Issue 5 Proposal

Smart Inverter Working Group

R.17-07-007

DRAFT

*Issue 5: Should the Commission require activation of advanced functionality in Phase 1-compliant inverters installed before September 9, 2017 and, if so, how?*

## Proposal Summary

The following four proposals were developed by various stakeholders as part of the working group process to address Issue 5.

### Proposal 1: Do not establish a program for retrofitting a legacy inverter to have Phase 1 functionality.

* This is a consensus proposal.

### Proposal 2: Explore the option of updating existing legacy inverters for only ride-through functions.

* This is a non-consensus proposal.
* The IOUs do not support.

### Proposal 3: Encourage, but do not require, replacing end-of-life inverters with smart inverters.

* This is a consensus proposal.

### Proposal 4: Make replacing end-of-life inverters with smart inverters the default option.

* This is a non-consensus proposal.
* The IOUs do support.

## 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 Electric Tariff Rule 21 (Rule 21). A generating resource interconnecting to the utility’s distribution system 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 (SIWG) was formed by parties of R.11-09-011 to develop proposals to take advantage of the new, rapidly advancing technical capabilities of inverters. In January 2014, the SIWG issued its “Recommendations for Updating the Technical Requirements for Inverters in Distributed Energy Resources,” which came to be known as Phase 1 functions.

On December 22, 2014, the Commission issued Decision (D.) 14-12-035, which adopted the IOUs’ revisions to Rule 21 with modifications incorporating the Phase 1 functions. On September 9, 2017, the Phase 1 functions become mandatory for all new Rule 21 inverter-based interconnections.

On July 13, 2017, the Commission initiated R.17-07-007 in order to consider refinements to the interconnection of distributed energy resources (DERs) under Rule 21, a successor proceeding to R.11-09-011. On October 2, 2017, the Commission circulated the Scoping Memo for the proceeding which established the issues including Issue 5. The [Scoping Memo](http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K476/196476255.PDF) assigned the Smart Inverter Working Group to develop a final report for recommending proposals to address Issue 5.

## Working Group Findings

**Inventory of Inverters**

The Working Group spent considerable effort to determine what portion of existing inverters could be updated with advanced inverter functionality. Three scenarios were considered:

* **Scenario 1**: All seven Phase 1 functions can be updated remotely via software update to inverters that already have firmware that is certified in compliance with UL 1741 SA;
* **Scenario 2**: All seven Phase 1 functions can be updated remotely, but require a firmware update that would not be certified; and
* **Scenario 3:** Systems larger than 500 kW for which all seven Phase 1 functions can be updated with a site visit and the firmware update would be certified.

A fourth scenario was discussed but not quantified, in which inverters could get updated by some but not all of the Phase 1 functions.

A survey was sent to the SIWG mailing list to assist with quantifying the amount of inverters and nameplate capacity for each of the three scenarios and for each of the three utilities. 8 inverter companies responded, representing roughly 81% of market share. The results from the inverter companies who responded are shown in Table 1. Only 1% - 5% of inverter capacity can be updated.

Table 1. Inventory of Upgradable Inverters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | **Utility** | **Total Number of Inverters**  | **Total Inverter Nameplate Capacity (MW)** | **% Updateable Inverter Capacity To Total Existing Capacity per Utility** | **Combined Inverter Nameplate Capacity (MW)** |
| **Scenario #1** | SDG&E | 30,324 | 12 | 1.45% | 235 |
| PG&E | 56,688 | 197 | 5.00% |
| SCE | 4,214 | 26 | 1.25% |
| **Scenario #2** | SDG&E | 166 | 4 | 0.47% | 41 |
| PG&E | 1,333 | 30 | 0.77% |
| SCE | 138 | 7 | 0.34% |
| **Scenario #3** | SDG&E | 0 | 0 | 0.00% | 0 |
| PG&E | 1 | 0 | 0.00% |
| SCE | 0 | 0 | 0.00% |

### Costs Associated with Each Group

Non-IOU stakeholders represented that the cost of updating inverters remotely (Scenario 1 and 2) is approximately $1-2/kW. This includes the time to engineer the update, the cost of data bandwidth, and the time of troubleshooting problems.

