REQUEST FOR PROPOSAL No. 52150

# DISTRIBUTED ENERGY RESOURCE MANAGEMENT SYSTEM (DERMS) for DISTRIBUTED ENERGY (DG) Enablement

Date: August 7, 2015

(Abridged for EPIC 2.02 DERMS Report)

# Article I: GENERAL INSTRUCTIONS AND PROVISIONS

REQUEST FOR PROPOSAL No. 52150

FOR DERMS for DG Enablement

| RFP Schedule | Date |
|---|---|
| RFP Issued to Vendors | 8/07/2015 |
| Vendors provide written questions for Webinar | 8/13/2015 |
| RFP Information Webinar with Vendors | 8/17/2015 |
| RFP Responses Due | 8/28/2015 |
| Announce Candidate Vendors (Shortlist) and Schedule Vendor Demonstrations | 9/11/2015 |
| Vendor Demonstrations (save the dates) | 9/21/2015 - 9/24/2015 |
| Select RFP Candidate | 10/20/2015 |
| Project Kick-off | 11/16/2015 |
| Pilot System Live in the Field | Q3 2016 |

The RFP Schedule is subject to change at PG&E's sole discretion at any time. While PG&E will endeavor to notify Bidders of any schedule change, PG&E shall not be liable for any change in the schedule or for failing to provide notice of any change.

## 1.0 INTRODUCTION

Pacific Gas and Electric Company (PG&E), incorporated in California in 1905, is one of the largest combination natural gas and electric utilities in the United States.  Based in San Francisco, the PG&E is a wholly-owned subsidiary of PG&E Corporation.  PG&E's operations are regulated by the California Public Utilities Commission (CPUC) and other regulatory agencies.

There approximately 20,000 employees who carry out PG&E's primary business—the transmission and delivery of energy. The company provides natural gas and electric service to approximately 15.5 million people throughout a 70,000-square-mile service area in northern and central California. Our customers include over 20,000 schools, 3,000 hospitals, 20,000 high-tech companies and 700 military facilities. As the primary natural gas and electric service provider for Central and Northern California, PG&E's service area stretches from Eureka in the north to Bakersfield in the south, and from the Pacific Ocean in the west to the Sierra Nevada in the east. PG&E provides electricity to over 5.3 million customers and natural gas to over 4.3 million customers.

PG&E is committed to enhancing its supply base to include contractors who can contribute to PG&E's corporate values, including  diversity, safety, environmental stewardship, and corporate integrity.  The RFP evaluation process is intended to provide opportunities for successful firms to expand their business with PG&E, new firms to establish business with PG&E, and for PG&E to realize reductions in costs, both internal and external, while experiencing enhanced commitment to corporate values.  This will be an exciting opportunity for PG&E and its suppliers – both current and new – to reshape the way we work together and to improve PG&E's operations.

## 2.0 PURPOSE OF REQUEST FOR PROPOSAL (RFP)

The objective of the Request for Proposal is to solicit bids to provide PG&E with a Distributed Energy Resource Management System (DERMS) platform to enable the continued integration of Distributed Generation (DG) for pilot demonstration in early 2016. PG&E seeks to implement an integrated supplier relationship with the selected Bidder(s), continuing the excellent service that PG&E has received to-date while also working collaboratively to reduce costs and expand services for both PG&E and the supplier. PG&E challenges each Bidder to propose innovative ideas to prepare for the future, improve efficiencies or reduce costs.

# Article II: TECHNICAL SPECIFICATION

REQUEST FOR PROPOSAL No. 52150
FOR: DERMS for DG Enablement

## 1.0 DERMS for ENABLEMENT OF DG RFP OVERVIEW

PG&E's long-term vision is for the electric distribution system to be a **Grid of Things**™, where the **grid is a platform that enables customer choice by connecting devices that produce, store, and consume energy**. This vision of a Grid of Things™ includes pricing signals that influence behavior and local energy transactions between various Distributed Energy Resources (DERs)[1] and the bulk transmission and distribution power grid. In the face of potential significant utility business model change, PG&E plans to build the capabilities needed to offer advanced energy services to customers. PG&E's vision is to have a **single integrated platform** that enables monitoring, and if needed, management and control of DERs to deliver safe and reliable service to all PG&E customers while maximizing the value of DERs, enabling California's progressive energy policy objectives.

