

PUBLIC UTILITIES COMMISSION

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January 26, 2017

Advice Letter 4983-E

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: Information Only Filing – Joint Investor-Owned Utilities Status
Report and Supporting Action Plan for the Development of
Advanced Inverter Functions for Smart Inverters (Phase 3)**

Dear Mr. Jacobson:

Advice Letter 4983-E is effective as of January 19, 2017.

Sincerely,

A handwritten signature in cursive script that reads "Edward Randolph".

Edward Randolph
Director, Energy Division

December 20, 2016

ADVICE 3533-E
(Southern California Edison Company U 338-E)

ADVICE 4983-E
(Pacific Gas and Electric Company U 39-E)

ADVICE 3022-E
(San Diego Gas & Electric Company U 902-E)

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA
ENERGY DIVISION

SUBJECT: Information-Only Advice Letter
Joint Investor-Owned Utilities Status Report and Supporting
Action Plan for the Development of Advanced Inverter
Functions for Smart Inverters (Phase 3)

In compliance with California Public Utilities Commission (CPUC or Commission) Decision (D.)16-06-052¹ and direction from Commission staff, Southern California Edison Company (SCE), Pacific Gas and Electric Company (PG&E) and San Diego Gas & Electric Company (SDG&E) (collectively, the Joint Investor-Owned Utilities or Joint IOUs) hereby submit a status report and proposed work plan (Work Plan) for further development of the advanced inverter functions for distributed energy resources (DERs) utilizing inverter-based technologies (*i.e.*, smart inverters) (Phase 3 Functions).

PURPOSE

The purpose of this Information-Only filing is to provide both a status report and related Work Plan regarding further development of the Phase 3 Functions.

¹ D.16-06-052, adopted June 23, 2016, is entitled *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.*

PROCEDURAL BACKGROUND

As part of D.16-06-052 (or the Decision), the Commission recognized that further consensus was needed on a number of issues supporting the formal adoption of the Phase 3 Functions.² In particular, the Commission encouraged parties involved with the Smart Inverter Working Group (SIWG) to reconvene in order to reach the necessary consensus on the Phase 3 Functions in advance of possible tariff revisions.³ In recognition of the need for additional work and to allow for flexibility, the Commission ordered the Joint IOUs to file Tier 3 advice letters no later than six months after the effective date of the Decision with proposed tariff revisions, or in the alternative, to file a status report and supporting work plan on additional efforts supporting the development of Phase 3 Functions.⁴ As discussed in further detail below, additional discussions have occurred regarding the Phase 3 Functions resulting in the development of the Work Plan. At the Commission's request, the proposed Work Plan is being filed via an advice letter to allow stakeholders an opportunity to comment. As additional efforts are required in support of the Work Plan, tariff revisions are premature at this time and are not included herein.

RULE 21 SMART INVERTER BACKGROUND

On September 22, 2011, the Commission initiated Rulemaking (R.)11-09-011 (Rule 21 proceeding) to review and, if necessary, revise the rules and regulations governing the interconnection of generation and storage resources to the electric distribution systems of the Joint IOUs. The Joint IOUs' rules and regulations pertaining to the interconnection of generating facilities are generally set forth in Electric Tariff Rule 21 (Rule 21).

Phase 1

Most generating resources require an inverter to convert direct current (DC) from the generating resource to the voltage and frequency of the alternating current (AC) distribution system. To develop proposals to incorporate additional inverter functionality in order to better integrate and mitigate the impacts of DERs at increasingly higher penetration levels, parties to the Rule 21 proceeding created the SIWG. In January 2014, the SIWG issued its "Recommendations for Updating the Technical Requirements for Inverters in Distributed Energy Resources" to propose technical design and operating revisions to Rule 21 for DERs utilizing inverter-based technologies, which came to be characterized as "Phase 1" of that group's efforts.

On July 18, 2014, the Joint IOUs filed and served in the R.11-09-011 docket a draft advice letter proposing changes to Rule 21 to incorporate the Phase 1 recommendations. On December 22, 2014, the Commission issued D.14-12-035, which adopted the Joint IOUs' revisions with modifications. Accordingly, the Joint IOUs filed advice letters on January 20, 2015 to revise relevant sections of Rule 21 and add

² *Id.* at pp. 6-7 of Attachment E.

