PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Agenda ID#16180

ENERGY DIVISION **RESOLUTION E-4898**

January 11, 2018

R E S O L U T I O N

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.

PROPOSED OUTCOME:

- Approves, with modifications, Pacific Gas and Electric, Southern California Edison and San Diego Gas & Electric's proposed revisions to the Electric Rule 21 Tariff incorporating eight Smart Inverter Working Group Phase 3 advanced functionality recommendations.
- Modifies the effective dates and adjusts technical requirements of the eight functions.
- Rejects the proposed revisions to the Electric Rule 21 Tariff communications requirements for smart inverters.

SAFETY CONSIDERATIONS:

- Implementation of smart inverter Phase 3 advanced functions could improve the safety and reliability of the distribution system and overall electric grid.

ESTIMATED COST:

- This Resolution is expected to reduce ratepayer costs associated with interconnecting distributed energy resources under the Electric Rule 21 Tariff by minimizing the impact of those resources on the distribution system.

By Advice Letters (ALs) 5129-E (Pacific Gas and Electric) and 3647-E (Southern California Edison), Filed on August 18, 2017, and 3106-E (San Diego Gas & Electric), Filed on August 17, 2017, hereafter collectively the Advice Letters or ALs.

SUMMARY

Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) request approval of modifications to Electric Rule 21 Tariff (Rule 21) that incorporate the Smart Inverter Working Group (SIWG) Phase 3 advanced functions recommendations. The recommendations are comprised of eight functions which can improve the performance of the distribution grid and the network as a whole. Subject to the modifications herein, this Resolution finds the proposed tariff revisions of Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric to be generally compliant with Decision (D.) 16-06-052.[1] This Resolution modifies the effective date of the function requirements, makes adjustments to the technical requirements of the eight functions, and rejects the proposed modifications to smart inverter communications requirements.

BACKGROUND

The Commission initiated Rulemaking (R.) 11-09-011 on September 22, 2011 to review and, if necessary, revise the rules and regulations governing the interconnection of generation and storage facilities to the electric distribution systems of the investor-owned utilities (IOUs). The IOUs' rules and regulations pertaining to the interconnection of generating facilities are set forth in the Electric Rule 21 Tariff. Generating resources interconnecting to the utility grid via Rule 21 which produce direct current (DC) power require an inverter to convert the DC from the generating resource to the voltage and frequency of the alternating current (AC) distribution system. 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.

[1] 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.

In March 2016, the SIWG completed its first set of recommendations for Phase 3 advanced functions.[2,3]

The Phase 3 advanced functions are summarized as follows:

1. **Monitor Key Distributed Energy Resource (DER) Data:** The inverter takes measurements as it converts power. With the ability to communicate, the inverter can send this information, such as voltage and active and reactive power, to the utility.

2. **DER Disconnect and Reconnect Command (Cease to Energize and Return to Service):** In certain situations, the utility may need to de-energize circuits to perform maintenance or repairs, or to prevent unsafe conditions during an emergency. With this function, the utility can send a command to the inverter to disconnect the DER from the local electrical system or prevent the DER from energizing the local system.

3. **Limit Maximum Active Power Mode:** This function establishes an upper limit on active power that a DER or system of DERs can produce or use. By limiting active power, this function helps to prevent voltage conditions and other related issues, especially in high DER penetration situations.

4. **Set Active Power Mode:** Similar to the previous function, this function establishes the active power that a DER or a system of DERs can produce or use.

5. **Frequency Watt Mode:** As a system-wide parameter, frequency is affected by all devices connected to the electric power system. High frequency events are often a sign of too much power in the grid and vice versa. Frequency Watt Mode is one method for countering these events, which is

[2] SIWG Phase 3 DER Functions: Recommendations to the CPUC for Rule 21, Phase 3 Function Key Requirements, and Additional Discussion Issues, Issued March 31, 2017.

[3] The SIWG's Phase 1 and Phase 2 recommendations were incorporated into Rule 21 April 2015 and April 2017.

accomplished by reducing power in response to rising frequency or vice versa.

6. **Volt Watt Mode:** As a general rule, the production of active power raises voltage. This relationship can be problematic for solar photovoltaic (PV) systems interconnecting in areas where utilities have not planned for voltage rise and where existing distribution equipment cannot lower voltage. Volt Watt Mode modifies active power from DERs based on predetermined voltage ranges to prevent the local voltage from rising/dropping outside of allowable levels.

7. **Dynamic Reactive Support:** This function is similar to the Volt Var Function from Phase 1. However, instead of modifying reactive power in response to the steady-state voltage level, this function responds to the rate of change in voltage.

8. **Scheduling Power Values and Models:** This function enables scheduling of active and reactive power, as well as modification of settings of other functions.

On June 23, 2016, the Commission adopted Decision 16-06-052, which directed the IOUs to file proposed revisions to Rule 21 setting forth any agreed-upon technical requirements, testing and certification processes, and effective dates for Phase 3 functions in Tier 3 Advice Letters no later than six months from the effective date of D.16-06-052 and in the absence of consensus, to file a work plan and an outline of next steps for tariff development. On November 17, 2016, the Commission's Energy Division hosted a public workshop with the purpose of providing guidance to the IOUs on the Advice Letter filings. During the workshop, it was determined that the development of the Phase 3 advanced function recommendations was insufficient at the time for the IOUs to propose revisions to Rule 21 adopting these functions.

On December 20, 2016, the IOUs jointly filed Tier 1 AL 4983-E that provided a work plan and an outline of next steps for tariff development including a status update on the activities outlined in the work plan by March 30, 2017. On March 31, 2017, the SIWG submitted final revisions to the Phase 3 recommendations. In addition, the IOUs filed the required status update on March 30, 2017. In accordance with the work plan, the IOUs each anticipated

filing a Tier 3 Advice Letter in June 2017. The June 2017 filing date was contingent on additional stakeholder discussions; additionally, in AL 4983-E, the IOUs stated, "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."

