

Decision 14-12-035 December 18, 2014

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA**

Order Instituting Rulemaking on the Commission's Own Motion to improve distribution level interconnection rules and regulations for certain classes of electric generators and electric storage resources.

Rulemaking 11-09-011  
(Filed September 22, 2011)

**INTERIM DECISION ADOPTING REVISIONS TO ELECTRIC TARIFF RULE 21 FOR PACIFIC GAS AND ELECTRIC COMPANY, SOUTHERN CALIFORNIA EDISON COMPANY, AND SAN DIEGO GAS & ELECTRIC COMPANY TO REQUIRE "SMART" INVERTERS**

**Summary**

Today's decision adopts modifications to Electric Tariff Rule 21 to capture the technological advances offered by smart inverters. Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company are authorized to file Advice Letters with revisions to Electric Tariff Rule 21.

**1. Background**

The Commission initiated Rulemaking (R.) 11-09-011 on September 22, 2011 to review and, if necessary, revise the rules and regulations governing

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<sup>1</sup> Pursuant to Commissioner Picker's May 13, 2014, Scoping Memo this portion of the proceeding is categorized as Quasi-Legislative and the remainder of the proceedings as ratesetting.

interconnecting generation and storage resources to the electric distribution systems of Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E). The utilities' rules and regulations pertaining to the interconnection of generation are generally set forth in Electric Tariff Rule 21.

On September 20, 2012, the Commission issued Decision (D.) 12-09-018 which adopted a settlement agreement that included revisions to Electric Tariff Rule 21 and provided separate Generator Interconnection Agreement for Exporting Generating Facilities and Exporting Generating Facility Interconnection Request. The revisions to Electric Tariff Rule 21 focused on the interconnection study process. The settlement agreement required that each utility revise its Electric Tariff Rule 21 to assign all interconnection requests to either the "Fast Track" - a screen-based, streamlined review process for net energy metering, non-export, and small exporting facilities or the Detailed Study with three study processes for more complicated generating facilities.

## **2. Revising Technical Specifications for Inverters**

Electric Tariff Rule 21 also sets forth the protective functions and equipment requirements for connection to the utilities' distribution networks. These requirements are based on the Institute of Electrical and Electronics Engineers' Standard 1547, which was last issued in 2003.

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. Wind and photovoltaic resources produce DC, and therefore need inverters, while hydroelectric and biomass generating units, which produce AC, do not. Generally, in California, about 90% of local (small scale) renewable generation is connected to the distribution grid through

inverters. Fostering deployment of this type of generation is one of the goals of the California Solar Initiative, among other important policy objectives of this Commission.

Since 2003, the technical capabilities of inverters have advanced substantially. Today's "smart inverters" have many capabilities, including:

- The delivery of DC power into an AC system, such as photovoltaic power to the AC grid; and the delivery of AC power to a DC load, as in charging a battery from the grid.
- The generation or absorption of reactive power so as to raise or lower the voltage at its terminals.
- Delivery of power in four quadrants, that is, positive real power and positive reactive power; positive real power and negative reactive power; negative real power and negative reactive power; and negative real power and positive reactive power.
- The detection of voltage and frequency at its terminals and the ability to react autonomously to mitigate abnormal conditions: to provide reactive power if the voltage is low; to increase real power output if the frequency is low.
- In combination with a communication link, to deliver real and reactive power and to charge and discharge storage facilities in accordance with signals from the utility.

If properly applied, smart inverters can improve the performance of the distribution grid and the network as a whole, or, conversely, if improperly applied, can present serious problems in terms of voltage control, the clearing of short circuits and the creation of dangerous "islanding" conditions. As greater numbers of renewable generating resources interconnect with the grid, the influence of the smart inverter will grow.

To develop proposals to take advantage of these new capabilities, the parties to this proceeding created the Smart Inverter Working Group (Working Group). In January 2014, Working Group issued its “Recommendations for Updating the Technical Requirements for Inverters in Distributed Energy Resources.” The Recommendations were circulated to the parties via a February 7, 2014 assigned Administrative Law Judge (ALJ) ruling and were the subject of the February 19, 2014 prehearing conference.