³ *Id.*

⁴ *Id.*

Section Hh to address the applicable inverter-based technologies and incorporate the functionalities unique to these inverters.⁵ While the advice letters were approved with an effective date of January 25, 2015, the Commission established in D.14-12-035 that the use of smart inverters would become mandatory at the later of (a) December 31, 2015 or (b) twelve (12) months after the date the Supplement A (SA) of UL-1741 (with California requirements) was approved by the full UL-1741 Standards Technical Panel. On September 8, 2016, UL announced the approval of the new UL-1741 SA to test and certify inverters and other utility interconnected distributed generation equipment for grid support functions enabling smarter and safer reactive grid interconnection. Thus, on September 13, 2016, the Joint IOUs filed advice letters to update Rule 21 to reflect that the use of smart inverters will become mandatory as of September 8, 2017.⁶

Phase 2

In addition to the requirements adopted in Phase 1, the SIWG also recommended a second phase to focus on communications between the grid operator and a DER (Phase 2) and a third phase to identify and address additional advanced inverter functionalities (Phase 3). A May 13, 2014 Assigned Commissioner Scoping Ruling⁷ directed the SIWG to file and serve a proposed description of issues ready for Commission resolution and a proposed schedule for these issues no later than July 18, 2014. SDG&E, on behalf of the SIWG, filed a timely Motion that described the SIWG's progress on Phase 2 deliberations and put forth an estimated schedule for completing the remaining Phase 2 tasks.

The SIWG completed its recommendations for Phase 2 communication protocols in February 2015.⁸ The recommendations for Phase 2 communication protocols include inverter communication capabilities and standards that are delineated across (a) Rule 21,⁹ (b) the Joint IOUs' Generator Interconnection Handbooks,¹⁰ (c) a California IEEE 2030.5 Implementation Guide,¹¹ (d) mutual IOU-DER owner/operator agreements,¹² and/or (e) market or vendor decisions.¹³

⁵ See SCE Advice 3167-E, PG&E Advice 4565-E and SDG&E Advice 2694-E.

⁶ See SCE Advice 3471-E, PG&E Advice 4914-E and SDG&E Advice 2956-E. The Commission's Energy Division approved the advice letters on October 12, 2016, with a September 13, 2016 effective date.

⁷ *Assigned Commissioners Amended Scoping Memo and Ruling requiring Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company to file proposed Revised Electric Tariff Rule 21.*

⁸ *Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters – Smart Inverter Working Group Phase 2 Recommendations*, dated February 28, 2015.

⁹ *Id.* at pp. 6-7.

¹⁰ *Id.* at pp. 7-8.

¹¹ *Id.* at pp. 8-9.

¹² *Id.* at p. 9.

¹³ *Id.* at p. 10.

On November 17, 2016, the Commission's Energy Division hosted a public "Smart Inverter Working Group Workshop on Adoption of Phase 2 and Phase 3 Recommendations Per D.16-06-052" (Workshop). One of the key objectives of the workshop was to provide guidance to the Joint IOUs on the Tier 3 Phase 2 and Phase 3 filings. During the workshop, it was determined that there was enough consensus for the Joint IOUs to propose revisions to Rule 21 to adopt the Phase 2 recommendations for communication protocols. The proposed tariff revisions are being filed concurrently on December 20, 2016 via separate advice letters, as required by the Decision.¹⁴

Phase 3

In March 2016, the SIWG completed its technical recommendations for the following Phase 3 Functions discussed below within the SIWG-sponsored document entitled "Recommended SIWG Phase 3 DER Functions and Key Requirements for Inclusion in Rule 21."¹⁵ The SIWG's recommendations, however, highlighted a number of outstanding issues with the Phase 3 Functions that required further resolution before they could be incorporated in Rule 21 as tariff requirements.¹⁶

The SIWG summarized the following eight (8) Phase 3 Functions outlined below for further review:

- I. **Monitor Key DER Data:**¹⁷ DER systems identified by utilities during the interconnection process shall have the capability to provide key DER data at the DER's electrical connection point (ECP) and at the point of common coupling (PCC) (through the meter), including key administrative, status and measurements on current energy and ancillary services;
- II. **DER Disconnect and Reconnect Demand:**¹⁸ The disconnect command shall either cause a "cease to energize" state or shall initiate the opening of the DER switch referenced in the ECP in order to galvanically isolate the DER system from the Local or Area EPS, while the reconnect command shall initiate the closing of the DER switch at the referenced ECP or shall end the cease to energize state;
- III. **Limit Maximum Real Power Mode:**¹⁹ This model shall limit the maximum real power level at the referenced ECP either as a percent of the maximum real power capability or to a specific real power value;

¹⁴ See SCE Advice 3532-E, PG&E Advice 4982-E and SDG&E Advice 3023-E.