On June 20, 2017, the IOUs jointly requested to extend the submittal date of the Tier 3 Advice Letters incorporating the Phase 3 advanced functions into Rule 21 to August 18, 2017. On June 27, 2017, Commission Executive Director Timothy Sullivan granted the IOUs' request for extension of the Advice Letters.

On August 17 (SDG&E) and August 18 (SCE and PG&E), 2017, the IOUs filed the Advice Letters to comply with D.16-06-052 proposing Rule 21 tariff revisions which set forth agreed-upon technical requirements, testing and certification processes, and effective dates for the smart inverter Phase 3 advanced functions. In addition, the Advice Letters proposed revisions to the smart inverters Phase 2 communications in the Rule 21 tariffs and mandatory activation for two of the eight Phase 3 advanced functions.

NOTICE

Notice of ALs was made by publication in the Commission's Daily Calendar. Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric state that a copy of the Advice Letters was mailed and distributed in accordance with Section 4 of General Order 96-B. The ALs were served to Service List R.11-09-011.

PROTESTS

Six groups of parties filed protest to ALs on September 6 and 7, 2017: Clean Coalition, Solar Energy Industries Association (SEIA), California Solar Energy Industries Association (CALSEIA), Sunrun, SunSpec Alliance, and the Joint Stakeholders, which consists of Tesla, ABB, Outback Power Technologies, and Enphase Energy.

Clean Coalition's protest to San Diego Gas & Electric's AL 3106-E was filed on September 7, 2017 and was dated as September 6, 2017. The protest was deemed late. On September 8, 2017, Energy Division informed Clean Coalition and San Diego Gas & Electric that the protest would still be considered. All other protests were timely filed.

The protests fell into general and function-specific issues and are discussed below.

I. General Issues

I.A. Claims that the Advice Letters are Non-compliant with D.16-06-052.
Clean Coalition asserts that the proposed revisions included in the Advice Letters are beyond the scope of the Smart Inverter Working Group and that which was ordered by D.16-06-052.[4] Clean Coalition argues that the scope of the Advice Letters should be limited to requiring certain capabilities for advanced inverters and not the mandatory activation of those capabilities. Clean Coalition recommends that the Commission not accept the Advice Letters at this time and instead refer the Advice Letters to the SIWG for expedited review and modification.

SEIA contends that the proposed revisions were not agreed upon by the SIWG and are not consistent with the expectations of D.16-06-052.[5] Particularly, SEIA references Attachment E of D.16-06-052, which states, "these eight capabilities would only be enabled or permitted after contractual or market agreements are made." SEIA argues that the Advice Letter process was insufficient for making determinations on smart inverter compensation and that there are open proceedings working on the development of the compensation mechanisms, specifically the interconnection proceeding, Rulemaking (R.) 17-07-007,[6] the

[4] Clean Coalition's Joint Protest to ALs.
[5] SEIA's Joint Protest ALs.
[6] Order Instituting Rulemaking to Consider Streamlining Interconnection of Distributed Energy Resource and Improvements to Rule 21.

Distributed Resources Plan (DRP) proceeding R.14-08-013,[7] and the Integrated Distributed Energy Resources (IDER) proceeding R.14-10-003.[8]

Sunrun claims that the Advice Letters do not meet the Commission's standards for approval because the relief the Advice Letters' request 1) is unjust and unreasonable, 2) would violate a Commission order, 3) is not authorized by statute or Commission order, 4) requires a formal evidentiary hearing and is inappropriate for an advice letter, and 5) is pending before the Commission in another formal proceeding.[9] Sunrun recommends that the Commission 1) reject the Advice Letters, 2) require the IOUs to build more consensus within the SIWG and then submit new advice letters setting forth agreed-upon, advanced inverter capabilities installed in deactivated mode as a default, 3) consider whether any critical issues of fact regarding the degree of curtailment customers would face from Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode, should be within the scope of R.17-07-007, and 4) leave questions of compensation and the operational requirements needed to justify such compensation to their appropriate formal proceedings in which the issues are properly scoped.

I.B. Proposals to Modify the Effective Dates for the Implementation of the Phase 3 Functions.

CALSEIA recommends that the Commission should change the proposed effective date for Function 1, Monitor Key DER Data, to 12 months for design and certification instead of the IOU-proposal of 9 months.[10,11] In addition, CALSEIA asserts that for all relevant functions, performance of the functions via aggregators must be allowed to avoid functionality that would be designed and may be later abandoned.

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[7] Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.

[8] Order Instituting Rulemaking to Create a Consistent Regulatory Framework for the Guidance, Planning and Evaluation of Integrated Distributed Energy Resources.

[9] Sunrun, Inc.'s Joint Protest to ALs.

[10] CALSEIA Protest of PG&E AL 5129-E and SCE AL 3547-E.

[11] CALSEIA Protest of SDG&E 3106-E.

SunSpec Alliance recommends that the timing of all of the requirements be harmonized to coincide with the next release of the international standards, Institute of Electrical and Electronics Engineers (IEEE) 1547 and 1547.1, because the staggered implementation of the function capabilities will have a financial impact on inverter manufacturers and create unnecessary complexities.[12]

I.C. Concerns about Differences Between the Proposed Modifications and the International Standards.

Several parties (Clean Coalition, SEIA, CALSEIA, the Joint Stakeholders) note variances in the proposed tariff revisions from the international standards, IEEE 1547 and IEEE 1547.1, and recommended modification to avoid direct conflict with the standard.[13,14,15]

II. Function-Specific Issues

II.A. CALSEIA and Sunrun Oppose Utilization of Function 2 and Function 3 without First Establishing Operational Rules.

CALSEIA recommends that the Commission prohibit the IOUs from using Function 2, DER Disconnect and Reconnect Command, and Function 3, Limit Maximum Active Power Mode, until the Commission approves operational rules. CALSEIA is concerned that without limitations, the IOUs will deploy the functions, which CALSEIA claims will result in curtailment, i.e. loss in active power, and consequently have a financial impact. Sunrun also has concerns with Functions 2 and 3 with regards to curtailment.