PG&E is presently looking for a technology platform that will support PG&E's grid, market, and customer operational capabilities in order to enable higher penetration of Distributed Generation (DG) onto the grid in order to facilitate evolution to a Grid of Things™. To date, approximately 2.1 gigawatts (GW) of DG at approximately 180,000 locations is interconnected to PG&E's system. By 2025, PG&E is estimating that approximately 6 GW[2] of load will be served by increased DG capacity, potentially from 500,000 interconnected locations. This DG is predominately comprised of solar photovoltaic (PV) generation.[3] As discussed in PG&E's Electric Distribution Resources Plan (DRP), filed with the California Public Utilities Commission (CPUC) on July 1, 2015, PG&E may face operational challenges in effectively and reliably operating the distribution system with high levels of interconnected DG unless **advanced technologies** are deployed. Without the proper management, control and operational oversight, increased penetration of DG, particularly solar photovoltaic (PV) generation, may cause operational issues such as high voltages during peak solar production hours, abnormally low voltage during load recovery periods, intermittent voltage fluctuations, load masking/phantom load for outage recovery, protection scheme desensitization, and device misoperation due to reverse power flow. Remediation of such issues has historically required capital upgrades to the grid. **A Distributed Energy Resource Management System (DERMS) that can operate and maintain the grid as well as facilitate management of DERs may provide opportunities to mitigate issues with less costly infrastructure investments.** PG&E is committed to achieving California energy policy objectives as cost effectively as possible, delivering safe, reliable, affordable, and clean energy to customers.

PG&E defines DERMS as an advanced software based system, potentially consisting of multiple components and subsystems, capable of sensing grid conditions, and monitoring and controlling the operation of DERs to maintain electricity delivery to loads during all operating modes. A DERMS platform is expected to enable PG&E to integrate a wide variety of flexible DER into real-time operations. DERMS should be able to optimize DER performance at multiple layers in the system hierarchy (i.e., customer, feeder, substation) in order to provide optimal power system performance based on local or regional requirements. This includes local optimization as well as distribution area, regional and system wide power system optimization applications

[1] DERs are both front-of-the-meter and behind-the-meter resources, and include but are not limited to: Distributed Generation, Energy Storage (chemical, mechanical and thermal), Demand Response / Load Control, and Electric Vehicles

[2] DRP 2015 IEPR Form 3.3 Submittal

[3] As of July 2015, one quarter of all rooftop solar installations in the U.S. are connected to PG&E's distribution system

delivered through DER portfolio optimization. The ability to optimize for multiple grid services with the same infrastructure enables a lower cost of ownership.

PG&E is issuing this **Development and Demonstration RFP** to assess the DERMS marketplace and build a pilot solution. Responses to this RFP will provide the information for PG&E to develop a DERMS strategy and scope a DERMS Project as part of PG&E's second triennial Electric Program Investment Charge (EPIC) program. **This DERMS Pilot Project is targeted to begin by the end of 2015, placing a DERMS pilot solution in the field by Q3 2016.** Responses to this RFP will enable meeting the timelines of the DERMS Pilot Project. Realizing that off the shelf solutions do not exist today to meet all future needs, PG&E seeks a scalable platform that can evolve to monitor and control more DERs to address additional use cases on an increasingly complex distribution system with more dynamic customer interactions. **Vendors should view this as potentially long term development and partnership opportunity, not just a contract seeking to recover invested cost for the pilot.** PG&E encourages vendors to partner and provide joint responses when multiple vendors have complimentary offerings to meet PG&E's needs.

