DOCKETED	
Docket Number:	23-ERDD-01
Project Title:	Electric Program Investment Charge (EPIC)
TN #:	262508
Document Title:	Hitachi America - Docket number 23-ERDD-01 DER Orchestration – Request for Information Response
Description:	N/A
Filer:	Kristine Banaag
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	3/28/2025 7:03:52 PM
Docketed Date:	3/28/2025

Mr. Archal Naidu
California Energy Commission

With Docket Number *23-ERDD-01*, the California Energy Commission (CEC) is seeking information for a potential future solicitation focused on research to expand the functionality of Virtual Power Plants (VPPs) to provide grid services that maintain power quality, which are traditionally met by legacy power plants with fossil gas-fired rotational generators. Attached please find our responses on the Request for Information (RFI) for "*DER Orchestration Research*."

Hitachi America worked with CEC on EPC-17-043, GLOW: A User-friendly Interface for GridLAB-D, in the past and has become very familiar with CEC's energy policy to achieve California's goal of 100 percent clean energy by 2045. Besides, we also worked with Department of Energy and utilities that have similar challenges on many clean energy projects. The working relationship with CEC and broad industry knowledge make Hitachi America uniquely qualified to be CEC's partner on this endeavor.

This document is organized around the RFI questions, providing specific responses to certain questions as per CEC instructions. Short biographies of key domain experts are included. Detailed information regarding our experiences and qualifications will be provided upon request.

Please feel free to contact us for any questions and/or comments. We are looking forward to working with you on this initiative. Your consideration is very much appreciated.

Sincerely,

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Use Cases that Require Validation through Demonstration

1. As California transitions away from traditional centralized fossil-gas generation and approaches a high penetration of intermittent renewables and inverter-based resources, what are the most needed grid service functions that aggregated DERs should be able to dispatch and that require validation in the near-term?

The most needed grid service functions from aggregated DERS in near-term are (1) Volt-VAR Control and (2) Dynamic Hosting Capacity Control.

- Volt-VAR Control (Coordinated Volt-VAR Control or Distribution-level voltage regulation) shall be required for DER interconnection, as it mitigates adverse impacts such as overvoltage without costly infrastructure upgrades to the grid. This can be achieved through a centralized control system that provides commands to individual DERs or groups of DERs within the same service area or branch. This service can regulate voltage within a feeder faster than traditional regulators and/or capacitor banks, which typically have a 30-second time delay. Consequently, Dynamic Hosting Capacity can be enabled, allowing higher DER penetration into the grid.
- Dynamic Hosting Capacity also benefits from the Volt-VAR Control function. Utilities can shift from using a conservative integration capacity policy based on worst-case scenarios and historical data to Dynamic Hosting Capacity, which relies on real-time data such as generated power from DER and load without violating operational limits. This service will enable the integration of more DERs into the grid, allowing the system to utilize higher power generation from DERs during morning and evening hours.

These two services will substantially increase the integration capacity of DERs in California, supporting the state's goal of achieving 90% clean energy by 2035 and 100% by 2045. As a result, additional ancillary services can also be provided collectively.

2. What performance metrics should a research demonstration achieve to assure confidence in resource dispatchability?

At a minimum, performance metrics should include (1) data interval from DER, (2) data accuracy from DER, (3) Communication time between VPP System to DER, (4) System Availability, and (5) Scalability.

Performance Metric	Success Value	Description
Data Interval	Vary based on service (e.g., less than 10 seconds for Volt/VAR control)	Interval of data update from DER to VPP system
Data Accuracy	95%	Data received at VPP system vs Data sent from DER
System Availability	95%	Availability of both DER and VPP system
Scalability	• 100-500 actual DER • 1,000-10,000 simulated DER	How VPP system can communicate and control a large number of DER in the distribution system. Success value of 100-500 actual DERs is demonstration/pilot project purpose. Success value of 5,000-10,000 is for future large-scale deployment.
Round-trip communication time	Vary based on service (e.g., less than 1 seconds for Volt/VAR control)	Round-trip time from VPP system to gateway device and/or inverter.

3. What role would Investor-Owned Utilities (IOUs) play in potential field demonstrations?

IOUs would be able to serve as members of the Technical Advisory Committee (TAC), providing input into the development of field demonstrations. The TAC is envisioned to contribute to the field demonstration by suggesting VPP use cases, suggesting performance metrics, and establishing success criteria.

Additionally, the TAC would be able to provide feeder data, historical load data, information on existing DER connections, insights into potential future load growth, and guidance on feeder selection. Most importantly, the TAC would play a crucial role in facilitating the interconnection of DERs to the grid.

3.2 What role could dynamic hosting capacity have in expanding the depth of services that inverter-based DERs could provide to the grid?

Dynamic hosting capacity would substantially increase the integration capacity of DERs by allowing utilities to transition from a conservative, rigid integration capacity policy to a dynamic hosting capacity approach without compromising operational limits or system stability. As a result, aggregators or VPP operators would be able to leverage additional services collectively and offer greater incentives for emerging markets, such as frequency response.

Gateway Conformance Testing for Dispatchable DERs

4. What is the industry need for dedicated testing and certification of DER gateway functionalities and conformance independent of the inverter or DER they are paired with? Would there be interest in a unified, open testing procedure that verifies DER gateways' functionality and adherence to utility-mandated communication requirements?