II.B. Claims that Advice Letters are not the Appropriate Venue for Determining the Activation of Function 5 and Function 6.

Several parties (SEIA, CALSEIA, Sunrun, the Joint Stakeholders) assert that Functions 5 and 6 should only be required capabilities and not have mandatory activation. SEIA references only Function 6. Sunrun argues that the default activation of Functions 5 and 6 for all prospective DERs creates curtailment risks that have not been studied. CALSEIA recommends that the effective date for

[12] SunSpec Alliance Protest to ALs.
[13] The Joint Stakeholders' Protest to SDG&E AL 3106-E.
[14] The Joint Stakeholders' Protest to SCE AL 3647-E.
[15] The Joint Stakeholders' Protest to PG&E AL 5129-E.

Functions 5 and 6 be the later of 1) 12 months after the effective date of the approval of the Advice Letters and 2) 3 months after approval of tariff elements addressing distributed grid services in all rate schedules. The Joint Stakeholders claim that R.17-07-007 would be a more appropriate venue for determining activation of these two functions.

II.C. Request to Remove or Clarify Function 7.
Several parties (CALSEIA, the Joint Stakeholders) contend that the tariff revisions left Function 7, Dynamic Reactive Power Support, as undefined and recommend that the function either be removed or clarified with additional details.

II.D. Disagreement on the Need for California-specific Scheduling Requirements, Function 8.
Several parties (SEIA, CALSEIA, Sunrun, the Joint Stakeholders) state that the need for Function 8, Scheduling Power Values and Modes, has not been demonstrated and it is unclear if, why, and when the functionality would be utilized. CALSEIA recommends that the function should be optional. Sunrun argues that the proposed Function 8 standards are California-specific, and that these standards and accelerated timelines for meeting the new requirements would diminish the health and vibrancy of California's inverter market. The Joint Stakeholders note that scheduling functionality is not part of the new IEEE 1547 standard and would be California-specific.

II.E. Opposition to the IOUs' Proposed Modifications to the Phase 2 Communications Requirements in Rule 21.
Sunrun contends that the proposed monitoring, communications and control requirements go beyond establishing the capabilities needed to operationalize DER aggregation to implicating customers' privacy interests and would require substantial upfront investments with no corresponding opportunities for returns. Sunrun has concerns with excluding aggregators from fulfilling communication capability requirements.

The Joint Stakeholders argue that aggregators must be allowed to fulfill the communication capability requirements. The Joint Stakeholders recommend that the communication requirements should not be required as a capability until 12 months after either 1) aggregators are allowed to perform the monitoring and control, and the IOUs have approved implementation plans, which include

funding for the utility and compensation for the inverter-based technologies, to use the communication capability or 2) the new IEEE P1547.1 standard is published.

SEIA also states that the communication requirements should remain as they are currently specified in Rule 21.

IOU REPLIES TO PROTESTS

III. The IOUs Recommend a Commission Public Workshop to Resolve the Issues Raised in the Protests.

In the IOUs' replies to protests, the IOUs recommend that the Commission direct the Energy Division to host an in-person workshop to support further consensus development for the Rule 21 tariff revisions incorporating the Phase 3 advanced functions and discuss issues raised in the protests. The IOUs also assert that additional regulatory work is required in order to implement the ability for smart inverter Phase 2 communications requirements to be fulfilled through an aggregator. SCE and SDG&E suggest that this aggregator work be placed within scope of the interconnection proceeding, R.17-07-007.

DISCUSSION

IV. October 25, 2017 Workshop

Pursuant to several parties' and the IOUs' request, the Energy Division held a public workshop on the Advice Letters on October 25, 2017 at the Commission. The purpose of the workshop was to discuss and, if possible, resolve issues raised in protests to the Advice Letters. The workshop resolved many of the disputed issues in the protests including:

- Alignment of Rule 21 requirements with the international standards, IEEE 1547 and IEEE 1547.1;
- Effective dates for mandatory capability of the eight functions;
- Clarifying the ability of aggregators to fulfill Rule 21 Smart Inverter functions;

- Technical requirements for Functions 1, 6, and 8;[16] and
- All eight functions may be activated by mutual agreement prior to the mandatory effective date.

The issues not resolved at the workshop and disposed of in this Resolution include:

- Approving inclusion of functions 2, 3, 4, and 7 as mandatory capabilities;
- The IOUs' proposal for activation of Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode, is reasonable and approved;
- Ordering the IOUs to file advice letters proposing updates the technical requirements for functions 4 and 7 no later than 5 months after approval of the original Advice Letters;
- The IOUs' proposal on Function 8, Scheduling Power Values and Modes, is reasonable and approved; and
- The IOUs' proposal to modify Smart Inverter Communication Requirements is rejected.

V. Summary of Treatment of Disputed Issues in the October 25, 2017 Workshop and This Resolution

Table 1 below provides an overview of the treatment of disputed issues in the October 25, 2017 workshop and this Resolution. In the section below, we discuss further our findings and conclusions on disputed issues.

[16] Following the workshop, the IOUs submitted to the Energy Division modifications to the proposed tariff revisions to incorporate the discussions from the workshop regarding technical requirements for Functions 1, 6, and 8. These are included in Attachment 1.