¹⁵ *SIWG Phase 3 DER Functions: Recommendations to the CPUC for Rule 21, Phase 3 Function Key Requirements, and Additional Discussion Points* (Version Eight), dated March 2016.

¹⁶ *Id.* at pp. 3-11.

¹⁷ *Id.* at p. 3.

¹⁸ *Id.* at p. 4.

¹⁹ *Id.* at p. 5.

- IV. **Set Real Power Mode:**²⁰ This mode shall set the real power level at the referenced ECP as a percent of the maximum real power capability or to a specific real power value;
- V. **Frequency-Watt Emergency Mode:**²¹ This mode shall provide settings to counteract frequency excursions during high or low frequency ride-through events by decreasing or increasing real power;
- VI. **Volt-Watt Mode:**²² This mode shall set the volt-watt curve parameters necessary to respond to changes in the voltage at the referenced ECP by decreasing or increasing real power;
- VII. **Dynamic Reactive Current Support:**²³ This mode shall provide reactive current support in response to dynamic variations in voltage (*i.e.*, rate of voltage change) rather than changes in voltage; and,
- VIII. **Scheduling Power Values and Modes:**²⁴ Schedules shall be capable of setting real and reactive power values as well as enabling and disabling DER modes for specific time periods.

Workshop discussions surrounding the Phase 3 Functions discussed above were centered upon parallel efforts currently underway with revisions to the national standard proposed by IEEE 1547,²⁵ which are expected to address the majority of the Phase 3 Functions. As discussed in further detail below, the Work Plan incorporates the current IEEE 1547 efforts and highlights additional areas of review or removal based on additional stakeholder discussions.

PROPOSED WORK PLAN:

Additional stakeholder calls occurred on November 28, 2016 and December 7, 2016, respectively, as a follow-up to the workshop discussed above to perform a gap analysis of the current IEEE 1547 efforts against the proposed Phase Three Functions. The following table describes the treatment of each Phase Three Function based on review of the IEEE 1547 efforts along with proposed next steps.

²⁰ *Id.* at pp. 6-7.

²¹ *Id.* at pp. 7-8.

²² *Id.* at pp. 8-9.

²³ *Id.* at pp. 9-10.

²⁴ *Id.* at 10-11.

²⁵ Institute of Electrical and Electronic Engineers (IEEE); the 1547 standard addresses the interconnection of distributed resources with power systems.

<u>Proposed Function</u>	<u>IEEE Review Status</u>	<u>Comments/Next Steps</u>
Function One – Monitor Key DER Data	Current IEEE 1547 standard appears to address the majority of the SIWG-proposed functions with the exception of alarming	Joint IOUs will prepare a list of alarms for inclusion within IEEE 1547
Function Two – DER Disconnect and Reconnect Command	Current draft of IEEE 1547 is expected to be updated to address this function	Joint IOUs will review next IEEE 1547 standard draft, when circulated, to verify function has been addressed
Function Three – Limit Maximum Real Power Mode	Current draft of IEEE 1547 is expected to be updated to address this function	Joint IOUs will review next IEEE 1547 standard draft, when circulated, to verify function has been addressed
Function Four – Set Real Power Mode	The Joint IOUs have determined that this function should be removed as it can be accomplished by the use of Function Three	No additional action needed
Function Five – Frequency Watt Emergency Mode	Current IEEE 1547 draft addresses this function	Joint IOUs will review future drafts to ensure function continues to be addressed
Function Six – Volt-Watt Mode	Current IEEE 1547 draft addresses this function	Joint IOUs will review future drafts to ensure function continues to be addressed
Function Seven – Dynamic Reactive Current Support	Current IEEE 1547 draft calls for this function to only be allowed under mutual agreement but has not completed development of the supporting technical requirements	Further stakeholder collaboration on the need for this function and supporting technical requirements
Function Eight – Scheduling Power Values and Modes	Current draft of IEEE 1547 combined with the proposed draft language of IEEE 2030.5 is expected to address this function	Joint IOUs will review future drafts to ensure function continues to be addressed

The gap analysis indicates that all but one of the proposed Phase 3 Functions are currently addressed in the IEEE 1547 standard or will likely be addressed in the next draft. However, as the refinements for the IEEE 1547 updates go through a stakeholder comment review prior to final publication, it is difficult to know with complete certainty when the revisions to the standard will be finalized within the IEEE approval process. Therefore, it is anticipated that the Commission will coordinate additional discussions involving SIWG members in the first quarter of 2017 to:

- Discuss the potential for California to coordinate with the IEEE 1547 standard based on review of the progress of the IEEE 1547 efforts,
- Work through the technical development of Function 7 and any other areas lacking Working Group consensus, and,
- Discuss potential contingency plans (if necessary) for a separate California effort supporting tariff development of the Phase 3 Functions.

