variety of circumstances. First, the implementation of smart inverter communications requirements was unexpectedly complicated. While the SunSpec CSIP was expected to fulfill the testing and certification needs of industry and of the utilities, it left significant gaps. Moreover, no government agency currently oversees the CSIP or vets testing labs to carry out the test procedures specified therein. These issues were compounded by the late release of the IOUs' implementation plans, which were provided to equipment manufacturers and developers of generating facilities on October 26, 2018—less than four months before the existing deadline. While these implementation plans were intended to provide clarity on the roll out of this new set of requirements, they generated additional uncertainty and controversy.

The extension will provide equipment manufacturers and developers of generating facilities with additional time to prepare for the forthcoming requirements. Hence, Energy Division staff find it appropriate to grant a six-month extension. As such, the deadline for compliance with the Smart Inverter Phase II communications requirements and with Phase III Functions 1 and 8 is extended to October 22, 2019.

This deadline extension applies only to the Smart Inverter Phase II communications requirements and to Functions 1 and 8 of the Smart Inverter Phase III requirements. It does not affect Smart Inverter Phase III Functions 5 or 6, which, pursuant to Resolution E-4898, OP 2.a, will be required for all inverter-based generating facilities as of February 22, 2019.

Cal P.U.C. Sheet No.	Title of Sheet	Cancelling Cal P.U.C. Sheet No.
43700-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 196	43195-E
43701-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 197	43196-E
43702-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 198	43197-E
43703-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 199	43198-E
43704-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 200	43199-E
43705-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 201	43200-E
43706-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 202	43201-E
43707-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 204	43202-E
43708-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 207	43203-E
43709-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 208	43204-E
43710-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 209	43205-E
43711-E*	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 210	43206-E
43712-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 211	43207-E
43713-E	ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS Sheet 212	43208-E

Cal P.U.C. Sheet No.	Title of Sheet	Cancelling Cal P.U.C. Sheet No.
43714-E*	ELECTRIC TABLE OF CONTENTS Sheet 1	43642-E*
43715-E*	ELECTRIC TABLE OF CONTENTS Sheet 20	43006-E

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

k. Ramp Rate Requirements

The Smart Inverter is required to have the following ramp controls for at least the following four conditions. These functions can be established by multiple control functions or by one general ramp rate control function. Ramp rates are contingent upon sufficient energy available from the Smart Inverter.

- Normal ramp-up rate: For transitions between energy output levels over the normal course of operation. The default value is 100% of maximum current output per second with a range of adjustment between 1% to 100%, with specific settings as mutually agreed by the Distributor Provider and the Producer.

- Connect/Reconnect Ramp-up rate: Upon starting to inject power into the grid, following a period of inactivity or a disconnection, the inverter shall be able to control its rate of increase of power from 1 to 100% maximum current per second. The default value is 2% of maximum current output per second, with specific settings as mutually agreed upon by the Distribution Provider and the Producer.

l. Frequency-Watt Requirements

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. (T) I (T)

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date. (N) (N)

Smart Inverters shall reduce their real power production as a function of system frequency, in accordance with the following:

- When system frequency exceeds 60.036 Hz, the active power output produced by the Smart Inverter shall be reduced by 50% of real power nameplate rating per hertz (5% of real power nameplate rating reduction per 0.1 hertz) (T)

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

l. Frequency-Watt Requirements (Cont'd.)