The Working Group recommended the following revisions to Electric Tariff Rule 21 in what it categorizes as “Phase 1”:

- a. Anti-Islanding Protection: Revise Electric Tariff Rule 21, Section H.1.a.(2) to reflect proposed new voltage ride-through settings;
- b. Low and High Voltage Ride-Through: Revise Electric Tariff Rule 21, Section H.1.a.(2) and Table H.1 to reflect proposed new default voltage ride-through requirements;
- c. Low and High Frequency Ride-Through: Revise Electric Tariff Rule 21, Section H.1.a.(2) and R21 Table H.2 to reflect proposed new frequency ride-through settings;
- d. Dynamic Volt-Var Operation: Revise Electric Tariff Rule 21, Sections H.2.a, H.2.b, H.2.i and R21 table H.1 to reflect proposed new dynamic volt/var operations requirements;
- e. Ramp Rates: Add new Electric Tariff Rule 21 subsection within Electric Tariff Rule 21, Section H to include proposed new ramp rate requirements;
- f. Fixed Power Factor: Revise Electric Tariff Rule 21, Section H.2.i to reflect the proposed new fixed power factor requirements; and

- g. Soft Start Reconnection: Revise Electric Tariff Rule 21, Section H.1.a.(2) to reflect proposed new reconnection by soft-start method.

On May 13, 2014, the assigned Commissioner issued his scoping memo directing the electric utilities to analyze these recommendations and propose specific modifications to Electric Tariff Rule 21.

On July 18, 2014, PG&E, SCE and SDG&E filed and served in this docket a draft Advice Letter filing setting forth revisions to Electric Tariff Rule 21 to conform to the seven recommendations made by the Working Group, and any other revisions needed to Electric Tariff Rule 21 to facilitate deployment of smart inverter capabilities.

On August 18, 2014, parties filed and served comments in this docket on the draft Advice Letter filings. Comments were filed by: Fronius USA LLC (Fronius), Power-One, Schneider Electric (Schneider), California Energy Storage Alliance, Empower Micro Systems, Inc., Clean Coalition, Enphase Energy, and Apparent Energy.<sup>2</sup>

All commenters praised the consensus built by the diligent hard work of the Working Group.

Several parties recommended delaying the effective date of the requirement for improved inverters, and explained that time was needed to research and develop technology to meet the new requirements, as well as obtain certification from Underwriters Laboratory. Specifically, these parties would extend the mandatory implementation date from the later of December 31, 2015,

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<sup>2</sup> The motions for party status of Qado Energy, Inc. (September 5, 2014) and OutBack Power Technologies (December 2, 2014) are granted.

or the date of approval by Underwriter's Laboratory, to the later of:

(1) 18 months after publication of revised Electric Tariff Rule 21, or (2) 12 months after the Underwriter's Laboratory approval.

Several parties also supported adopting definitions for two specific types of voltage, reference and offset, and refining the definitions of "mandatory operation" and "voltage excursion." Several parties suggested that adding greater than or equal to and less than or equal to arrows to the voltage ride-through and frequency ride-through tables would improve precision.

Power-One and California Solar Energy Industries Association (CALSEIA) proposed allowing existing inverters to be replaced with a similar quality inverter; that is, an inverter that did not meet the definition of smart inverter. Power-One argued that the objective of the revisions was to encourage new installations to incorporate smart inverters, and not to require that existing inverters, which may still be under warranty, to be replaced with smart inverters.

Power-One and Fronius noted that the draft Advice Letters did not have exemptions from the voltage and frequency ride-through requirements for stand-by systems, and advocated for such exemptions. Power-One also suggested that the connect/reconnect ramp-up rate should be mutually agreed upon by the producer and distribution system manager.

CALSEIA reiterated its request that the Commission require the utilities to provide financial assurances that revenue to producer systems will not be diminished by Advanced Grid Functionalities. CALSEIA claimed that "new rate structures are needed that more accurately represent the value of [Advanced Grid Functionalities] on the grid." CALSEIA stated that until new rate structures

are adopted, producers should not be required to operate in a manner that yields lower revenue.<sup>3</sup>

### **Discussion**

Pursuant to Public Utilities Code Section 451 each public utility in California must:

Furnish and maintain such adequate, efficient, just and reasonable service, instrumentalities, equipment and facilities, ...as are necessary to promote the safety, health, comfort, and convenience of its patrons, employees, and the public.

The duty to furnish and maintain safe equipment and facilities falls squarely on California public utilities, including electric utilities.