Table 1: Summary of Workshop and Resolution Proposed Outcome by Function

Function	Workshop Results	Outcome of Resolution E-4898
Function 1 Monitor Key DER Data	Stakeholders Recommend Alignment with IEEE 1547.	Modify IOU Proposed Language to Align with International Standard IEEE 1547.
Function 2 DER Disconnect and Reconnect Command (Cease to Energize and Return to Service)	It was Found that There is No Need for Modification.	Adopt IOU Proposed Language.
Function 3 Limit Maximum Active Power Mode	It was Found that There is No Need for Modification.	Adopt IOU Proposed Language.
Function 4 Set Active Power Mode	Stakeholders State the Need for Clarifications on "Optional" Definition and Technical Requirements.	Adopt IOU Proposed Language. Will Require Later Revision and IOUs Shall File Technical Requirements in 5 Months.
Function 5 Frequency Watt Mode	Stakeholders Had General Consensus on Activation; Sunrun Concerned about Storage Units Being Called for Underfrequency Events.	Adopt IOU Proposed Language.
Function 6 Volt Watt Mode	Stakeholders Recommend Alignment with IEEE 1547; No Consensus was Reached on Activation; Stakeholders Concerned about Compensation and Amount of Curtailment.	Modify IOU Proposed Language to Align with International Standard IEEE 1547.
Function 7 Dynamic Reactive Support	Stakeholders State the Need for Clarifications on "Optional" Definition and Technical Requirements.	Adopt IOU Proposed Language. Will Require Later Revision and IOUs Shall File Technical Requirements in 5 Months.
Function 8 Scheduling Power Values and Modes	Stakeholders Affirm Need for Minor Modification; No Consensus was Reached on Capability Requirement.	Modify IOU Proposed Language on Technical Requirements Based on Stakeholder Feedback from Workshop.
Effective Dates	Stakeholders Reached Consensus on Effective Dates.	Modify IOU Proposed Dates to Workshop Consensus Effective Dates.

Phase 2 Communication Requirements	Stakeholders Concerned that IOUs are Removing the Ability of Aggregators to Fulfill Requirements.	Reject IOU Proposed Modification.

The disputed issues are addressed below are organized by general issues and function-specific issues.

VI. General Issues

VI.A. The Advice Letters were Properly Filed in Compliance with D.16-06-052. Ordering Paragraph 9 of D.16-06-052 ordered the IOUs to "file proposed 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."[17] D.16-06-052 also allowed the IOUs to file a work plan in the absence of consensus in lieu of a December 2016 advice letter filing. The filed work plan set a deadline of 6 months, which was subsequently extended to 8 months. During this time, the IOUs engaged with stakeholders weekly to develop tariff revisions and meet the Commission-approved timeline for adoption into Rule 21. Therefore, while several parties (Clean Coalition, SEIA, Sunrun) claimed that the proposed tariff revisions are not in compliance with Decision 16-06-052 and that the Advice Letters should be rejected pending further review by the Smart Inverter Working Group, the Commission finds that the Advice Letters represent the extensive collaboration completed to date by all parties and have been properly filed with the Commission expectations. Furthermore, the revised modifications to Rule 21 represent agreed-upon technical requirements, testing and certification processes, and effective dates following the Commission Staff hosted workshop, as discussed.

[17] D.16-06-052 OP 9: Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company shall file proposed revisions to Tariff Rule 21 setting forth any agreed-upon technical requirements, testing and certification processes, and effective dates for Phase 2 communications protocols and phase 3 additional advanced inverter functions in separate Tier 3 advice letters no later than six months from the effective date of this decision.

We reject Sunrun's assertion that the Advice Letters do not meet the Commission's standards for approval. We find that the Advice Letters were filed properly in compliance with D.16-06-052. The SIWG is a collaborative process that often yields significant stakeholder consensus that helps inform Commission decision making. The SIWG cannot always achieve 100% consensus, nor are the SIWG's deliberations binding upon the Commission. We consider the consensus and non-consensus view points, and make decisions on the merits of each issue.

VI.B. The Updated Effective Dates Represent Consensus of Stakeholders.
Several parties recommended that the effective dates for the requirements be synchronized with the release of the IEEE 1547 and IEEE 1547.1. Sunrun expressed concerns that the accelerated timelines for meeting the new requirements would diminish the health and vibrancy of California's inverter market. At the October 25, 2017 workshop, stakeholders resolved these disputes and settled on two dates for requiring the Phase 3 functions. The capability of smart inverters to perform Functions 1, 5, 6, and 8 was determined to be the later of: 1) 12 months after the approval of advice letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E or 2) 9 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. This date was chosen to align with dates already approved for Phase 2 communication requirements. For Functions 2, 3, 4, and 7, it was determined that the effective date should be the earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision. This date was chosen to better align with IEEE standards, but to not delay beyond the Commission's goal in the DER Action Plan to have all smart inverter functionality fully operational by the end of 2019.

The net result of these two effective dates is to consolidate effective dates for Phase 2 and 3 functions into two dates to minimize transitions for smart inverter manufacturers, customers, and utilities. These dates also align with development of operational requirements of smart inverters and rules and procedures for adjusting smart inverter functions via communication controls which is scoped into R.17-07-007 and scheduled for Commission Decision in Summer 2019.

At the workshop, it was anticipated that this Resolution would be voted on at the December 14, 2017 Commission Meeting. However, due to time constraints, this Resolution is being voted on at the January 11, 2018 Commission Meeting. To

align with previous expectations, we modify the effective dates of Functions 1, 5, 6, and 8 by 1 month, thereby taking into account the time difference. Thus, the capability of smart inverters to perform Functions 1, 5, 6, and 8 will be the later of: 1) 11 months after the approval of advice letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E or 2) 9 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.[18]

The IOUs shall make a supplemental compliance Advice Letter filing to reflect the agreed-upon effective dates.

Table 2: Effective Dates Proposed in IOU ALs and Effective Dates Based on October 25, 2017 Workshop Consensus

Function	Effective Date Proposed in IOU ALs	Effective Date Based on Workshop Consensus
Function 1 Monitor Key DER Data	Later of: 1) March 2018 or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.	Later of: 1) 11 months after the approval of advice letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 2 DER Disconnect and Reconnect Command (Cease to Energize and Return to Service)	12 months after IEEE 1547.1 standard revisions approval.	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
Function 3 Limit Maximum Active Power Mode	12 months after IEEE 1547.1 standard revisions approval.	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
Function 4 Set Active Power Mode	Optional Upon Mutual Agreement between Utility and Applicant.	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
Function 5 Frequency Watt	12 months from Commission approval of	Later of: 1) 11 months after the approval of advice letters PG&E 5129-E, SCE 3647-E,

[18] The deadline of 9 months after the release of a test standard is not affected by the effective date of this Resolution. The effective dates of Functions 2, 3, 4, and 7 are also not affected by the effective date of this Resolution.