In support of the Work Plan, the Joint IOUs will provide a status update on these activities to be filed with the Commission no later than March 30, 2017. Further, each IOU anticipates filing a subsequent Tier 3 advice letter in June 2017 to propose tariff revisions to Rule 21 to incorporate the Phase 3 Functions and the SIWG's recommendation on synchronization with the IEEE 1547 standard. The filing date for the Tier 3 advice letters may be modified upon approval from the Commission's Energy Division, with support of SIWG members, if deemed appropriate to maintain synchronization with IEEE 1547 and still be within reason of attaining the goal of smart inverters reaching full functionality by 2020 as stated in the Commission's DER Action Plan.

No cost information is required for this advice filing.

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

TIER DESIGNATION

Pursuant to Part C of Appendix E of the Decision, this advice letter is submitted with a Tier 1 designation.²⁶

²⁶ "No later than six months after the effective date of this decision, the Utilities are directed to propose revisions to Tariff Rule 21 setting forth any agreed-upon technical requirements, testing and certification processes, and effective dates for Phase 2 communication protocols and Phase 3 additional advanced inverter functions in separate Tier 3 advice letters (*i.e.*, one advice letter each for Phase 2 and Phase 3). **In the absence of consensus on certain issues, the utilities shall file a status report and work plan on these efforts.**"

NOTICE

Anyone wishing to provide a response to this advice filing may do so by letter via U.S. Mail, facsimile, or electronically, any of which must be received no later than 20 days after the date of this advice filing. Responses should be submitted to:

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, California 94102
E-mail: EDTariffUnit@cpuc.ca.gov

Copies should also be mailed to the attention of the Director, Energy Division, Room 4004 (same address above).

In addition, responses and all other correspondence regarding this advice letter should also be sent by letter and transmitted via facsimile or electronically to the attention of:

Russell G. Worden
Managing Director, State Regulatory Operations
Southern California Edison Company
8631 Rush Street
Rosemead, California 91770
Telephone: (626) 302-4177
Facsimile: (626) 302-4829
E-mail: AdviceTariffManager@sce.com

Laura Genao
Managing Director, State Regulatory Affairs
c/o Karyn Gansecki
Southern California Edison Company
601 Van Ness Avenue, Suite 2030
San Francisco, California 94102
Facsimile: (415) 929-5544
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Attn: Megan Caulson
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Erik Jacobson
Director, Regulatory Relations
c/o Megan Lawson
Pacific Gas and Electric Company
77 Beale Street, Mail Code B10C
P.O. Box 770000
San Francisco, CA 94177
Facsimile: (415) 973-1448
E-mail: PGETariffs@pge.com

There are no restrictions on who may file a response, but the response shall set forth specifically the grounds upon which it is based and must be received by the deadline shown above.

In accordance with General Rule 4 of GO 96-B, SCE is serving copies of this advice filing to the interested parties shown on the attached GO 96-B and R.11-09-011 service lists. Address change requests to the GO 96-B service list should be directed by electronic mail to AdviceTariffManager@sce.com, SDG&ETariffs@semprautilities.com, PGETariffs@pge.com, or at (626) 302-3719. For changes to all other service lists, please contact the Commission's Process Office at (415) 703-2021 or by electronic mail at Process_Office@cpuc.ca.gov.

Further, in accordance with Public Utilities Code Section 491, notice to the public is hereby given by filing and keeping the advice filing at SCE's corporate headquarters. To view other SCE advice letters filed with the Commission, log on to SCE's web site at <https://www.sce.com/wps/portal/home/regulatory/advice-letters>. To view other SDG&E advice letters filed with the Commission, visit SDG&E's web site at <http://www.sdge.com/rates-regulations/tariff-information/advice-letters>. To view other PG&E advice letters filed with the Commission, visit PG&E's web site at <http://www.pge.com/tariffs/>.