The burden of proving that particular facilities are safe also rests with the utility. The purpose of Electric Tariff Rule 21 is to ensure that generating facilities interconnect with California electric distribution or transmission systems subject to requirements that they maintain safe operating conditions for utility customers, personnel, and the general public, as well as to retain electric system integrity.

In today's decision, we adopt revisions to Electric Tariff Rule 21, developed largely through consensus, that require new inverters used by interconnecting generating facilities to have enhanced technical capabilities. These new inverter standards will allow interconnected generating facilities to offer system support functions to distribution or transmission system operators. As set forth below, we resolve three remaining but relatively minor issues and authorize the electric

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<sup>3</sup> CALSEIA comments at 3 - 4.

utilities to file Advice Letters with revisions to their respective Electric Tariff Rule 21 conforming to today's decision and to be effective on filing.

Also in today's decision, we set the course for bringing to fruition the promise of these new inverter standards. The purpose of the new inverter functionalities is to allow grid operators to obtain grid support services for dispersed locations and at a lower cost than currently available. To achieve this objective, generating facility operators must install the smart inverters, capable of communications, and then must also have a convenient and economical means to make these services available to the transmission or distribution system operator. This step will be the next objective of this proceeding and contained within the third investigatory Phase of the Working Group work.

#### Issues for Resolution

The effective mandatory date of the requirements adopted today shall be the later of December 31, 2015, or 12 months after the date the Underwriters Laboratory approves the applicable standards. This effective mandatory date should not be construed as a gating factor for the installation of inverters with the applicable standards. With the revision of Electric Tariff Rule 21, we permit and encourage the utilities to work with installers to deploy smart inverters as quickly as possible. To achieve our goal of having enhanced inverters deployed expeditiously while not causing market disruptions, smart inverter requirement shall be permitted and encouraged to be used, but not mandated, on all new inverter installations up until the date that these new standards become mandatory. These new standards do not apply to inverters installed prior to the revision of Electric Tariff Rule 21.

Further, the soft-start connect ramp-up rate and the soft disconnect ramp-down rate should be set as requested.



We also accept the consensus from the parties on the following revisions: (1) Section Hh.2.f.i.; (2) the Frequency Ride-Through Table, Hh-2; (3) Voltage Ride-Through Table Hh-1; and (4) the Definitions VRef, VRefOfs, Mandatory Operation and Voltage Excursion. These consensus revisions are set forth in Attachment A.

### **1. Effective Mandatory Date of Enhanced Inverter Requirements**

In their draft revisions to Electric Tariff Rule 21, the utilities recommended that inverters that can perform functions which autonomously contribute to grid support during excursions from normal operating conditions – “smart inverters” – be required mandatory effective the later of December 31, 2015 or the date Underwriter Laboratory approves the new standards.<sup>4</sup> Smart inverter requirement shall be permitted and encouraged to be used, but not mandated, on all new inverter installations up until the date that these new standards become mandatory. These new standards do not apply to inverters installed prior to the revision of Electric Tariff Rule 21.

As described above, some commenters requested a date certain, i.e., December 31, 2015, or June 2016, and others sought to extend the effective date of the new standards to the later of: (1) 18 months after publication of revised Electric Tariff Rule 21, or (2) 12 months after the Underwriter’s Laboratory updated standard approval.

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<sup>4</sup> Specifically, the date the Supplement SA of UL-1741 (with California requirements) is approved by the full UL-1741 Standards Technical Panel.

A date certain is not practical because the Underwriter's Laboratory standard revision process does not offer a date certain for completion. In adopting these new standards for Electric Tariff Rule 21 today, we would like to see them implemented at the earliest practicable date, while still allowing inverter manufacturers adequate time to seek necessary certifications.

In an effort to find the right balance between the utilities' proposal and Power-one and Schneider's proposal, we adopt the effective mandatory date of the new inverter requirements as the later of either (1) December 31, 2015 or (2) 12 months after the date the Supplement SA of UL-1741 (with CA requirements) is approved by the full UL-1741 Standards Technical Panel.

## **2. Replacement Inverters**

In their draft Electric Tariff Rule 21, the utilities propose that, after the effective mandatory date for the new standards, traditional inverters currently in operation, which fail, should be replaced with inverters that meet the new standards. Commenters proposed allowing installed inverters to be replaced with an inverter not classified as a Smart Inverter. One party argued that the objective of the revisions to Electric Tariff Rule 21 was to encourage new installations to incorporate smart inverters, and not to require that existing inverters, which may still be under warranty, to be replaced with smart inverters.