Mode	the Phase 3 advice letters.	and SDG&E 3106-E or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 6 Volt Watt Mode	12 months from Commission approval of the Phase 3 advice letters.	Later of: 1) 11 months after the approval of advice letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.
Function 7 Dynamic Reactive Support	Optional Upon Mutual Agreement between Utility and Applicant.	Earlier of: 1) December 2019 or 2) 12 months after approval of the IEEE 1547.1 standard revision.
Function 8 Scheduling Power Values and Modes	Later of: 1) March 2018 or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.	Later of: 1) 11 months after the approval of advice letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E or 2) 9 months following SunSpec Alliance Communication Protocol Certification Test Standard.

VI.C. The Updated Technical Requirements for Functions 1, 6, and 8 Represent Consensus of Stakeholders.

Despite not coming to agreement about the activation of Function 6 and the inclusion of Function 8, the workshop participants reached consensus on technical requirements for Functions 1, 6, and 8. Per the discussions from the October 25, 2017 workshop, the IOUs submitted modifications to the proposed tariff revisions to the Commission's Energy Division on November 3, 2017. These modifications incorporate the SIWG agreed-upon technical requirements and address many of the stakeholder concerns regarding harmonizing with the international standard, IEEE 1547.[19]

For Function 1, Monitor Key DER Data, the measurement of current is removed and energy storage capacity is represented by percentage of energy storage capacity and not available kWh.

For Function 6, Volt Watt Mode, the active power output is reduced at a rate of 25% instead of the IOU-proposed 50% of real power nameplate rating per one

[19] These revisions are detailed in Appendix A.

percent of nominal voltage and the active power output produced by the smart inverter is reduced to 0 watts when the measured voltage is greater than 110% instead of 108%.

For Function 8, Scheduling Power Values and Modes, modifications to the normal ramp up rate and reconnect ramp up rate set points were removed and clarification was added on when the smart inverter will respond to changing its mode of operations.

Therefore, we find that the updated technical requirements for Functions 1, 6, and 8, detailed in Appendix A, reflect consensus of the Smart Inverter Working Group and should be adopted into Rule 21.

The IOUs shall make a supplemental compliance Advice Letter filing to incorporate the revisions in Appendix A.

We discuss outstanding issues with Functions 6 and 8 separately.

VI.D. Stakeholders Supported All Functions to be Permissible by Mutual Agreement Before the Mandatory Date.

At the October 25, 2017 workshop, stakeholders agreed to provide the option for the utilization of the functions before the effective dates upon mutual agreement between the utility and inverter-based generating facility. Therefore, we find that the ability to utilize the Phase 3 Functions prior to the effective dates by mutual agreement between the utility and generating facility reflect consensus of the Smart Inverter Working Group and should be adopted into Rule 21.

We order the IOUs to add the following language to each Phase 3 function in Rule 21 with the effective dates discussed in the previous section.

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

The IOUs shall make a supplemental compliance Advice Letter filing to incorporate the ability to utilize the Phase 3 Functions prior to the effective dates by mutual agreement between the utility and the generating facility.

VII. Function-Specific Issues

VII.A. We Reject Protesters' Call to Prohibit the Use of Function 2, DER Disconnect and Reconnect Command, and Function 3, Limit Maximum Active Power Mode.

CALSEIA recommended that the Commission prohibit the IOUs from using Functions 2 and 3 until the Commission approves the operational rules for utilizing smart inverter functions. We reject this proposal.

The IOUs ALs require smart inverters to have the capability to perform these two functions and do not require the functions to be activated immediately. Rule 21 R.17-07-007 is scoped to develop operational rules for smart inverter functions by the summer of 2019. CALSEIA's rejection of these functions would stand in the way of the Commission's goal of achieving fully operational smart inverters by the end of 2019 because the Commission cannot develop operational rules for smart inverter functions that have not been adopted as required capabilities.

As discussed in the Effective Dates Section, the capability to perform these functions will not be required until the earlier of: 1) December 2019 or 2) 12 months after the IEEE 1547.1 standard revision is approved, which is after the date that R.17-07-007 plans to have a proposed decision on the operational requirements of smart inverters. Thus, we find no need to prevent the IOUs from utilizing the smart inverter functions and reject CALSEIA's recommendation.

Therefore, we determine there is no need to prohibit utilization of Functions 2 and 3.

The IOUs shall incorporate Functions 2 and 3 as proposed when making the supplemental compliance Advice Letter filing.

VII.B. The IOUs' Proposal for Activation of Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode, is Reasonable and Approved. To Address Concerns, the IOUs are Ordered to Study the Impacts of Activation for Both Functions.

In response to parties' claim that the Advice Letters go beyond the scope ordered by D.16-06-052, we find that D.16-06-052 neither required nor prohibited the IOUs from proposing mandatory activation as part of the technical requirements. Particularly, SEIA's reference to Attachment E of D.16-06-052 is incorrect in that

the statement, "these eight capabilities would only be enabled or permitted after contractual or market agreements are made,"[20] was not a Commission directive. The statement in Attachment E was a reference to the SIWG's Phase 3 recommendations, which was not adopted in full by the Commission. The Commission directed the IOUs to use the recommendations to develop their tariff revisions. However, the recommendations themselves are not binding.

In addition, activation of Functions 5 and 6 does not eliminate the potential for compensation for these functions as would be developed through other proceedings including the IDER and the interconnection proceeding, R.17-07-007. The Commission will consider the development of compensation mechanisms in open proceedings, and the study of these functions will assist in determining appropriate levels and mechanisms for compensation if compensation is found to be warranted. We reject SEIA's assertion that requiring activation of Functions 5 and 6 is a compensation question beyond the scope of these ALs. It is a reasonable part of utilizing smart inverter functionality to benefit the grid and ratepayers.