***Pricing Directions***

This is a Development and Demonstration RFP. As such PG&E desires to understand how vendors plan to demonstrate their present functionality and develop (where needed) advanced functionality for pilot deployment in collaboration with PG&E. Respondents should provide pricing to meet the Phase 1 Use Cases and Business Requirements indicated below. The structure of provided pricing should be as follows:

- Provide pricing in Attachment C of the RFP Submittal: Pricing Sheet.
- Price list should indicate which elements of the pricing are fixed (i.e., do not scale as the size of an installation changes) vs. which elements are variable and depend on the size of the pilot (e.g., number of devices, MW) and the number of use cases addressed.
- Pricing should be as granular as is practical, defining key cost drivers and assumptions. This will allow PG&E to fine tune the project scope prior to contracting to most closely align with PG&E's needs while providing a cost effective solution.
- Vendors should provide details of proposed project staffing, including roles and staffing (FTEs) per role over time.
- Price list should indicate if there are specific uses cases listed below that would require additional incremental spend
- Additional vendor identified use cases that provide added value in support of the project purpose are encouraged. Additional use cases should be identified in the price list indicating any incremental added cost (if applicable).
- This RFP provides directional requirements and vendors are encouraged to detail existing and planned platform functionality. For each use case, out-of-the-box functionality versus developmental needs should be detailed.
- PG&E views this RFP as an opportunity to build a long term development partnership for the rapidly evolving DERMS landscape. Vendors should specify in-kind investments that they are making in their DERMS solution to enable a successful platform in addition to the specific quoted items.

The solution sought in this RFP is not intended to replace present or planned PG&E capabilities or systems (e.g., DMS, SCADA, VVO, FLISR, GIS, or Grid Operations Situational Intelligence analysis & visualization tool), but to add new functionality as outlined below.

## 2.0 SCOPE & OBJECTIVES BY PHASE

PG&E is taking a phased approach to piloting and potentially implementing a DERMS. This approach allows the complexity of DERMS to gradually increase, as the penetration of different DERs increases and the capabilities of DERMS solutions improve. The DERMS Pilot is presently broken into two phases, with Phase 1 being implemented in the field in 2016, and Phase 2 implemented as early as 2017.

- **Phase 1** will focus on piloting a system to control a limited number of DERs and address potential local operational challenges associated with high DG penetration at the feeder and/or substation level. The DERMS pilot is expected to enable interconnection of additional DG and thereby enable customer choice. Phase 1 is expected to contain economic signals (rates and potentially market pricing), and will explore opportunities to incentivize participation of DERs with the intent of allowing PG&E to monitor and control the DER.

- **Phase 2** will expand the number and diversity of DERs as well as introduce more complex economic signals into DERMS. Phase 2 will evaluate DERMS' ability to optimize dispatch for a diverse set of objectives including grid operations, load-leveling and market participation to maximize economic value of DERs. By the end of Phase 2, PG&E desires that DERMS will enable a wide range of DER provided distribution grid services with different performance requirements and unique time dimensions, including:
    - Distribution capacity deferral services
    - Voltage and reactive power services
    - Power quality services
    - Reliability services

The table below shows PG&E's present view of DERMS evolution from Phase 1 to Phase 2.

| | **Phase 1** | **Phase 2** |
|---|---|---|
| **What DERs will DERMS Monitor & Control?** | • DG with conventional inverters (monitor and forecast output)<br>• Energy storage with conventional inverters<br>• DG and energy storage connected with Smart Inverters[4]<br>• DERs that are PG&E, customer, and 3rd party owned, on both sides of the meter | • Demand Response and Load Control<br>• Electric Vehicles and/or Electric Vehicle Charging Equipment |
| **Control Strategy** | • Optimized for grid conditions/constraints, potentially also using rates and price signals to drive DER control decisions<br>• Direct control and/or control via aggregators | • Participate in existing and/or emerging markets for grid services<br>• Enable economically optimal dispatch of DERs<br>• Direct control and control via multiple DER aggregators |

[4] For the purpose of this RFP, PG&E views "Smart Inverters" as uni-directional (DG) and bi-directional (Storage) inverters that will comply with expected updates to UL/ANSI 1741 and IEEE 1547 standards, as well as recommendations from the Smart Inverter Working Group informing revision of California's Rule 21 distributed-generation interconnection requirements.

## 3.0 PHASE 1 DERMS USE CASES AND SOLUTION REQUIREMENTS

Information in this section is intended to assist Vendor understanding the general functionality required of DERMS.