At this point in time, we are convinced by Power-One's arguments that requiring already installed inverters to be replaced by smart inverters may affect manufacturer warranties. As a result, we find that allowing existing inverters to be replaced with an existing inverter not classified as a Smart Inverter, but of equal or greater ability than the original, should be allowed. Given that the body of knowledge relating to Smart Inverters is growing quickly, we invite the

utilities and Working Group to develop proposals that encourage the replacement of existing inverters with smart inverters at time of failure.

Therefore, we reject the replacement requirements set forth in draft Electric Tariff Rule 21, Section H.d.ii, as proposed by the utilities, and instead adopt Enphase's recommended language for Section H.d.ii:

The replacement of an existing inverter to an inverter that is not classified as a Smart Inverter is allowed per Section H. Section H may be used in all or in part, for replacement inverter based technologies by mutual agreement of the Distribution Provider and the Applicant.

### **3. Provisions for Uninterruptible Power Supplies, Critical Loads, and Microgrids**

In their comments, Schneider, Enphase and Power-One all reference the need to make a special allowance in the Electric Tariff Rule 21 revisions for inverters that serve on-site back-up power needs. In their reply comments, the utilities oppose these allowances, but do not provide supporting evidence for their position. Given the important reliability and resilience function that distributed generation coupled with an inverter can provide to a customer, we find that the Electric Tariff Rule 21 revisions should be revised to reflect Power-One and Enphase's recommendation in Section H.2.b.ii):

#### **Load Shedding or Transfer**

The voltage and frequency ride-through requirements of H 2.b.ii) 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 Local EPS prior to any voltage disturbance, and the Local EPS disconnects from the Area EPS, along with Local EPS load, such that the net change in real power flow from or to the Area EPS is less than 10% of the aggregate Smart Inverter capacity; or b) Local EPS load real power demand equal to 90% to 120% of the predisturbance

aggregate Smart Inverter real power output is shed within 0.1 seconds of Smart Inverter disconnection.

We also find that Schneider's recommendation to organize discussions with utilities to find better ways to accommodate back-up power systems that grid-interconnect has merit. We therefore recommend that the utilities begin such a process, and one year after the adoption of Revised Electric Tariff Rule 21 bring proposed modifications to Electric Tariff Rule 21 back to the Commission for consideration.

#### **4. Volt/Var**

Commenting parties, like Power-One and Fronius, noted further revision to Section Hh.2.j. regarding increased information within the Volt/Var definitions. The utilities replied that this level of detail need not be included in the tariff since such detailed specifications are not yet ripe for inclusion. We request that the utilities investigate this level of detail and make a proposal as to the details based on experience in one year's time from the passage of this revision of Electric Tariff Rule 21.

#### **5. Ramp-Down Specification**

In their draft Electric Tariff Rule 21 revisions, the utilities proposed that the soft-start connect ramp-up rate and the soft disconnect ramp-down rate be set at 2% of maximum current output per second. Commenters opposed including a soft disconnect ramp-down rate and proposed that the rate should be mutually agreed upon by the distribution or transmission system operator and the generating facility. In particular, Schneider states that the proposed ramp-down rate would preclude the ability of inverters to provide maximum power point tracking, which it states is a critical functionality of an inverter.

Given the nascent nature of smart inverter deployment, we are convinced by Schneider's concerns, which are echoed by Power-One and Enphase, that a

ramp-down requirement may have unintended consequences. As a result, we will adopt the connect/reconnect ramp rate specifications proposed by Schneider, which would be added to the utilities' proposed Section Hh.k.2 normal ramp-up rate provisions:

**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, with specific settings as mutually agreed upon by the Distributor Provider and the Producer.

We invite this topic to be reconsidered either by the utilities proposing subsequent modifications that include ramp-down requirements or by the Working Group via a filing in this proceeding or in a subsequent phase after this revision of Electric Tariff Rule 21.

#### **6. Adjusted Ride-Through Tables**

Parties included updated Voltage and Frequency Ride-Through tables in their comments. In reply comments, utilities supported this recommendation. Therefore, we adopt the updated frequency and voltage ride through tables as included by Fronius in their comments.