The benefits of Functions 5 and 6 are apparent by the SIWG Phase 3 recommendations and have the potential to avoid or defer distribution upgrades, along with the other Phase 3 functions. Function 5, Frequency Watt Mode, will allow DERs to respond to frequency changes, which is of substantial importance as the grid displaces traditional inertia-providing fossil fuel generation with renewable technologies, many of which do not provide the same inertia. Function 6, Volt Watt Mode, will assist in places where high DER penetrations at the distribution level may drive feeder voltage too high.

In earlier SIWG work, Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode, were once part of the Phase 1 autonomous functions, but were not included in Phase 1, because of time constraints. We see Functions 5 and 6 as having some of the same attributes of Phase 1 autonomous functions. Activation of Function 5 and 6 has benefits to the grid and to ratepayers.

[20] Attachment E of Decision 16-06-052: History and Status of the Smart Inverter Working Group.

With respect to Function 5, the frequency throughout the Western Interconnection[21] is effectively the same (60 Hz). Calling DERs to support frequency events (fundamentally a system-wide problem) has the potential to affect all constituents of the Western Interconnection, which has a population over 80 million. The significance of this situation is not lost on the Commission. In addition, the SIWG noted the importance of regulating frequency autonomously in emergency situations, as this function does, because the response must be fast to be of benefit.

The agreed-upon technical requirements for Function 6 as submitted by the IOUs following the October 25, 2017 workshop allow for voltage measurements closer to the Point of Common Coupling (PCC) or calculating the voltage change between the PCC and the point of connection (POC) to establish the PCC voltage. As stated in the IOUs' Electric Rule 2 tariffs, the service voltage delivered to customers at the PCC is +/-5% from 100% of nominal voltage. The technical settings of the Volt Watt Mode function specify beginning use of the function at 106% of nominal voltage. Thus, the usage of this function is anticipated to be minimal.

Furthermore, voltage situations caused by DERs may adversely affect the surrounding customers and present safety concerns. Volt Watt Mode eliminates these concerns. Moreover, while enabling Volt Watt Mode may cause small reductions in energy production for some customers, the function will also allow more customers to interconnect DERs and ultimately facilitate higher penetrations of DER installations.

Therefore, we approve the IOUs' request to have mandatory activation of Functions 5 and 6. Additionally, in order to inform proceedings on compensation and respond to stakeholders' concern of curtailment risks of the functions, we order the IOUs to work with stakeholders to monitor the frequency and amount of curtailment posed by Functions 5 and 6 and to present findings to the Commission two years after the mandatory activation of Functions 5 and 6 in a report. At that point, the Commission may re-examine the activation of the

[21] The Western Interconnection includes all or part of 14 western continental states of the U.S., parts of western Canada, and northern Mexico.

functions and/or compensation of the functions in relevant proceedings. Without data on the usage of the functions, the policy debate will be permanently stuck in a conundrum. Stakeholders argue that Functions 5 and 6 should not be activated until the value of the functions is determined. However, the value of Functions 5 and 6 cannot be determined until they are activated and it can be seen which systems are affected and how often. The IOUs shall consult with the Energy Division on the content of the report to monitor the effects of activating Functions 5 and 6.

Therefore, we find the IOU proposal to be reasonable and adopt Functions 5 and 6 into Rule 21. We also order the IOUs to monitor the effects of activating Functions 5 and 6.

The IOUs shall incorporate Functions 5 and 6 when making the supplemental compliance Advice Letter filing.

VII.C. The Capability of Smart Inverters to Perform Function 4, Set Active Power Mode, and Function 7, Dynamic Reactive Current Support, are Not Optional. However, Additional Updates to the Technical Requirements for These Functions are Required.

Stakeholders at the October 25, 2017 workshop requested clarification on the proposed language of Functions 4 and 7 that the functions are "Optional Upon Mutual Agreement between Utility and Applicant." Specifically, they inquired whether it was optional to have the capability or optional to activate the functions once the capability is mandatory. We determine it is the latter, and clarify that the Phase 3 development is for establishing the capability of smart inverters. Our reason is that without requiring smart inverters to have these capabilities, this effort does not achieve the goal of enhancing DERs' ability to integrate into the grid. Thus, we determine that the capability for Functions 4 and 7 is required for all new inverter-based Rule 21 interconnections, along with the other six functions.

In protests, several parties argued that the tariff revisions setting the technical requirements for Function 7 are undefined and recommended that the function either be removed or clarified with additional details. Stakeholders at the October 25, 2017 workshop also expressed uncertainty about the requirements for Function 4. Further discussion revealed the need for clarification of the technical requirements for these two functions. However, to avoid delaying the

implementation of all smart inverter Phase 3 functions, we approve the proposed tariff revisions for Function 4 and Function 7 as proposed and order the IOUs to each file a Tier 2 advice letter no later than 5 months after the approval of this Resolution. The Tier 2 ALs shall clarify the technical requirements for Functions 4 and 7. The IOUs are ordered to work with the SIWG to clarify these requirements. The IOUs shall attach to their ALs a report summarizing the degree of consensus achieved for the revised technical requirements of Functions 4 and 7. There shall be no further delay in order to meet the planned effective date for these functions adopted in this Resolution.

Therefore, we determine Functions 4 and 7 are required and order the IOUs to work with the Smart Inverter Working Group to clarify the technical requirements in 5 months.

The IOUs shall incorporate Functions 4 and 7 as proposed when making the supplemental compliance Advice Letter filing.

VII.D. The IOUs' Proposal on Function 8, Scheduling Power Values and Modes, is Reasonable and Approved.

Several parties asserted that the need for scheduling has not yet been demonstrated and it is unclear when the functionality would be used. Parties also noted that the scheduling functionality would be California-specific. We do not find these arguments to be convincing to prevent smart inverter development in California. The SIWG Phase 1 functions were California-specific at the time of their adoption. It was only after the Phase 1 functions were placed into Rule 21 that the international standard IEEE 1547 developed similar functionality. Furthermore, many if not all of the protestors are part of the Smart Inverter Working Group which set the Phase 3 advanced function recommendations and identified scheduling as a key capability to be added to Rule 21. Therefore, we reject CALSEIA's recommendation that the function be optional. We also note that the issue of operational rules for utilizing Function 8 is scoped into the R.17-07-007.