**The primary objective of Phase 1 is to demonstrate DERMS' ability to create opportunities for PG&E's customers to continue to interconnect clean DG to the distribution grid.** PG&E's existing planning and system investment processes mitigates anticipated issues through infrastructure upgrades that are potentially costly and lengthy projects. PG&E anticipates that a DERMS may have the ability solve or remediate operational issues anticipated to result from incremental interconnection of DG in an expedient and cost effective manner.

In Phase 1 PG&E envisions DERMS fulfilling the following seven (7) use cases to enable DG, framing problems/opportunities, and use cases to address these. **PG&E welcomes proposals that also identify other problems/opportunities and use cases that align with PG&E's phased pilot and implementation of DERMS.**

### 3.1 Managing Equipment Capacity Constraints

- **Problem:** Substations and distribution assets with high levels of DG but periods of low load may experience conditions of reverse power flows that cause equipment to exceed operating parameters. Highly loaded circuits may also experience equipment overload conditions. Typically anticipated capacity issues are addressed in the planning process requiring equipment upgrades.
- **Potential DERMS Solution:** Dynamic control of DERs to increase load (e.g., charge energy storage, increase load on load control devices) or reduce generation (e.g., curtailing DG production or storage output) to dynamically mitigate overload issues through operational control.

### 3.2 Mitigate Voltage Issues

- **Problem:** High and low voltage issues can occur in the vicinity of DERs particularly PV. Typically anticipated voltage issues are addressed in the planning process requiring equipment upgrades.
- **Potential DERMS Solutions:**
  - DERMS control of DER can manage real and reactive power output, or adjust power factor using Smart Inverter autonomous settings to moderate voltage levels.
  - DERMS coordination with utility-owned voltage and reactive power regulating devices (e.g., substation load tap changer, line voltage regulator, line capacitor, solid state volt/var control devices), possibly coordinating with a Volt/VAR Optimization (VVO) or Volt/VAR Control (VVC) application running in parallel.

### 3.3 Resource Intermittency

- **Problem:** DER intermittency can pose issues with energy demands and voltage response. Typical voltage regulation schemes have operational dead bands that range from 30 seconds to 2 minutes which may be able to keep up with the changes, but causes extra burden on devices which reduces expected lifetime.
- **Potential DERMS Solution:** Coordinated output management and voltage control of DERs using DG and energy storage through Smart Inverters.

### 3.4 Operational Flexibility

- **Problem:** DER interconnection is studied for a circuit's normal, as-built configuration. Circuits may be switched in abnormal configurations to accommodate grid maintenance, construction, and operations. DER impact is not typically analyzed for all possible abnormal system configurations. This could result in reduced power quality and reliability during these periods. High DER penetrations have the potential to back feed into the abnormally connected substation and cause thermal and/or voltage issues.
- **Potential DERMS Solution:** Use DERMS to monitor grid conditions during DER operation when operating during abnormal circuit configurations. Control and manage DERs to reduce negative impacts during operation in abnormal configurations. Support circuit switching operations and allow maximum utilization of DERs on newly formed circuit topologies while maintaining system operating parameters within allowable range.

### 3.5 Load Masking/Phantom Load

- **Problem:** As more behind the meter DERs interconnect to the distribution grid, impacts on the overall reliability and operability of the grid, including transmission market operations, may become an additional barrier due to the netting of generation and load. On feeders with high levels of DERs, Operators may underestimate the amount of present system load if not properly informed of the active generation downstream of switching devices. When switching line sections over to other circuits and configurations, they may cause voltage issues or thermal overloads because of this load masking issue.
- **Potential DERMS Solution:** DERMS could provide insight to grid operators about the available DER power capable to serve abnormal loads during emergency transfers. Furthermore control of DERs (including Demand Response and DG) can lessen the feeder load that needs to be transferred thus reducing the overall load burden.

### 3.6 DER Aggregation

- **Problem:** Currently DER is studied and interconnected assuming historical load and resource diversification. Recent discussions with the California ISO and California Public Utilities Commission (CPUC) have started to allow the concept of aggregated DER participation in the ISO market. This possibly can cause some problems given the assumptions made about typical operation in the original interconnection agreement. If existing systems bid into this market and start operating differently from originally studied and possibly all at once, then the non-typical worst case (total aggregate) scenario may be realized and create conditions that were not mitigated.
- **Potential DERMS Solution:** DERMS will monitor DERs and coordinate with or respond to other dynamic market conditions on the grid to ensure proper distribution reliability.