There is an industry need and interest in a unified, open testing and certification framework for DER gateway functionalities and conformance independent of the inverter or DER. This approach would (1) Improve interoperability among different gateways and various DERs/inverters from multiple vendors and (2) ensure compliance with utility-mandated communication standards, such as SunSpec Modbus in IEEE 1547. Standardized testing and certification would enhance seamless integration, reliability, and scalability across the DER ecosystem.

5. Which requirements should this testing tool cover in its scope?

At a minimum, the test should cover communication standards such as IEEE 1547 to ensure (1) interoperability with different DERs/inverters from various vendors, (2) functionality of bidirectional communication with utilities or aggregator VPP systems, and (3) capability to relay commands from the VPP system to control DERs/inverters. These tests would help validate seamless integration, compliance, and reliable operation within the DER ecosystem.

6. What should be the baseline performance requirements of DER gateways for the following functions?

- **Performance in DER communication**
- **Interoperability of communication between DER devices from various manufacturers**
- **Responsiveness in DER dispatch**

At a minimum, performance metrics for DER gateways should include (1) Data Interval from DER, (2) System Availability, (3) Scalability, (4) Local Data Storage. These metrics ensure the gateway's effectiveness in maintaining seamless communication, reliability, and adaptability within the VPP system.

Performance Metric	Success Value	Description
Data Interval	Vary based on service requirement (e.g., less than 10 seconds for Volt/VAR control)	The frequency at which data is collected from DERs to VPP system
System Availability	98%	The reliability and uptime of the gateway and VPP system
Scalability	• 10-20	The ability to support increasing numbers of DERs and data flow.
Local data storage	>= 4 hour of data	The capability to store data locally in case of communication outage.
Average CPU utilization	<= 70%	The processing capability to ensure that the gateway can handle the load effectively.

The DER gateway shall support communication standards such as SunSpec Modbus in IEEE 1547 to ensure interoperability of communication with DERs/inverters from various vendors.

Round-trip communication time, or latency, and responsiveness in DER dispatch may be tested in conjunction with the VPP system and DER/inverter to ensure timely response. However, this should not be tested in isolation, as the gateway is not the only device in the end-to-end VPP system. Other components, such as the VPP system or inverter, will also contribute to the overall latency of the system.

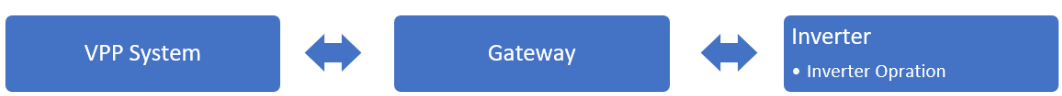

Fig 1 High-level communication between VPP System, gateway, and inverter.

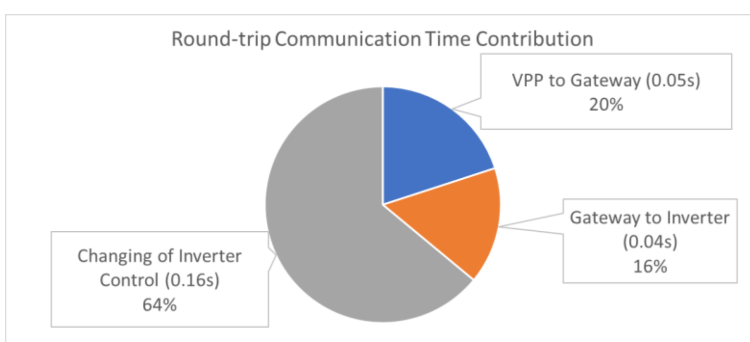

Fig 2 Example of round-trip time contribution.

7. Should this research scope (gateway conformance testing) be under a separate funding group to be conducted independent of the VPP demonstrations, or should this scope be incorporated as a phase of a larger VPP field deployment demonstration?

Gateway conformance testing research should be under a separate funding group and be conducted independently of the VPP demonstration research. Gateway conformance testing research would focus solely on gateway conformance to ensure that the gateway complies with all established requirements.

The VPP demonstration research should focus more on validating the functionality and value of VPP services. While the gateway will be an integral part of the overall end-to-end test, it does not need to comply with every standard and requirement set forth in the "Gateway conformance testing research." The VPP demonstration research will focus on end-to-end performance and functionality of VPP with actual DERs/inverters in real-world scenarios.

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Hitachi America Key Team Members

Bo Yang, Vice President, Energy Solution Lab. She received the Ph.D. degree from Arizona State University. She is currently leading the Energy Solution Lab, Hitachi America. She has over 20 years of experiences on technology innovation and go-to-market. Her focus area includes distribution energy resource integration, grid stability, resilience, and control.

Yanzhu Ye, Senior Manager, Energy Solution Lab. She received the Ph.D. degree from the University of Tennessee. She is a Principal Research Scientist with the Energy Solution Labs, Hitachi America R&D. She has more than 15 years of research and development experiences in energy industry. Her work focuses on distribution grid operation control and planning, renewable integration study, and data analytics application.

Panitarn Chongfuangprinya, Senior Manager, Energy Solution Lab. He received the Ph.D. degree from The University of Texas at Arlington. He is a Principal Research Scientist with Hitachi America. He has over 15 years of experience working with electric utilities. His areas of expertise are smart grid strategy, machine learning, power system analysis, renewable energy impact, load forecasting, reliability analysis, and asset management.

Natsuhiko Futamura, Backend Developer, Energy Solution Lab. He received the Ph.D. degree from Syracuse University and has been actively engaged in research across high performance computing, computational biology, and the power IoT field. His expertise lies in designing the backend of large-scale power IoT systems, focusing on efficient computation, communication, and data management to handle vast volumes of data.