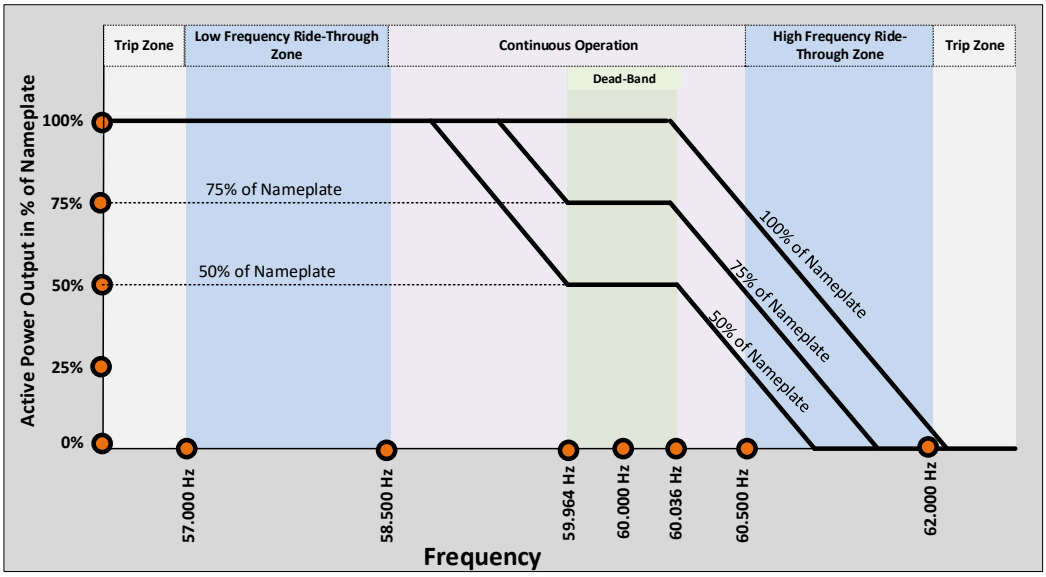
- When system frequency moves under 59.964 Hz, the active power output produced by the Smart Inverter shall be increased by 50% of real power nameplate rating per hertz (5% of real power nameplate rating increase per 0.1 hertz) when inverter is capable of increasing real power production. (T)

- The default dead-band should be +/- 0.036 Hz from 60 Hertz (59.964 Hz to 60.036 Hz). When the system frequency is in range of 59.964 Hz and 60.036 Hz, the Smart Inverter is not required to decrease power as a function of system frequency. (T) I (T) (D)

- Open loop response time for Frequency –Watt shall be 5 seconds.

- Figure Hh-2 illustrated this requirement for three levels of output power. Figure Hh-2 is for illustration purposes only.

Figure Hh-2: Active Power as a Function of System Frequency



Note: the frequency markers on the horizontal axis are not drawn to scale. (N)

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

m. Voltage-Watt Default Settings Requirements (T)

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. (T) I (T)

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date. (N) (N)

Smart Inverters shall reduce their real power production as a function of measured voltage at the inverter terminals 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 (for 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 – illustrates the required rate of reduction. When export of active power is controlled, a certified inverter and control system shall be used. (N) (N) (N) (N)

(Continued)

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

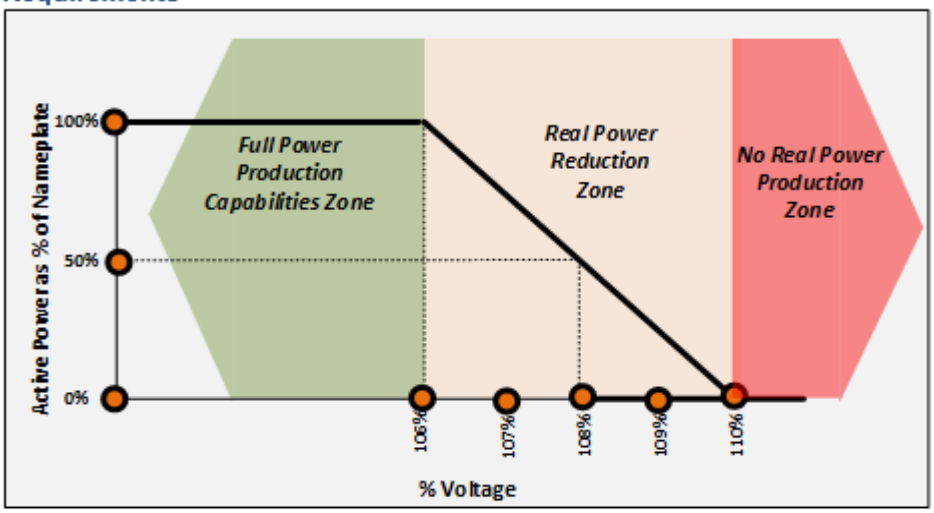
2. PREVENTION OF INTERFERENCE (Cont'd.)

m. (Cont'd.)