### 3.7 Enabling Dispatch of DG and Energy Storage based on economic signals

- **Opportunity:** Enable PG&E's ability to facilitate a potential future distribution marketplace for 3rd party-owned DERs
- **Potential DERMS Solution:** DERMS can receive economic signals from the Utility wholesale markets or rate structures that it would translate into control signals or communicate directly to DERs.

PG&E anticipates that DERMS will meet the following directional Business Requirements shown below to deliver Phase 1 Use Cases. RFP respondents are encouraged to challenge these assumptions and/or propose additional requirements or key capabilities.

- **Phase 1 BR 1:** Platform shall be able to simulate distribution systems, enabling scenario-based what-if evaluation of various grid conditions. Note: this requirement does not anticipate replacement of PG&E's existing planning tools. The DERMS is expected to provide simulation capabilities that facilitate the understanding of the control actions the DERMS platform would take under various scenarios.
- **Phase 1 BR 2:** Platform shall have the ability to automatically identify newly connected DERs and enable the management of DER participation in DERMS control schemes by supporting defined processes for registering, commissioning, and decommissioning devices. Identification of DERs shall include behind the meter DERs, third party DERs, and utility owned DERs.
- **Phase 1 BR 3:** Platform should group, schedule , and dispatch multiple DERs based on different DER and grid capabilities to meet the desired use cases including:
    - DERs on both sides of the meter
    - Aggregated DERs via 3rd party head-end systems
    - Utility owned DERs
- **Phase 1 BR 4:** Platform shall be able to support the management of DERs for various functions to meet the stated use cases including load curtailment, load shifting, generation curtailment, and regulation.
- **Phase 1BR 5:** Platform shall provide functionality to control active and reactive power (through aggregation or direct control of DERs)
- **Phase 1 BR 6:** Authorized utility users shall be able to create and modify operational constraints for individual DERs as well as at the grid system (and at user defined sub-system) levels.
- **Phase 1 BR 7:** Platform shall provide real-time or near real-time availability, status, and output (or net output) of individual or aggregated DERs, including acknowledgment of successful dispatch of DERs.
- **Phase 1 BR 8:** DER data including status, communication failures, and analog values shall be tracked and made available for configurable reports, as well as for data exchange with other enterprise systems.
- **Phase 1 BR 9:** Platform shall be able to transmit and receive information to DERs directly and via third parties' head-end systems.
- **Phase 1 BR 10:** Platform shall be compatible with the Smart Inverter Working Group requirements for communicating with Smart Inverters and California Public Utilities Commission (CPUC) Rule 21 requirements for other interconnected technology.
- **Phase 1 BR 11:** Platform shall provide optimization capabilities that support the automatic creation of the ideal mix of potentially disparate DERs in response to system needs (as outlined in the use cases).
- **Phase 1 BR 12:** The Platform shall be able to acquire data necessary to optimize available resources from various sources, including grid system data and resource performance projections from both within the DERMS and from third party head-end aggregation systems.

- **Phase 1 BR 13:** Platform shall provide forecasting to enable users to predict the near-term and long-term performance capabilities of available resources.
- **Phase 1 BR 14:** The DERMS Vendor shall provide training to support and facilitate implementation of the system and adoption by PG&E pilot users.
- **Phase 1 BR 15:** DERMS shall accommodate dispatch of multiple energy storage systems with different operating capabilities (i.e., different owners, different energy storage battery chemistries and resulting charge and discharge requirements).

The directional Phase 1 Business Requirements drive the Phase 1 IT Requirements shown below. The system architecture shall enable the DERMS to operate in concert with software and hardware systems, including those owned and operated by PG&E, as well as external systems (e.g., aggregator head-end systems). Interfaces with these systems shall support data exchange, supervisory control, event management, etc. Data must be acquired, exchanged, stored, and retrieved such that it enables the desired DERMS functionalities, including forecasting and reporting, while complying with prescribed privacy and security standards as provided in Questionnaire Section J of this document.