For questions directed at SCE, please contact Kathryn Enright at (909) 274-3583 or by electronic mail at Kathryn.Enright@sce.com. For questions directed at SDG&E, please contact Megan Caulson at (858) 654-1748 or by electronic mail at mcaulson@semprautilities.com. For questions directed at PG&E, please contact Kingsley Cheng at (415) 973-1419 or by electronic mail at K2c0@pge.com and PGETariffs@pge.com.

Southern California Edison Company

/s/ Russell G. Worden
Russell G. Worden

RGW:ke:cm
Enclosures

CALIFORNIA PUBLIC UTILITIES COMMISSION

ADVICE LETTER FILING SUMMARY ENERGY UTILITY

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

Company name/CPUC Utility No.: Southern California Edison Company (U 338-E)

Utility type:

ELC GAS
 PLC HEA WATER
 T

Contact Person: Darrah Morgan

Phone #: (626) 302-2086

E-mail: Darrah.Morgan@sce.com

E-mail Disposition Notice to: AdviceTariffManager@sce.com

EXPLANATION OF UTILITY TYPE

ELC = Electric GAS = Gas
 PLC = Pipeline HEAT = Heat WATER = Water

(Date Filed/ Received Stamp by CPUC)

Advice Letter (AL) #: 3533-E

Tier Designation: 1

Subject of AL: **Information-Only Advice Letter - Joint Investor-Owned Utilities Status Report and Supporting Action Plan for the Development of Advanced Inverter Functions for Smart Inverters (Phase 3)**

Keywords (choose from CPUC listing): Compliance

AL filing type: Monthly Quarterly Annual One-Time Other

If AL filed in compliance with a Commission order, indicate relevant Decision/Resolution #:

Decision 16-06-052

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: _____

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: _____ No. of tariff sheets: -0-

Estimated system annual revenue effect: (%): _____

Estimated system average rate effect (%): _____

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: None

Service affected and changes proposed¹: _____

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

¹ Discuss in AL if more space is needed.

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

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, California 94102
E-mail: EDTariffUnit@cpuc.ca.gov

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Laura Genao
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c/o Karyn Gansecki
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**PG&E Gas and Electric
Advice Filing List
General Order 96-B, Section IV**

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Albion Power Company	Don Pickett & Associates, Inc.	OnGrid Solar
Alcantar & Kahl LLP	Douglass & Liddell	Pacific Gas and Electric Company
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Atlas ReFuel	Ellison Schneider & Harris LLP	Regulatory & Cogeneration Service, Inc.
BART	Evaluation + Strategy for Social Innovation	SCD Energy Solutions
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CENERGY POWER	Green Charge Networks	Seattle City Light
CPUC	Green Power Institute	Sempra Energy (Socal Gas)
California Cotton Ginners & Growers Assn	Hanna & Morton	Sempra Utilities
California Energy Commission	ICF	SoCalGas
California Public Utilities Commission	International Power Technology	Southern California Edison Company
California State Association of Counties	Intestate Gas Services, Inc.	Southern California Gas Company (SoCalGas)
Calpine	Kelly Group	Spark Energy
Casner, Steve	Ken Bohn Consulting	Sun Light & Power
Center for Biological Diversity	Leviton Manufacturing Co., Inc.	Sunshine Design
City of Palo Alto	Linde	Tecogen, Inc.
City of San Jose	Los Angeles County Integrated Waste Management Task Force	TerraVerde Renewable Partners
Clean Power	Los Angeles Dept of Water & Power	TerraVerde Renewable Partners, LLC
Clean Power Research	MRW & Associates	Tiger Natural Gas, Inc.
Coast Economic Consulting	Manatt Phelps Phillips	TransCanada
Commercial Energy	Marin Energy Authority	Troutman Sanders LLP
Cool Earth Solar, Inc.	McKenna Long & Aldridge LLP	Utility Cost Management
County of Tehama - Department of Public Works	McKenzie & Associates	Utility Power Solutions
Crossborder Energy	Modesto Irrigation District	Utility Specialists
Crown Road Energy, LLC	Morgan Stanley	Verizon
Davis Wright Tremaine LLP	NLine Energy, Inc.	Water and Energy Consulting
Day Carter Murphy	NRG Solar	Wellhead Electric Company
Defense Energy Support Center	Nexant, Inc.	Western Manufactured Housing Communities Association (WMA)
Dept of General Services	ORA	YEP Energy