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

(N)

Figure HH-3 – Volt-Watt Requirements



(N)

Percent (%) of nominal voltage

(D)

(D)

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

n. Dynamic Reactive Power Support Function (T)

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. (N)

The utilization of this function is allowed and optional upon the mutual agreement of the Distribution Provider and the Applicant, before the effective date. (N)

o. Default Activation States (T)

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

	Function	**State**	
1	Anti-islanding	activated	(T)
2	Low/High Voltage Ride-Through	activated	
3	Low/High Frequency Ride-Through	activated	
4	Dynamic Volt/VAR operations	activated	
5	Ramp rates	activated	
6	Fixed power factor	deactivated	
7	Reconnect by "soft-start" methods	activated	(T)
8	Frequency-Watt*	activated	(N)
9	Volt/Watt*	activated	(N)
10	Set Active Power Function Mode (Optional)	activated under mutual agreement	(T)
11	Dynamic Reactive Power Support Mode (Optional)	activated under mutual agreement	(T)

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

* These functions must be activated for Interconnection Requests submitted on or after February 22, 2019. (N)

(Continued)

ELECTRIC RULE NO. 21 Sheet 201
GENERATING FACILITY INTERCONNECTIONS

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

p. Phase 3 Function (N)

Table of Phase 3 Effective Dates Pursuant to Resolution E-4898:

Phase 3 Function #		
	Description	**Effective Date (note)**
1	Monitor Key DER Data	**August 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
2	DER Disconnect and Reconnect Command (Cease to Energize and Return to Service)	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
3	Limit Maximum Active Power Mode	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
4	Set Active Power Mode	12 months after approval of a nationally recognized standard that includes the function.
5	Frequency Watt Mode	**February 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
6	Volt Watt Mode	**February 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
7	Dynamic Reactive Support	12 months after approval of a nationally recognized standard that includes the function.
8	Scheduling Power Values and Modes	**August 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.

Note: The utilization of any of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date. (N)

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

q. Load Shedding or Transfer (T)

The voltage and frequency ride-through requirements of Hh.2.b.(ii) and Hh.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 Generation Facility prior to any voltage disturbance, and the Generation Facility disconnects from the Distribution Provider's T&D system, along with Generation Facility load, such that the net change in real power flow from or to the Distribution Provider is less than 10% of the aggregate Smart Inverter capacity; or b) Generation Facility load real power demand equal to 90% to 120% of the pre-disturbance aggregate Smart Inverter real power output is shed within 0.1 seconds of Smart Inverter disconnection.

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.

(Continued)

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

5. COMMUNICATION REQUIREMENTS

a. The communication protocol requirements included in this section Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. The communications requirements herein shall be between: (T) I (T)

(i) the Distribution Provider and the individual Generating Facility's inverter control or energy management system;

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

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

(D)

(Continued)

ELECTRIC RULE NO. 21 Sheet 207
GENERATING FACILITY INTERCONNECTIONS

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

6. SCHEDULING CAPABILITY REQUIREMENTS

a. Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with a minimum scheduling memory capability of at least 24 events. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. (T) I I (T)

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date. (N) (N)

Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function.

(i) Modifications to the voltage and reactive set-points of the Dynamic volt/var function. (D) (D)

(ii) Modifications to the reactive power set-points for the fixed power factor function. (T)

(iii) Modifications to the voltage and watt-reduction level set-points for the volt/watt function. (T)

(Continued)

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

6. SCHEDULING CAPABILITY REQUIREMENTS (Cont'd.)

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

(i) Scheduling capability requirements may be stored at the Generating Facility Energy Management System (GFEMS). The GFEMS shall communicate the necessary commands to the Smart Inverters within 10 minutes from when GFEMS received the scheduling information:

(ii) Scheduling capability requirements may be stored at the Smart Inverter Control Unit (SMCU) within the Generating Facility. The SMCU shall communicate necessary commands to the Smart Inverters within 10 minutes from when SCMU received the scheduling information.

(iii) 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 Inverters within 15 minutes of the aggregator receiving the scheduling information.

(iv) Other options may be utilized by mutual agreement between the Applicant and Distribution Provider.

c. 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. (N)

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.