Therefore, we find that requiring the capability to perform Function 8 is reasonable and will be required.

The IOUs shall incorporate Function 8 when making the supplemental compliance Advice Letter filing.

VII.E. Smart Inverter Communication Requirements and Role of Aggregators

In the Advice Letters, the IOUs proposed modifications to the communication requirements, which effectively prohibit the ability for aggregators to fulfill the communications requirements of smart inverters for Rule 21 at this time. The Commission already approved the Phase 2 communication requirements in Resolution E-4832 on April 6, 2017. Therefore, we reject the IOU-proposed modifications to the smart inverter communication requirements as they attempt to address a matter the Commission has already ruled upon.

Since the Commission already approved Phase 2 Communication requirements that named aggregators as capable of fulfilling Smart Inverter communication functions, we reiterate that aggregators will have a role in fulfilling Rule 21 Smart Inverter Functions. The Scoping Memo of the Rule 21 proceeding R.17-07-007, filed October 2, 2017, has scoped the development of forms and agreements to allow aggregators to fulfill Smart Inverter requirements. The Commission is scheduled to issue a Decision on aggregator forms and agreements in fall 2018. Stakeholders acknowledged this at the October 25, 2017 workshop and supported parallel timelines for the smart inverter communication function implementation date[22] and the development of the aggregator forms and agreements. We refer parties to participate in R.17-07-007 for further discussion of this issue, and therefore, determine that this issue is out of scope for this Resolution.

Finally, we reject the Joint Stakeholders' recommendation to change the implementation date for the communication requirements, because Resolution E-4832 already approved the effective date for Phase 2 smart inverter communications as well. Therefore, we find that the Phase 2 communication requirements were already approved in Resolution E-4832 and reject the IOU proposal for modification.

[22] The communication requirements are mandatory on or after the later of 1) March 1, 2018 or 2) 9 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.

The IOUs shall remove the proposed modifications to Rule 21 Phase 2 communication requirements when making the supplemental compliance Advice Letter filing.

Table 3: Summary of Resolution Conclusions by Function

Function	Section of Resolution E-4898	Outcome of Resolution E-4898
Function 1 Monitor Key DER Data	Resolved in Section VI.C.	We Adopt Technical Requirements Included in Appendix A.
Function 2 DER Disconnect and Reconnect Command (Cease to Energize and Return to Service)	Resolved in Section VII.A.	We Determine There is No Need to Prohibit Utilization of Function.
Function 3 Limit Maximum Active Power Mode	Resolved in Section VII.A.	We Determine There is No Need to Prohibit Utilization of Function.
Function 4 Set Active Power Mode	Resolved in Section VII.C.	We Determine Function is Required and Order IOUs to File Technical Requirements in 5 Months.
Function 5 Frequency Watt Mode	Resolved in Section VII.B.	We Adopt IOU Proposal that Activation is Mandatory and Order IOUs to Monitor Impact.
Function 6 Volt Watt Mode	Resolved in Sections VI.C. and VII.B.	We Adopt Technical Requirements Included in Appendix A. We Adopt IOU Proposal that Activation is Mandatory and Order IOUs to Monitor Impact.
Function 7 Dynamic Reactive Support	Resolved in Section VII.C.	We Determine Function is Required and Order IOUs to File Technical Requirements in 5 Months.
Function 8 Scheduling Power Values and Modes	Resolved in Section VI.C. and VII.D.	We Adopt Technical Requirements Included in Appendix A. We Determine Capability is Required.
Effective Dates	Resolved in Section VI.B.	We Adopt Consensus Effective Dates.
Communication Requirements	Resolved in Section VII.E.	We Determine that Communication Requirements were Already Adopted in Resolution E-4832 and Reject IOUs' Proposal for Modification.

COMMENTS

Public Utilities Code section 311(g)(1) provides that this resolution must be served on all parties and subject to at least 30 days public review and comment prior to a vote of the Commission. Section 311(g)(2) provides that this 30-day period may be reduced or waived upon the stipulation of all parties in the proceeding.

The 30-day comment period for the draft of this resolution was neither waived nor reduced. Accordingly, this draft resolution was mailed to parties for comments, and will be placed on the Commission's agenda no earlier than 30 days from today.

FINDINGS

1. D.16-06-052 directed the IOUs to file Advice Letters to incorporate the Smart Inverter Working Group Phase 3 Advanced Functions Recommendations into Electric Rule 21 Tariff.
2. San Diego Gas & Electric filed AL 3106-E on August 17, 2017. Pacific Gas and Electric and Southern California Edison filed ALs 5129-E and 3647-E on August 18, 2017.
3. On October 25, 2017, the Energy Division held a public workshop to assist the IOUs and the Smart Inverter Working Group to reach consensus on the Phase 3 advanced functions requirements and to discuss the Advice Letters.
4. The Smart Inverter Working Group achieved significant consensus on technical requirements, testing and certification processes, and effective dates.
5. Pacific Gas and Electric, Southern California Edison and San Diego Gas & Electric properly filed revisions to Electric Rule 21 Tariff to comply with D.16-06-052 Ordering Paragraph 9.
6. Acceptance of a late protest was in the public's interest and there was no harm rendered in accepting a late protest.
7. The Smart Inverter Working Group is a collaborative process that often yields significant stakeholder consensus to help inform Commission decision making.
8. It is reasonable for the Commission to consider consensus and non-consensus view points of Smart Inverter Working Group members and make decisions on the merits of each issue.

