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# Enphase Energy Comments on CEC IEPR Distribution Interconnection Workshop

*Additional submitted attachment is included below.*

June 6, 2023

California Energy Commission
Docket No. 23-IEPR-05
715 P Street
Sacramento, CA 95814

**Re: Docket No. 23-IEPR-05 – Enphase Energy Comments on the May 9, 2023 Commissioner Workshop on Clean Energy Interconnection – Electric Distribution Grid**

Enphase Energy, Inc. (Enphase) respectfully submits the following comments in response to the May 9, 2023 *Commissioner Workshop on Clean Energy Interconnection to the Electric Distribution Grid* (Workshop), held as part of the California Energy Commission's (CEC) IEPR process. Enphase focuses its comments on emerging uses of Power Control Systems (PCS) technologies to enable the rapid deployment of customer-sited clean energy resources despite growing barriers to energization and interconnection.

## I. Executive Summary

- PCS technology can be used in a voluntary flexible interconnection tariff that would give customers an option to connect customer-sited energy resources, when connecting under existing tariffs is not possible without grid upgrades.
- Utility control of systems is not necessary to leverage the benefits of PCS. During the flexible interconnection process, the utility will determine necessary control set points as a condition of interconnection, which will then dictate the levels of import / export limitation needed during a grid event.
- A flexible interconnection tariff utilizing PCS does require any additional costs borne by either the customer or the utility. PCS is UL certified and approved for use today to prevent inadvertent export under Rule 21. The UL certification is being expanded to cover the limitation of energy imports from the grid, though allowances for comparable PCS-based import limitations do not exist under current electric rules. The use of PCS for curtailment under a new optional flexible interconnection tariff simply builds on existing uses of PCS.
- The implementation pathway to utilize PCS under a new optional flexible interconnection tariff should be quick given its existing use in California for interconnection under Rule 21, which has the potential to be used to alleviate existing energization and interconnection challenges in a timely manner.

## II. Introduction

Enphase is a leading manufacturer of residential solar microinverters, energy storage, electric vehicle charging stations, and home energy management systems. Enphase is headquartered in Fremont, California and has deployed microinverters at over 3 million homes globally, promoting the self-consumption of locally generated clean energy.


47281 Bayside Parkway, Fremont, CA 94538 Tel: 707.763.4784

Enphase appreciates the renewed focus at the CEC, California Public Utilities Commission (CPUC), and legislature[1] on grid infrastructure buildout and readiness to enable transportation and building electrification, as well as the deployment of distributed solar and batteries that enhance grid reliability and customer resiliency. As highlighted at the Workshop, the state is facing several interrelated barriers to efficiently connecting new customers and customer-sited resources. Chief among these is the long lead times for distribution transformers – critical grid components that are often entailed in grid upgrades – due to supply chain constraints, and the well-publicized delays in utility grid construction that has greatly hampered electrification and distributed energy resource (DER) projects and new customer service connections.

Enphase wishes to highlight the role of Power Control Systems (PCS) energy management software that can enable the rapid deployment of electrification technologies and DERs. PCS is certified technology that limits the net current flow at the customer meter, allowing precise control and optimization of behind-the-meter resources to stay within the rated capacity limits of a customer's main panel, their utility service connection, and the distribution circuit.

PCS maximizes the utilization of existing grid infrastructure and customer facilities and can avoid the need to pursue capacity upgrades that would otherwise be entailed in connecting *unmanaged* customer-sited resources. To this end, PCS should be a cornerstone of efforts to streamline energization and interconnection processes and timelines, and in a way that mitigates the $50 billion price tag for distribution infrastructure upgrades – an estimate from a recently commissioned CPUC study of the investment needed to meet the state's electrification targets through 2035, in the absence of load management strategies.[2]

## III. PCS Background

PCS is not a single discrete device, nor does it entail a consistent configuration across technology providers. Instead, PCS is a software overlay to one or more electrification technologies or DERs that adjusts their load or generation levels in response to the actual current at a customer premises. This is accomplished through real-time local communications between a site-level gateway or controller or embedded networking capabilities in a device, and a current transformer (CT) (or comparable) installed directly downstream of the customer meter that measures the real-time current at the Point of Common Coupling (PCC). The PCS orchestrates the operation of downstream connected devices based on the current reading at the PCC, import and export limits (either pre-programmed or dynamically managed), and a customer's preferences or requirements.