(Continued)

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

7. MONITORING AND TELEMETRY REQUIREMENTS

a. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. (T) I I (T)

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date. (N) (N)

Smart Inverter shall have the capability to communicate its performance information including:

(i) Smart Inverter production or consumption of active power (Watts).

(ii) Smart Inverter consumption or production of reactive power (VARs) (D) I I (D)

(iii) Phase measured at the AC terminals of the Smart Inverter (Volts) (N)

(iv) Frequency measured at the AC terminals of the Smart Inverter (Hz) (T)

(Continued)

ELECTRIC RULE NO. 21 Sheet 210
GENERATING FACILITY INTERCONNECTIONS

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

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

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

(i) The Smart Inverter shall be capable of communicating the operational state of charge as a percentage of energy storage capacity. (T) (T) (D) (D)

c. 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:

(i) In-Service state: 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 Hh.6

(ii) Not In-Service state: 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 Hh.

(Continued)

ELECTRIC RULE NO. 21 Sheet 211
GENERATING FACILITY INTERCONNECTIONS

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

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

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

(i) 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.

(ii) When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility should communicate the following:

a) The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility

b) The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility

(iii) 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. (T)

(Continued)

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

8. CONTROL THROUGH COMMUNICATION CAPABILITIES

a. The capability for these requirements will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the earlier of the dates shown in the "Table of Phase 3 Effective Dates Pursuant to Resolution E-4898" in Section Hh.2.p. (T) I I I (T)

The utilization of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date. (N) I (N)

Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

(i) Cease to energize control command. When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the ECP in order to galvanically isolate the DER system from the Distribution System

(ii) 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

(iii) 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.

(iv) 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. (L) I I I (L)

(v) 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 H.6. (T)

(Continued)

ELECTRIC TABLE OF CONTENTS Sheet 1

TABLE OF CONTENTS

(Continued)

ELECTRIC TABLE OF CONTENTS Sheet 20

(Continued)

Advice 5302-E-C
February 20, 2019

Attachment 3

Redline of Changes to Electric Rule 21

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

k. Ramp Rate Requirements

The Smart Inverter is required to have the following ramp controls for at least the following four conditions. These functions can be established by multiple control functions or by one general ramp rate control function. Ramp rates are contingent upon sufficient energy available from the Smart Inverter.

- Normal ramp-up rate: For transitions between energy output levels over the normal course of operation. The default value is 100% of maximum current output per second with a range of adjustment between 1% to 100%, with specific settings as mutually agreed by the Distributor Provider and the Producer.

- Connect/Reconnect Ramp-up rate: Upon starting to inject power into the grid, following a period of inactivity or a disconnection, the inverter shall be able to control its rate of increase of power from 1 to 100% maximum current per second. The default value is 2% of maximum current output per second, with specific settings as mutually agreed upon by the Distribution Provider and the Producer.

l. Frequency-Watt Requirements

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard ~~12 months from the date the Phase 3Smart Inverter Advanced Function Advice Letter (AL 5129- E) wasmade effective by the Commission. Smart Inverters shall reduce theirreal power production as a function~~.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverters shall reduce their real power production as a function of system frequency, in accordance with the following:

- When system frequency exceeds 60.036 ~~60.1~~ Hz, the active power output produced by the Smart Inverter shall be reduced by 50% of real power nameplate rating per hertz (5% of real power nameplate rating reduction per 0.1 hertz)

(Continued)