In comments on the Proposed Decision, Fronius sought flexibility in the range. PG&E proposed in its reply comments to add the option for mutual agreement as to the frequency range. We adopt PG&E's proposed addition. PG&E also agreed to Fronius' request for more flexibility in the automatic transfer provision of the voltage and frequency ride-through requirements. We adopt this proposal as well.

#### Harmonizing Rule 21 Revisions with Federal Wholesale Tariffs

Consistent with our past practice, we will ask the utilities to seek such approval from the Federal Energy Regulatory Commission as may be needed for

conforming changes to their federal wholesale Tariffs interconnection specifications.<sup>5</sup>

Realizing the Value of Smart Inverters

The voltage on a distribution line is now controlled by shunt capacitors, voltage regulators on the line, and a voltage regulator in the distribution transformer at the substation controlled by a line drop compensation algorithm. The smart inverter has the potential to substitute for all of these measures with greater accuracy and at lower cost. To capture the potential for improved voltage control along with the cost savings, the owners of smart inverters connected to the grid must to provide this support as needed by the distribution provider, on terms and conditions acceptable to the inverter owner. Establishing the appropriate level of compensation for inverter owners under the different circumstances that will arise in the real world of transmission and distribution system operation is a complex undertaking. Such an undertaking is necessary, however, if California is to benefit from the investments being made in smart inverters.

Collaboration and consensus have been the hallmark of this proceeding to date, and we are hopeful that this will continue as we move toward bringing the value of smart inverters to day-to-day grid operations. To initiate this next part of the proceeding, our Energy Division Staff will sponsor a workshop to receive proposals from all interested parties, including the distribution providers, equipment vendors, trade associations and other interveners. Subsequent workshops will be held as needed until consensus among the parties is reached

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<sup>5</sup> See, e.g., D.12-09-018 at 32, and D.14-04-003.

or divergent opinions are well defined. At that point, the Energy Division will make recommendations for a Commission decision or further proceedings.

Among the issues to be addressed are: should voltage support be measured in kilovolt-amperes reactive and kilovolt-ampere reactive-hours, the equivalent of real power and energy? Should dollar values be assigned to each, either through bidding by the producers or in negotiations between the producers and the distribution providers? Should frequency support be measured by power injected into the grid or absorbed from it (the charging of a storage device) in kilowatts and kilowatt-hours? How should this be priced, either through bidding by the producers or in negotiations between the producers and the distribution provider? How would the ancillary services be controlled? Options include active control by the distribution provider, which through a communication system would control the real and reactive output of the producer's generator or smart inverter; by contract: the generator provides real and reactive power at certain times of the day; or in response to predetermined grid conditions: e.g., when the voltage at the Point of Common Coupling falls to a certain value, the inverter produces reactive power. Such other parameters for measuring ancillary services and other contractual issues as may be brought up by the parties.

### **3. Comments on Proposed Decision**

The proposed decision of Commissioner Picker in this matter was mailed to the parties in accordance with Section 311 of the Public Utilities Code and comments were allowed under Rule 14.3 of the Commission's Rules of Practice and Procedure. Comments were filed and served on December 3, 2014 by: PG&E, SCE, SDG&E, the Solar Energy Industries Association, OutBack Power

Technologies, and Fronius USA, LLC. Reply comments were filed and served on December 8, 2014, by: PG&E, SCE, SDG&E, and Apparent, Inc.

We have addressed the comments and replies in the substantive sections of today's decision as set forth above by specifying that a replacement inverter must be of equal or greater ability than the original, the normal ramp-up rate should be specified in the tariff, and the Voltage and Frequency Ride-Through requirements can and should allow for more flexibility. We also requested that the utilities make federal filings, and clarify that compensation for smart inverter functionalities is not presumed.

In comments, Fronius requested additional flexibility in the definition of "momentary cessation" to allow for other than the zero current recommended by the utilities. In reply comments, PG&E proposed allowing for any flow below 10% of the maximum continuous output current rating. We adopt PG&E's proposed revision to the definition of momentary cessation.

With these revisions, we adopt the Proposed Decision of Commissioner Picker.

#### **4. Assignment of Proceeding**

Commissioner Michael Picker is the assigned Commissioner and Maribeth A. Bushey is the assigned ALJ in this proceeding.

#### **Findings of Fact**

1. The parties to this proceeding created the Working Group which issued in January 2014 its "Recommendations for Updating the Technical Requirements for Inverters in Distributed Energy Resources."