PCS technologies are certified by the "UL 1741 Certification Requirements Decision (CRD) for Power Control Systems," which was first published in March 2019. The CEC maintains a database of solutions that have received UL 1741 CRD certification on its approved solar inverter list.[3] PCS certification has heretofore been focused on generation resources and energy storage. A process to revise UL 1741 CRD

[1] E.g., Assembly Utilities and Energy Committee Informational Hearing, "Electrical Distribution Planning: How Addressing Current Delays in Connecting to the Distribution Grid may Ensure Readiness for an Electrified Future," held May 24, 2023. https://www.assembly.ca.gov/media/assembly-utilities-and-energy-committee-20230524

[2] Kevala, Inc., "Electrification Impacts Study, Part 1: Bottom-Up Load Forecasting and System-Level Electrification Impacts Cost Estimates," issued May 9, 2023 in CPUC Rulemaking 21-06-017. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M508/K423/508423247.PDF

[3] https://solarequipment.energy.ca.gov/Home/PowerControlSystem


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is currently underway, which will result in two new standalone UL standards for PCS: UL 1741 Supplement (S)E, covering export limitations, and UL 1741 SF covering import limitations, expected to be published by Q3 2023 and Q4 2024, respectively.

A related standard, UL 916, covers dynamic energy management functionality, but for loads only. UL 1741 SE and SF will certify energy management functions for one or more on-site generation resources in addition to loads. It is necessary to have a separate load management standard for sites that include generation, as it introduces much more complexity and safety considerations than solely loads served by the grid.

Safe operations of PCS systems are assured by functional safety requirements in the UL certification process, including normal operating tests, abnormal operating tests, and control of safety critical software. The PCS CRD has a table of self-tests that the system must perform at the time of commissioning to check for abnormal operations or configurations. Then, a series of self-checks occurs once a day for normal operations, which will detect abnormal configurations and revert the system to a controlled state by shutting down the onsite generation. For instance, if contact with the CT is lost, the PCS makes it physically impossible to export more than the upper capacity limit.

Similarly, the National Electric Code (NEC) Section 625.42 requires PCS to shut down in the event of a "malfunction." The UL revision process is interpreting this to mean that if an issue was not caught in the daily self-check, but then the system exceeds the export limit for a certain amount of time, it will shut down the system completely.

## IV. Use of PCS in existing California electric rules and proceedings

PCS, or the related concept of "automated load management" (described below) has been approved for use or is under preliminary consideration in the following IOU electric rules and CPUC proceedings.

### a. Net Energy Metering "Integrity"

PCS is commonly deployed for the use case of ensuring "NEM Integrity" for batteries paired with solar PV systems that receive Net Energy Metering / Net Billing Tariff export compensation. PV-plus-storage systems can deploy PCS in one of two modes to ensure that a customer only receives export compensation for energy that is generated by the on-site solar array: "Import Only" mode, which prevents battery discharges from being exported to the grid; and "Export Only" mode, which ensures that the battery can only charge from the PV.

### b. Rule 21

#### i. Non-Export, Limited Export, Inadvertent Export

PCS is an approved method by which DERs can achieve Non-Export (Option 8), Limited Export (Option 9), or Inadvertent Export (Options 10, 11) for the purposes of Rule 21 Initial Review Screen I ("Will power be exported across the PCC?").[4] Despite these allowances, Enphase has experienced that IOUs may continue to require traditional protection equipment or wires solutions such as transformer upgrades, non-export relays, or reclosers in certain DER interconnections, even if a project uses certified PCS for

[4] E.g., PG&E Rule 21, Section G.1.i, Sheet 147, https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_RULES_21.pdf

export limitations. These redundant measures add significant timelines and costs to a project – often greater than the cost of the DERs themselves – and can end up killing the project altogether.

#### ii. Limited Generation Profile

The CPUC is currently considering how to enable DER projects to elect a "Limited Generation Profile" for grid exports at the time of interconnection based on the circuit hosting capacity values calculated by the Integration Capacity Analysis (ICA).[5] It should be noted that the ICA maps only incorporate data from the primary distribution system and do not include data from the secondary distribution system, namely distribution service transformers that connect individual or small groups of customers to the grid. Furthermore, though there are ICA maps in the works to reflect circuit hosting capacity for new load, these maps are primarily used for informational purposes and have not been incorporated into any of the relevant electric rules for load-related upgrades, in the manner of a "Limited Load Profile."

### c. Transportation Electrification (TE)

The concept of dynamically curtailing EV charging to stay within a site's capacity limits and avoid the need for wires upgrades has typically been discussed in terms of "automated load management" (ALM). The CPUC has pursued inroads for ALM as part of its adopted program designs for IOU EV infrastructure investments, though it remains inconsistent in its implementation.