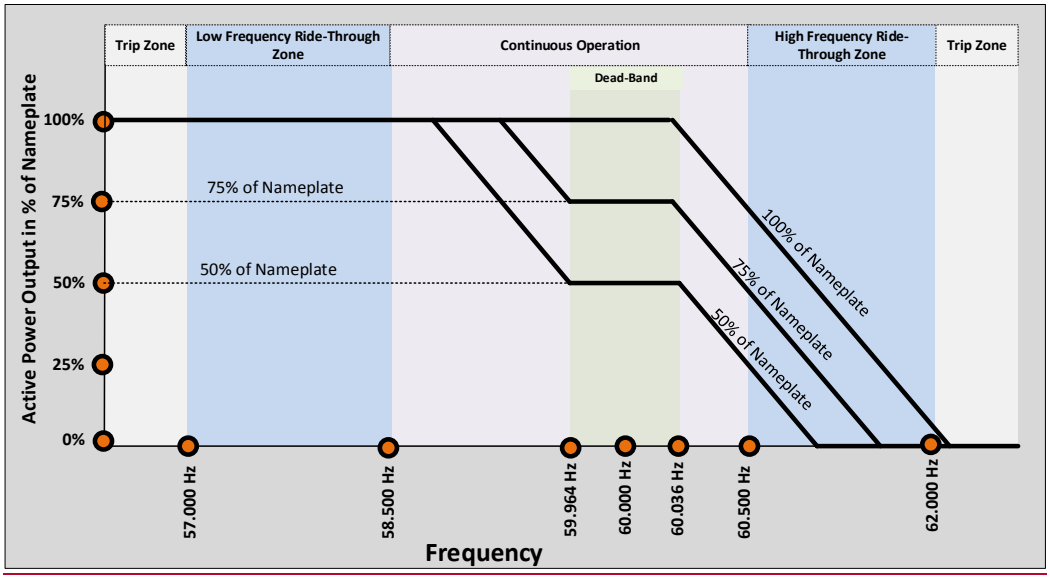
Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

l. Frequency-Watt Requirements (Cont'd.)

- When system frequency moves under 59.964 ~~59.9~~ Hz, the active power output produced by the Smart Inverter shall be increased by 50% of real power nameplate rating per hertz (5% of real power nameplate rating increase per 0.1 hertz) when inverter is capable of increasing real power production.
- The default dead-band should be +/- 0.036 ~~0.1~~ Hz from 60 Hertz (59.964 ~~59.9~~ Hz to 60.036 ~~60.1~~ Hz). When the system frequency is in range of 59.964 ~~59.9~~ Hz and 60.036 ~~60.1~~ Hz, the Smart Inverter is not required to ~~increase or~~ decrease power as a function of system frequency.
- Open loop response time for Frequency –Watt shall be 5 seconds.
- Figure Hh-2 illustrated this requirement for three levels of output power. Figure Hh-2 is for illustration purposes only.

Figure Hh-2: Active Power as a Function of System Frequency



Note: the frequency markers on the horizontal axis are not drawn to scale.

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

m. Voltage-Watt Default Settings Requirements

This requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard ~~12 months from the date the Phase 3Smart Inverter Advanced Function Advice Letter (AL 5129-E) wasmade effective by the Commission~~.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverters shall reduce their real power production as a function of measured voltage at the inverter terminals 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 (for 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% ~~50%~~ of active ~~real~~ power nameplate rating per one percent of nominal voltage. Figure Hh-3 – Volt-Watt Requirements – illustrates the required rate of reduction. When export of active power is controlled, a certified inverter and control system shall be used.

(Continued)

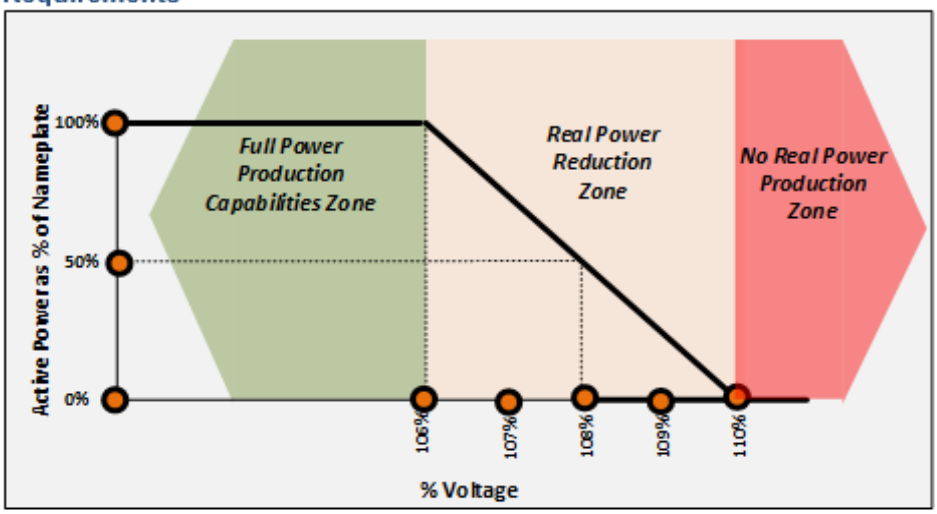
Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

2. PREVENTION OF INTERFERENCE (Cont'd.)

m. (Cont'd.)