2. The Working Group recommended the following revisions to Electric Tariff Rule 21:



- a. Anti-Islanding Protection: Revise Electric Tariff Rule 21, Section H.1.a.(2) to reflect proposed new voltage ride-through settings;
- b. Low and High Voltage Ride-Through: Revise Electric Tariff Rule 21, Section H.1.a.(2) and Table H.1 to reflect proposed new default voltage ride-through requirements;
- c. Low and High Frequency Ride-Through: Revise Electric Tariff Rule 21, Section H.1.a.(2) and R21 Table H.2 to reflect proposed new frequency ride-through settings;
- d. Dynamic Volt-Var Operation: Revise Electric Tariff Rule 21, Sections H.2.a, H.2.b, H.2.i and R21 table H.1 to reflect proposed new dynamic volt/var operations requirements;
- e. Ramp Rates: Add new Electric Tariff Rule 21 sub-section within Electric Tariff Rule 21, Section H to include proposed new ramp rate requirements;
- f. Fixed Power Factor: Revise Electric Tariff Rule 21, Section H.2.i to reflect the proposed new fixed power factor requirements; and
- g. Soft Start Reconnection: Revise Electric Tariff Rule 21, Section H.1.a.(2) to reflect proposed new reconnection by soft-start methods.

3. On May 13, 2014, the assigned Commissioner issued his scoping memo directing the electric utilities to analyze the Working Group's recommendations and propose specific modifications to Electric Tariff Rule 21.

4. On July 18, 2014, PG&E, SCE and SDG&E filed and served a draft Advice Letter filing setting forth revisions to Electric Tariff Rule 21 to conform to the seven recommendations made by the Working Group.

5. On August 18, 2014, parties filed and served comments on the draft Advice Letter filings, with relies on September 8, 2014.

6. After the utilities' filing and the comments, three issues remained and required resolution in today's decision.

7. Setting a reasonable mandatory effective date of the requirements adopted herein of the later of December 31, 2015, or 12 months after the date the Underwriters Laboratory approves the applicable standards strikes a reasonable balance between the utilities and the inverter manufacturer commenters' recommendations.

8. Our goal of having enhanced inverters deployed expeditiously while minimizing market disruption is best achieved by allowing existing inverters installed prior to the revision of Electric Tariff Rule 21 to be replaced with an inverter that may or may not be classified as a Smart Inverter.

9. Inverters serving back-up power systems shall be given an exemption from these requirements if they meet the specifications recommended by Enphase and Power-One in their comments.

10. The soft-start connect ramp-up rate should be set as recommended by the Schneider at 1 to 100% of maximum current per second, with the potential for specific settings to be set upon mutual agreement by provider and grid operator.

### **Conclusions of Law**

1. Inverters installed after the effective date of the requirements adopted in today's decision should comply with the updated standards applicable to all inverters, with the exception of inverters that are installed to replace inverters that were in place prior to the effective dates in this Decision and inverters that serve back-up power systems, as defined herein.

2. The ramp-up rate should be set as requested by Schneider at 1 to 100% of maximum current per second, with the potential for specific settings to be set upon mutual agreement by provider and grid operator, and the normal ramp-up rate should be set as proposed by the utilities.

3. The proposed effective mandatory date of the requirements adopted herein should be the later of December 31, 2015, or 12 months from the date the Underwriters Laboratory approves the applicable standards.

4. No more than 30 days after the effective date of this order, PG&E, SCE and SDG&E should be authorized to file and serve a Tier 1 Advice Letter, effective on five days notice, which revises Electric Tariff Rule 21 as proposed in the July 18, 2014, filing and is consistent with today's decision.

5. Consistent with our past practice, we should request the utilities to seek such approval from the Federal Energy Regulatory Commission as may be needed for conforming changes to their federal wholesale Tariffs interconnection specifications.

6. The next stage of this proceeding will focus on revising Electric Tariff Rule 21 to include communications protocols, as that recommendation process based on building consensus is currently underway. The next focus of investigation in this proceeding should be on establishing the appropriate level of compensation, if any, for inverter owners providing grid support functions.

7. The consensus modifications to the utilities' proposal set forth in Attachment A to today's decision should be adopted.

8. The Joint Motion of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company Regarding Implementation of Smart Inverter Functionalities filed on July 18, 2014, should be granted consistent with today's decision.