- **Phase 1 ITR 1:** The basic display and interactive capabilities of the graphical user interface must provide a simple, intuitive, and versatile experience for various users including DER program administrators and system operators
- **Phase 1 ITR 2:** Platform cyber security shall be implemented as specified in the guidelines - NISTIR 7628
- **Phase 1 ITR 3:** Platform shall have historian functionality or integrate with an existing historian (such as OSISoft PI)
- **Phase 1 ITR 4:** Platform shall be capable of error handling and notification
- **Phase 1 ITR 5:** Platform shall be capable of alarm logging and notification
- **Phase 1 ITR 6:** Platform shall support high availability (HA) architecture.
- **Phase 1 ITR 7:** Platform shall support Disaster Recovery (DR) architecture.
- **Phase 1 ITR 8:** Platform shall support open architecture for integration with external systems both Operational Technology (e.g., SCADA, DMS, OMS, etc.) as well as IT (e.g., MDMS, ERP, MWFM etc.).
- **Phase 1 ITR 9:** Platform shall implement all applicable interoperability standards.

## 4.0 PHASE 2 DERMS VISION

Phase 2 of the DERMS Pilot in will build upon Phase 1 and take into account evolving technological and regulatory developments and anticipated higher availability of flexible DERs on the system.

**Phase 2 will expand the diversity and number of DERs under control of DERMS**. In addition to more DG and energy storage resources, Phase 2 will include a larger and more diverse portfolio of DR resources with differing capabilities in both flexibility and speed of dispatch. PG&E also anticipates new opportunities for DERMS to control electric vehicle charging. In Phase 2 the DERMS platforms will be required to manage a more complex DER portfolio with a mix of aggregated resources and direct control, behind the meter and utility owned.

**Phase 2 will add new layers of optimization and use cases**. Phase 2 will evaluate DERMS ability to optimize across several objectives, considering the economic value DERs provide for customers, DER owners, the utility and the overall grid system. DERMS will need to sort and aggregate DERs into groups based on different asset capabilities and ability to dynamically assign advanced energy and power management functions by location, time, and market opportunities. DERMS will maximize the value of each resource by optimizing it for end use, grid operations, load-leveling and market participation with dispatch of DERs via a transactive approach using market signals. Additionally In phase 2 DERMS will assess available DER to operate in island mode and serve customers to increase reliability. DER will be signaled when this mode of operation is desired and be signaled when necessary to revert back to grid-tied operation.

As DERMS matures, PG&E may explore and develop new utility customer programs, service offerings and business models built on the DERMS platform.

**Phase 2 may require increased integration with existing PG&E systems and customer programs**. **RFP respondents are encouraged to discuss if integrating with these systems is necessary to deliver PG&E desired and/or Vendor proposed Phase 1 functionality.**

- DMS/SCADA: Connection to the systems that deliver real-time telemetry and the as-operated system model to drive automation and scalability.
- Volt/VAR Optimization (VVO, also called Volt/VAR Control, Integrated Volt/VAR Control): DER capabilities to control and optimize distribution system voltage and reactive power being considered by the VVO application that controls substation and distribution line voltage and reactive power regulating equipment (e.g., substation load tap changer, line voltage regulator, line capacitor).
- Demand Response Management System (DRMS): coordination or control of resources managed by DRMS.
- Fault Location, Isolation and Service Restoration (FLISR, also called Distribution Automation Circuit Reconfiguration, Distribution Feeder Automation): potentially automate reconfiguration (e.g., switching) of distribution topology based on DER capabilities or measured/forecast output to manage constraints.

To deliver the Phase 2 vision, PG&E believes that DERMS should meet the following directional Business Requirements shown below. RFP respondents are encouraged to challenge these assumptions and/or propose additional requirements or key capabilities.

- **Phase 2 BR1:** Platform shall support Interoperability with and seamless communication between PG&E operational and enterprise systems, associated databases and distribution engineering modeling and analysis tools accessed by the DERMS
- **Phase 2 BR2:** Platform shall have adaptability to automatically and continuously update the distribution system tools and models to accurately reflect a distribution feeder's most recent operational configuration either via integration with existing DMS or propose to provide such features via the proposed Platform.
- **Phase 2 BR3:** Platform shall support & implement integration of network models, market models, and renewable resource models
- **Phase 2 BR4:** Platform shall integrate dynamic rate structures and market signals to communicate price signals to DER assets and/or 3rd party aggregators.