- When the measured voltage is greater than 110% ~~108%~~ of nominal voltage (Example: 132 ~~129.6~~ volts on a 120 volts nominal), the export of active power output to the grid at the PCC or the production of active power ~~produced~~ by the Smart Inverter shall be reduced to 0 watts

Figure HH-3 – Volt-Watt Requirements



Percent (%) of nominal voltage

~~n. 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 allowed and optional upon the mutual agreement of the Distribution Provider and the Applicant.~~

(Continued)

ELECTRIC RULE NO. 21 Sheet 200
GENERATING FACILITY INTERCONNECTIONS

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

no. 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 allowed and optional upon the mutual agreement of the Distribution Provider and the Applicant, before the effective date.

op. Default Activation States for Phase 1 Functions

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

	Function	State
1(i)	Anti-islanding	activated
2(ii)	Low/High Voltage Ride-Through	activated
3(iii)	Low/High Frequency Ride-Through	activated
4(iv)	Dynamic Volt/VAR operations	activated
5(v)	Ramp rates	activated
6(vi)	Fixed power factor	deactivated
7(vii)	Reconnect by "soft-start" methods	activated
8(viii)	Frequency-Watt*	activated
9(ix)	Volt/Watt*	activated
10(x)	Set Active Power Function Mode (Optional)	activated under mutual agreement
11(xi)	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.

* These functions must be activated for Interconnection Requests submitted on or after February 22, 2019.

(Continued)

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

p. Phase 3 Function

Table of Phase 3 Effective Dates Pursuant to Resolution E-4898:

Phase 3 Function #		
	Description	**Effective Date (note)**
1	Monitor Key DER Data	~~February~~**August 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
2	DER Disconnect and Reconnect Command (Cease to Energize and Return to Service)	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
3	Limit Maximum Active Power Mode	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
4	Set Active Power Mode	12 months after approval of a nationally recognized standard that includes the function.
5	Frequency Watt Mode	**February 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
6	Volt Watt Mode	**February 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
7	Dynamic Reactive Support	12 months after approval of a nationally recognized standard that includes the function.
8	Scheduling Power Values and Modes	~~February~~**August 22, 2019**, which is 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.

Note: The utilization of any of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date.

(Continued)

ELECTRIC RULE NO. 21 Sheet 202
GENERATING FACILITY INTERCONNECTIONS

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

2. PREVENTION OF INTERFERENCE (Cont'd.)

gr. Load Shedding or Transfer

The voltage and frequency ride-through requirements of Hh.2.b.(ii) and Hh.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 Generation Facility prior to any voltage disturbance, and the Generation Facility disconnects from the Distribution Provider's T&D system, along with Generation Facility load, such that the net change in real power flow from or to the Distribution Provider is less than 10% of the aggregate Smart Inverter capacity; or b) Generation Facility load real power demand equal to 90% to 120% of the pre-disturbance aggregate Smart Inverter real power output is shed within 0.1 seconds of Smart Inverter disconnection.

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.

(Continued)

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

5. COMMUNICATION REQUIREMENTS

a. The communication protocol requirements included in this section Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted ~~February~~August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard ~~on or after 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~~. Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. The communications requirements herein shall be between:

(i) the Distribution Provider and the individual Generating Facility's inverter control or energy management system;

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

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

~~[A] Communication utilizing this aggregator option is not permitted at this time.~~

(Continued)

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

6. SCHEDULING CAPABILITY REQUIREMENTS

a. Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with a minimum scheduling memory capability of at least 24 events. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after ~~February~~August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard ~~the later of (i) 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 recognize communication protocol certificate test standard~~.

The utilization of this function is permissible under mutual agreement between the utility 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.

(i) Modifications to the voltage and reactive set-points of the Dynamic volt/var function.