In addition, non-IOU stakeholder representatives stated that the cost of updating inverters onsite (Scenario 3) by sending a service technician to a customer site to do an inverter upgrade typically costs approximately $500. It could be less if there is a local installer partner that can do the work. It can be a lot more if the Original Equipment Manufacturer has to visit a remote site.

Non-IOU stakeholders also represented that customers would want a monetary incentive to participate. Non-IOU stakeholders provide an example, if the minimum amount that would begin to be interesting to a customer with a small rooftop system is a one-time payment or credit of $10, this equates to approximately $2/kW (assuming a 5kW system).

### Legal Issues Around Customer Consent

To require activation of advanced functionality in Phase 1 - compliant inverters installed before

before September 9, 2017, legal issues must be considered to implement such decision:

1) Parties to CPUC-jurisdictional interconnection agreements must comply with Rule 21 and the Commission retains jurisdiction of its form agreements.

See for example the following provisions in SCE’s Form 14-731 (Non-Exporting Generating Facility Interconnection Agreement) that is representative of provisions in the IOUs’ pro forma agreements:

Section 5.1: “Producer is responsible for operating the Generating Facility in compliance with all SCE’s tariffs, including but not limited to SCE’s Rule 21, and any other regulations and laws governing the Interconnection of the Generating Facility.”

Section 13.2: “13.2 This Agreement shall, at all times, be subject to such changes or modifications by the Commission as it may from time to time direct in the exercise of its jurisdiction.”[[1]](#footnote-1)

2) Absent Commission action as described in #1, most if not all of the current CPUC approved pro forma interconnection agreements provide for revision by mutual agreement, which would involve the consent of the customer.

## Working Group Proposals

### Proposal 1: Do not establish a program for retrofitting a legacy inverter to have Phase 1 functionality.

**Summary**: Because the percentage of systems that can be updated to all seven functions is small, it does not justify the resources required to implement a program to do so.

**Status:** Consensus.

**Discussion:** The Working Group agrees that while Phase 1 functions are beneficial, it does not outweigh the costs and efforts to implement a program that either (1) mandates or (2) offers a voluntary program to activate Phase 1 functions in existing inverters. In particular, the low number of inverters that were identified through data requests discussed previously, highlights that the money and time required to implement a supporting retrofit program would not yield worthwhile results.

### Proposal 2: Explore the option of updating existing inverters for only ride-through functions.

**Summary:** There are likely at least one million solar systems in California with inverters that can be updated with the voltage and frequency ride-through functions. Non-IOU stakeholders proposed that the Commission and the California Independent System Operator should consider whether it is worth $3/kW (Non-IOU stakeholder determined) to turn those functions on for those systems. The $3/kW valuation was derived from ….

**Status:** Non-Consensus.

**Discussion:** The IOUs do not support the partial activation of some of Phase 1 functions to a subset of interconnection customers. These inverters are existing and will eventually reach end of life at which point the IOUs recommend the inverters be replaced with smart inverters. The effort to update them albeit remote, outweighs the benefit of having a subset of inverters have the voltage and frequency ride-through functions. The IOUs would need to work through:

* **Contractual Issues:** The legal issues around customer consent as noted above and contractual requirements with vendors who would perform the update whether that is an installer or manufacturer.
* **Tracking:** The IOUs already monitor which inverters are legacy separately from Phase 1 - compliant inverters. This would require a new partially Phase 1 - compliant category of inverters.
* **Cost**: The incentive for customers to voluntarily participate is not justified by the benefits and if the customers do not opt in, the cost to administer and contact customers would have been spent with zero benefit.

### Proposal 3: Encourage, but do not require, replacing end-of-life inverters with smart inverters.

**Summary:** Encourage replacement of existing inverters with Smart Inverters but maintain language in Rule 21 Section Hh.