9. This proceeding should remain open to bring the value of smart inverters to day-to-day grid operations and ratepayers.

10. This decision should be effective immediately.

**I N T E R I M   O R D E R**

Therefore, **IT IS ORDERED** that:

1. The motion Joint Motion of Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company Regarding Implementation of Smart Inverter Functionalities filed on July 18, 2014, is granted, subject to the modifications set forth in today's decision.

2. No later than 30 days after the effective date of this order, Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company are authorized to file and serve a Tier 1 Advice Letter, effective on five days notice, which revises Electric Tariff Rule 21 as proposed in the July 18, 2014, filing and are consistent with today's decision.

3. Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company are requested to seek approval from the Federal Energy Regulatory Commission as may be needed for conforming changes to harmonize their federal wholesale Tariffs interconnection specifications with the revisions to Electric Tariff Rule 21.

4. The utilities are ordered to file a Tier 1 Advice Letter updating Electric Tariff Rule 21 indicated the date of the approval of Supplemental SA of UL 1741 (with CA requirements) within five days of its approval.

5. One year after the adoption of Revised Electric Tariff Rule 21, the utilities will make a proposal regarding: the provisions for Uninterruptible Power Supplies, Critical Loads, and Microgrids; enhanced Volt/Var specifications based on detailed analysis gathered from utilizing these functions; inclusion of a consensus-based ramp-down specification.

6. The motions for party status of Qado Energy, Inc. (September 5, 2014) and OutBack Power Technologies (December 2, 2014) are granted.

7. Rulemaking 11-09-011 remains open.

This order is effective today.

Dated December 18, 2014, at San Francisco, California.

MICHAEL R. PEEVEY

President

MICHEL PETER FLORIO

CATHERINE J.K. SANDOVAL

CARLA J. PETERMAN

MICHAEL PICKER

Commissioners

## Attachment A

### Agreed Upon Revisions to Definitions

1. VRef: The reference voltage or nominal voltage.
2. VRefOfs: The offset from the reference voltage due to the location of the Smart Inverter system on a distribution feeder. This may be a setting or may be calculated dynamically from local voltage measurements.
3. Mandatory Operation: The Smart Inverter operates at maximum available current without tripping during Distribution Provider’s Transmission or Distribution System excursions outside the region of continuous operation. Any functions that protect the Smart Inverter from damage may operate as needed.
4. Voltage Excursion: Beginning when Distribution Provider’s Transmission or Distribution System voltage at the PCC exits the Near Nominal magnitude range and ending when voltage re-enters the Near Nominal magnitude range.

Table Hh-1: Voltage Ride-Through Table

Region	Voltage at Point of Common Coupling (% Nominal Voltage)	Ride-Through Until	Operating Mode	Maximum Trip Time
High Voltage 2 (HV2)	$V \geq 120$			0.16 sec.
High Voltage 1 (HV1)	$110 < V < 120$	12 sec.	Momentary Cessation	13 sec.
Near Nominal (NN)	$88 \leq V \leq 110$	<del>Continuous Operation</del> <u>Indefinite</u>	Continuous Operation	<del>Continuous Operation</del> <u>Not Applicable</u>
Low Voltage 1 (LV1)	$70 \leq V < 88$	20 sec.	Mandatory Operation	21 sec.
Low Voltage 2 (LV2)	$50 \leq V < 70$	10 sec.	Mandatory Operation	11 sec.
Low Voltage 3 (LV3)	$V < 50$	1 sec.	Momentary Cessation	1.5 sec.

Table Hh-2: Frequency Ride-Through Table

System Frequency Default Settings	<u>Minimum Range of Adjustability (Hz)</u>	Ride-Through Until (s)	Ride-Through Operational Mode	<u>Default Clearing Trip Time (s)</u>
$f > 62$	62 - 64	No Ride Through	Not Applicable	0.16
$60.5 < f \leq 62$	<u>60.1</u> - 62	299	Mandatory Operation	300
$58.5 \leq f \leq 60.5$	<u>Not Applicable</u>	Indefinite	<u>Continuous Operation</u>	<u>Not Applicable</u>
$57.0 \leq f < 58.5$	57 - <del>60</del> <u>59.9</u>	299	Mandatory Operation	300
$f < 57.0$	53 - 57	No Ride Through	Not Applicable	0.16

**(End of Attachment A)**