9. The IOUs and the Smart Inverter Working Group worked in good faith to develop the technical requirements, testing and certification processes, and effective dates for the smart inverter Phase 3 advanced functions.
10. D.16-06-052 neither required nor prohibited the IOUs from proposing revisions to Electric Rule 21 Tariff setting forth mandatory activation requirements for Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode.
11. The revised effective dates for the Phase 3 advanced functions reflect consensus of the Smart Inverter Working Group.
12. It is reasonable to incorporate the consensus-based effective dates.
13. The Electric Rule 21 Tariff revisions in Appendix A reflect consensus technical requirements from the October 25, 2017 workshop.
14. It is reasonable to adopt the consensus technical requirements in Appendix A for Functions 1, Monitor Key DER Data, 6, Volt Watt Mode, and 8, Scheduling Power Values and Modes.
15. It is reasonable to allow utilization of functions under mutual agreement between the utility and customer before the effective date of each function.
16. The proposed revisions for Function 2, DER Disconnect and Reconnect Command, and Function 3, Limit Maximum Active Power Mode, require smart inverters to have the capability to perform these functions and do not require the functions to be used.
17. It is reasonable to adopt the proposed revisions for Functions 2 and 3 as proposed.
18. It is reasonable for the IOUs to require activation of Function 5, Frequency Watt Mode, and Function 6, Volt Watt Mode.
19. Activation of Function 5 and Function 6 does not preclude the Commission determining that customers should be compensated at a later time.
20. It is reasonable for the IOUs to monitor and report on the impacts of activating Function 5 and Function 6.
21. Development of Function 4, Set Active Power Mode, and Function 7, Dynamic Reactive Current Support, requires additional discussion.
22. It is reasonable to require the utilities to propose additional technical requirements for Functions 4 and 7 five months from the effective date of this Resolution.
23. It is reasonable for the IOUs to require the capability to perform Function 4 and Function 7 as proposed.
24. It is reasonable for the IOUs to require the capability to perform Function 8.

25. Resolution E-4832 approved the revisions to Electric Rule 21 Tariff to incorporate the Smart Inverter Working Group Phase 2 Communications Recommendations.
26. The Commission approved the ability of aggregators to fulfill smart inverter Phase 2 communication requirements in Resolution E-4832.
27. R.17-07-007 has scoped the issue of developing the forms and agreements for distributed energy resources aggregators to fulfill Rule 21 requirements related to smart inverters.
28. R.17-07-007 has scoped the operational requirements of smart inverters and the rules and procedures for adjusting smart inverter functions via communication controls.

THEREFORE IT IS ORDERED THAT:

1. Advice Letters PG&E 5129-E, SCE 3647-E, and SDG&E 3106-E are approved as modified herein.
2. Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric shall each file a supplemental Tier 1 compliance advice letter within 10 days to modify Electric Rule 21 Tariff to incorporate the changes as ordered herein:
    a. The IOUs shall incorporate the consensus-based effective dates;
    b. The IOUs shall incorporate the revisions in Appendix A of this Resolution on Functions 1, 6, and 8;
    c. The IOUs shall incorporate the ability to utilize the Phase 3 Functions prior to the effective dates by mutual agreement between the utility and the generating facility;
    d. The IOUs shall incorporate Functions 2, 3, 4, 5, and 7 as proposed; and
    e. The IOUs shall remove the proposed modifications to Phase 2 communications requirements.
3. Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric shall each file a Tier 2 advice letter proposing revisions to Electric Rule 21 Tariff setting forth additional technical requirements for Function 4 and Function 7 and a report on consensus no later than five months from the effective date of this Resolution.
4. Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric shall work with stakeholders to monitor the frequency and amount of curtailment posed by Function 5 and Function 6 and, in consultation with the

Commission's Energy Division, file a report no later than two years after the mandatory activation of Function 5 and Function 6 on the findings.

This Resolution is effective today.

I certify that the foregoing resolution was duly introduced, passed and adopted at a conference of the Public Utilities Commission of the State of California held on January 11, 2018; the following Commissioners voting favorably thereon:

_____
TIMOTHY J. SULLIVAN
Executive Director

APPENDIX A – Electric Rule 21 Tariff Revisions Incorporating Agreed-Upon Technical Requirements from the October 25, 2017 Workshop

Note that the effective dates in the revised tariff language below do not yet reflect the consensus-based dates which were determined through the October 25, 2017 workshop and have been marked for illustrative purposes.

Function 1, Monitor Key DER Data

Section Hh.7. Monitoring and Telemetry Requirements
The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted ~~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~~. The Smart Inverter shall have the capability to communicate its performance information including:

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

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

c. ~~Phase currents measure at the AC terminal of the Smart Inverter (amps)~~

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

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

The Smart Inverter shall be capable of communicating the ~~available kWh~~ percentage of operations ~~for the~~ energy-storage capacity. ~~Available kWh~~ 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.

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

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

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

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

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

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

Function 6, Volt Watt Mode

Section Hh.2.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 12months from the Phase 3 Smart Inverter Function Advice Letter (AL 3647-E) was made effective by the Commission~~. Smart Inverters shall reduce their real power production as a function measured voltage at the inverter terminal or at the Generating Facility Point of Common Coupling (PCC) in accordance with the following:

- *When the measured voltage is greater than 106% of nominal voltage (Example: 127.2 volts on a 120 volts nominal), the active power output produced by the Smart Inverter shall be reduced at a rate of 25~~50~~% of real power nameplate rating per one percent of nominal voltage. Figure Hh-3 Volt-Watt Requirements illustrate the required rate of reduction.*

- *When the measured voltage is greater than 1~~08~~10% of nominal voltage (Example: ~~129.6~~132 volts on a 120 volts nominal), the active power output produced by the Smart Inverter shall be reduced to 0 watts.*

Function 8, Scheduling Power Values and Modes

Section Hh.6. Scheduling Capability Requirements
Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with minimum scheduling memory capability of at least 24 events. The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted 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~~. Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function:

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

- ~~*Modification to the normal ramp-up rate and reconnect ramp-up rate set-points.*~~

- *Modifications to the reactive power set-points for the fixed power factor function.*

- *Modifications to the voltage and watt-reduction level set-points for the volt/watt function.*

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

Scheduling capability requirements may be 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.

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.

Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverter within 15 minutes of the aggregator receiving the scheduling information.

Other options may be utilized by mutual agreement between the Applicant and Distribution Provider

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.