**Status:** Consensus, IOUs prefer Proposal 4 but support Proposal 3.

**Discussion:** Inverters wear out over time faster than solar panels and for some customers have already been replaced. A typical inverter warranty is 10-15 years, while a typical solar panel warranty is 20-25 years. Most solar systems will need to replace their inverters one time during the system lifetime.

Rule 21 requires all newly installed solar systems to have inverters with the Phase 1 smart inverter functions. However, it does not require replacement inverters to include those functions. Section H.3.d.ii states, “The replacement of an existing inverter to an inverter that is of

equal or greater ability than the original is allowed per Section H. Section Hh may be used in all or in part, for replacement inverter-based technologies by mutual agreement of the Distribution

Provider and the Applicant.”

This provision was established in D.14.12.035 due to concerns from inverter manufacturers that equipment replacements that are not like-for-like could void warranties and could create conflicts with other inverters at a location or be unreasonably difficult to install. Solar systems are designed with specific inverters, and the electrical configuration and physical space may not be able to accommodate a different inverter, if a full replacement is required and not only a firmware update.

It is likely that the majority of inverters at their end of life will be replaced with smart inverters because that is what will be commonly available. The Working Group considered whether to ask the Commission to allow for revisions to Rule 21 to require replacement inverters to be smart inverters, but acknowledged that it would need to include exceptions. Any requirement that old inverters be replaced with smart inverters would need to include exceptions if:

* There would be an electrical conflict between old and new inverters in solar systems with multiple inverter;
* The physical space could not host a smart inverter without substantial reconstruction;
* The National Electric Code would require substantial new switches, fuses, or other additional equipment to go along with a smart inverter;
* The appropriate size smart inverter is not available; and
* It would void a warranty.

Non-IOU Working Group members: Given the number of exceptions that would be needed, the Working Group recommends not establishing such a requirement. Again, the expectation is that most inverters will be replaced with smart inverters even without a requirement.

IOU Working Group members: The IOUs continue to support the replacement of existing inverters with Smart Inverters to the extent possible consistent with comments provided in response to the Commission's 2014 decision.[[2]](#footnote-2)

### Proposal 4: Make replacing end-of-life inverters with smart inverters the default option.

**Summary:** Revise Rule 21 Section Hh to make replacement of existing inverters with Smart Inverters the default requirement with exceptions. Any requirement that old inverters be replaced with smart inverters would need to include exceptions if:

* There would be an electrical conflict between old and new inverters in solar systems with multiple inverters;
* The physical space could not host a smart inverter without substantial reconstruction;
* The National Electric Code would require substantial new switches, fuses, or other additional equipment to go along with a smart inverter;
* The appropriate size smart inverter is not available; and
* It would void a warranty.

**Status:**

**Discussion:**

IOU Working Group members: The IOUs continue to support the replacement of existing inverters with Smart Inverters to the extent possible consistent with comments provided in response to the Commission's 2014 decision.[[3]](#footnote-3) IOUs therefore recommend modifying Rule 21 and proposal that the Commission to modify D14-12-035 to make replacement of existing inverters with smart inverters the default requirement and allow for exceptions.

The IOUs acknowledge that as non-IOU stakeholders as highlighted that it is likely that the majority of inverters at their end of life will be replaced with smart inverters because that is what will be commonly available, but propose to support this with this proposed rule change. The IOUs strongly support this versus a program to retroactively update existing inverters with Phase 1 functionality. It would also not be logical to have a requirement that allows inverters to be replaced with non-smart inverters and then implement a program to update inverters after the fact.

Non-IOU Working Group members:

1. Language like this is required by GO 96-B, Energy Industry Rule 6.3. [↑](#footnote-ref-1)
2. Placeholder for 2014 Decision Reference, [↑](#footnote-ref-2)
3. Placeholder for 2014 Decision Reference, [↑](#footnote-ref-3)