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?*

1. **Proposal Summary**
2. **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). 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 (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.

1. **Working Group Findings**

**Inventory of Inverters**

The Working Group spent considerable effort to determine what portion of existing inverters could be upgraded 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
* 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.

X inverter companies were surveyed, representing X% of market share. The results are shown in Table 1. Only 1% - 5% of inverter capacity can be upgraded.

Table 1. Inventory of Upgradable Inverters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Utility** | **Total Number of Inverters** | **Total Number of Projects** | **Total Inverter Nameplate Capacity (MW)** | **% Updateable Inverter Capacity To Total Existing Capacity** | **Combined Inverter Nameplate Capacity (MW)** |
| **Scenario #1** | SDG&E | 30,324 | 1,973 | 12 | 1.45% | 235 |
| PG&E | 56,688 |  | 197 | 5.00% |
| SCE | 4,214 | 4,214 | 26 | 1.25% |
| **Scenario #2** | SDG&E | 166 | 51 | 4 | 0.47% | 41 |
| PG&E | 1,333 |  | 30 | 0.77% |
| SCE | 138 | 138 | 7 | 0.34% |
| **Scenario #3** | SDG&E | 0 | 0 | 0 | 0.00% | 0 |
| PG&E | 1 |  | 0 | 0.00% |
| SCE | 0 | 0 | 0 | 0.00% |

**Costs Associated with Each Group**

The cost of updating inverters remotely is approximately $1-2/kW. This includes the time to engineer the upgrade, the cost of data bandwidth, and the time of troubleshooting problems.

Added to this is the cost of incentivizing customers to allow upgrades. 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.

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.

**Legal Issues Around Customer Consent**

The interconnection agreement constitutes a contract between the customer and the utility that allows the certain equipment to operate in parallel with the distribution system. There is a provision in the interconnection agreement that allows the utility to create additional requirements if they are needed for the safe and reliable operation of the grid, but it is highly debatable whether that would be justified in this case. The Working Group agrees that any changes to existing inverters should only be done with customer consent.

1. **Working Group Proposals**

**1. Do not establish a program for retrofits**

Because the percentage of systems that can be upgraded to all seven functions remotely is small, it is not worth the effort to set up a program to do so.

**2. Explore the option of only upgrading the ride-through functions**

There are likely at least one million solar systems in California with inverters that can be upgraded with the voltage and frequency ride-through functions. The utilities and the California Independent System Operator should give further consideration to whether it is worth $3/kW to turn those functions on for those systems.

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

Inverters wear out over time faster than solar panels. 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 no 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.

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 change 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 inverters, if the physical space could not host a smart inverter without substantial reconstruction, if the National Electric Code would require substantial new switches, fuses, or other additional equipment to go along with a smart inverter, if the appropriate size smart inverter were not available, or if it would void a warranty. 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.