Ordering Paragraph 5 of CPUC Decision 20-12-029, implementing the requirements of Senate Bill 676 (Bradford, 2019) to establish strategies for vehicle-grid integration, required the IOUs to identify how they will deploy customer-side ALM at host sites in any future applications for TE investment programs, as well as the standard evaluation criteria to determine host sites where ALM would benefit ratepayers by reducing costs while meeting host site needs for EV charging. The only applicable program to be proposed and adopted since that decision, PG&E's EV Charge 2, received CPUC approval to incorporate the use of ALM to help lower installation costs and manage the program budget.[6]

Then, the CPUC's recently adopted TE Framework, approving $1B in customer-side make-ready rebates for multi-unit dwellings and medium-duty / heavy-duty vehicle charging, ordered an ALM study to be completed by Q1 2024.[7] The study will review the current state of ALM technology and whether additional rebates should be extended to host sites for utilizing ALM, reflecting a share of the overall ratepayer savings ALM can realize in exchange for a site host agreeing to curtailed charging levels. D.22-11-040 also modified D.20-12-029's directives regarding ALM to instead focus on IOU customer education regarding ALM technologies and ratepayer savings and directed IOU Technical Assistance services to include available ALM and DER options to lower deployment costs.

Compared to the CPUC's program-centric approach to ALM, Assembly Bill 841 (Ting, 2020) addressed the provision of utility-side infrastructure for EV charging in a more holistic fashion. The bill triggered the creation of new electric rules for the provision of front-of-the-meter make ready infrastructure needed

[5] See Resolution E-5230 in Rulemaking 17-07-007, issued December 9, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M499/K779/499779492.PDF

[6] Decision 22-12-054, issued December 19, 2022, p. 54, Finding of Fact 29, Conclusion of Law 21, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K043/500043974.PDF

[7] Decision 22-11-040, issued November 21, 2022, pp. 177-180, Finding of Fact 117, Conclusion of Law 106, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M499/K005/499005805.PDF

to energize new TE projects. The bill also deemed that the associated costs would be covered as a common investment by all ratepayers through the General Rate Case, rather than being the host site customer's responsibility (above a set allowance) as it would otherwise be under Electric Rules 15 and 16.

The new electric rules and cost responsibility regime are only available to separately metered TE projects, removing a financial incentive for customers to deploy EV charging with ALM on an existing meter and customer service connection, as customers or projects can access unrestricted charging without directly paying for the requisite connection capacity. This of course does not mitigate the transformer shortage or IOU construction delays, which provide other motivations to use ALM, but the resulting new electric rules (Rule 29 for PG&E and SCE, Rule 45 for SDG&E) do not include considerations for ALM.

## V. Recommendations for expanded use of PCS

Enphase respectfully extends the following recommendations to unlock the full potential of PCS:

1. Order further research at an independent, reputable, third-party research entity such as EPRI or a national lab (e.g., NREL, PNNL) to test and validate the ability of PCS to avoid thermal overloading of common grid components such as distribution transformers. This work can inform future standards and tariff development and, critically, can give IOUs confidence that PCS-only import / export limitation settings do not pose a risk to the grid and that redundant, expensive protection schemes are unnecessary.

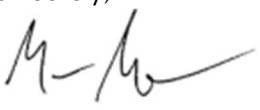
2. Create an optional tariff for energization and interconnection by which customers can connect new electrification technologies and / or DERs using PCS to limit the net import / export at the Point of Common Coupling, to avoid upgrades to the distribution circuit and customer facilities (service transformer, service drop, etc.). In electing this tariff option, customers would have to agree to an up-front import / export curtailment schedule, informed by distribution circuit constraints as indicated in the Limited Generation Profile and a future "Limited Load Profile", and a determination of the available capacity from a customer's service transformer and service drop. In the future, when IOUs have implemented DER Management Systems (DERMS), this curtailment schedule could be managed dynamically in real-time through communications to DER aggregators or individual systems.

    a. In the alternative, modify existing electric rules pertaining to load related upgrades (Rules 2, 3, 15, 16, 29 / 45) and DER interconnection (Rule 21) to achieve the above

## VI. Conclusion

Enphase appreciates the consideration of these comments and looks forward to working with the agencies and legislature to explore policy solutions that can promote use of PCS, to the benefit of the state's electric customers and ratepayers.

Sincerely,



Marc Monbouquette
Senior Manager, Policy and Government Affairs
Enphase Energy

 47281 Bayside Parkway, Fremont, CA 94538 Tel: 707.763.4784