~~(ii) Modification to the normal ramp-up rate and reconnect ramp-up rate set-points~~

(ii~~i~~) Modifications to the reactive power set-points for the fixed power factor function

(iii~~v~~) Modifications to the voltage and watt-reduction level set-points for the volt/watt function

(Continued)

ELECTRIC RULE NO. 21 Sheet 208
GENERATING FACILITY INTERCONNECTIONS

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

6. SCHEDULING CAPABILITY REQUIREMENTS (Cont'd.)

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

(i) Scheduling capability requirements may be stored at the Generating Facility Energy Management System (GFEMS). The GFEMS shall communicate the necessary commands to the Smart Inverters within 10 minutes from when GFEMS received the scheduling information:

(ii) Scheduling capability requirements may be stored at the Smart Inverter Control Unit (SMCU) within the Generating Facility. The SMCU shall communicate necessary commands to the Smart Inverters within 10 minutes from when SCMU received the scheduling information.

(iii) 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 Inverters within 15 minutes of the aggregator receiving the scheduling information.

(iv) Other options may be utilized by mutual agreement between the Applicant and Distribution Provider.

c. 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.

(Continued)

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

7. MONITORING AND TELEMETRY REQUIREMENTS

a. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after ~~February~~August 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard ~~the later of (i) 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 recognize communication protocol certificate test standard~~.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverter shall have the capability to communicate its performance information including:

(i) Smart Inverter production or consumption of active power (Watts).

(ii) Smart Inverter consumption or production of reactive power (VARs)

~~(iii) Phase currents measure at the AC terminal of the Smart Inverter (Amps)~~

~~(iv) Phase voltage measured at the AC terminals of the Smart Inverter (Volts)~~

(iii) Phase measured at the AC terminals of the Smart Inverter (Volts)

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

(Continued)

ELECTRIC RULE NO. 21 Sheet 210
GENERATING FACILITY INTERCONNECTIONS

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

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

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

(i) The Smart Inverter shall be capable of communicating the ~~percentage of operations~~ operational state of charge as a percentage of energy-storage capacity. ~~Operational energy of the energy storage system is amount energy which can be used to support the energy needs of the electric system including the energy needs for the load within the generating facility or the Distribution System.~~

c. 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:

(i) In-Service state: 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 Hh.6

(ii) Not In-Service state: 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 Hh.

(Continued)

ELECTRIC RULE NO. 21 Sheet 211
GENERATING FACILITY INTERCONNECTIONS

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

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

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

(i) 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.

(ii) When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility should communicate the following:

a) The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility

b) The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility

(iii) When the Generating Facility with Smart Inverters includes one or multiple energy storage systems: The available operational ~~kWh~~ energy should be communicated as an aggregate of all the energy storage systems

(Continued)

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

8. CONTROL THROUGH COMMUNICATION CAPABILITIES

a. The capability for theseis requirements will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the earlier of the dates shown in the "Table of Phase 3 Effective Dates Pursuant to Resolution E-4898" in Section Hh.2.p ~~nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry recognize communication protocol certificate test standard~~.

The utilization of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

(i) Cease to energize control command. When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the ECP in order to galvanically isolate the DER system from the Distribution System

(ii) 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

(iii) 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.

(iv) 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.

(~~i~~v) 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 H.6

(Continued)

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Advice Filing List
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City of San Jose
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Linde
Los Angeles County Integrated Waste Management Task Force
Los Angeles Dept of Water & Power
MRW & Associates
Manatt Phelps Phillips
Marin Energy Authority
McKenzie & Associates

Modesto Irrigation District
Morgan Stanley
NLine Energy, Inc.
NRG Solar

Office of Ratepayer Advocates
OnGrid Solar
Pacific Gas and Electric Company

Pioneer Community Energy
Praxair
Regulatory & Cogeneration Service, Inc.
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SDG&E and SoCalGas

SPURR
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Seattle City Light
Sempra Utilities
Southern California Edison Company
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Spark Energy
Sun Light & Power
Sunshine Design
Tecogen, Inc.
TerraVerde Renewable Partners
Tiger Natural Gas, Inc.

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