- **Phase 2 BR5:** Platform shall implement management and forecasting of distributed generation, storage resources, flexible load and demand response (via integration with existing Demand Response Management System (DRMS).
- **Phase 2 BR6:** Platform shall be able to integrate with existing Voltage/VAR control and distribution automation systems or provide such capabilities.

## 5.0 RFP ASSUMPTIONS

- PG&E issued a Distribution Control Center of the Future (DCCoF) RFI in June 2015. This DERMS Development & Demonstration RFP will be evaluated in parallel to the DCCoF RFI. Where the DCCoF RFI informs the strategy for PG&E potentially adopting an Advanced Distribution Management System for use by all Distribution Operators in all Distribution Control Centers, DERMS initially may be a tool that is used by a limited number of Distribution Operators / Engineers on a limited part of PG&E's system.
- PG&E does not view DERMS as just a grid control center application. DERMS could be operated from a Distribution Control Center, an Energy Trading Desk, and a Customer Program Operations Desk (e.g., Demand Response Operation).
- PG&E does not presently have a DERMS system and this RFP is not intended to replace existing PG&E systems such as DMS, SCADA, VVO, FLISR, GIS, Grid Operations Situational Intelligence analysis & visualization tool. Instead, DERMS will complement these.
- DERMS is not presently intended to replace PG&E's existing distribution planning tools (e.g., CYME, LoadSeer).
- Implementing DERMS will require a combination of centralized and distributed intelligence.
- DERMS may require external inputs on load and generation forecasts.
- DERMS will not drive or inform system protection settings. PG&E does not view DERMS as being a platform to manage dynamic transient protection functions.

**Abbreviations**

| | |
|---|---|
| SM UIQ | Smart Metering UIQ (SSN Head-end) |
| EEP | Electric Emergency Plan |
| AFW | Application for Work |
| DTS | Dispatcher Training Simulator |
| ILIS/DOD | Information Logging Information System/ Distribution Operator Dashboard |
| RSA | Restoration Switching Analysis |
| VVO | Volt/VAR Optimization |
| VVC | Volt/VAR Control |
| DER | Distributed Energy Resource |
| DERM | Distributed Energy Resource Management |
| DG | Distributed Generation |
| POP | Planned Outage Planner |
| GIS | Geographic Information System |
| ESM | Energy Storage Management |

OMT/ODT Outage Management Tool/ Outage Dispatch Tool
GOSI Grid Operations Situational Intelligence
B2B/M2M Business to Business/Machine to Machine
WFMS Workforce Management System
OSI Soft PI OSI Soft PI Historian
FLA/FLISR Fault Location Analysis/Fault Location Isolation & Service Restoration
DSE Distribution State Estimator
RTSCADA PG&E's Existing SCADA System (Proposals should include replacing this system or integrating with this system)

# Article III: TECHNICAL RPF SUBMISSION

REQUEST FOR PROPOSAL No. 52150
FOR: DERMS for DG Enablement

## Attachment A - Cover Letter and DERMS Phase 1 Pilot Proposal

Please use this attachment as a suggested outline for your Project Proposal Overview and Cover Letter. Vendors may choose to open and close this with the language of their choice (such as provide company background, experience, qualifications, etc.)

1. **Proposed Platform Overview**
    - Provide an overview of the proposed DERMS platform

2. **Proposed Platform Mapping Against Proposed Phase 1 Use Cases outlined in Article II Section 3**
    - Discuss how the proposed DERMS platform meets or doesn't meet the objectives of the seven use cases described in the RFP. If specific use cases aren't met by your proposal, summarize if you have plans of developing capabilities to meet the use case.
    - Discuss if you recommend additional use cases be included in phase 1? If so, please discuss these in similar detail to how PG&E framed the use cases in the RFP.

3. **Proposed Platform Mapping Against Phase 1 Business and IT Requirements**
    - Discuss how your proposed DERMS platform addresses the Phase 1 Business and IT Requirements. If these requirements cannot be met, please describe if this impacts the ability of the DERMS platform to meet the objectives of the PG&E DERMS Pilot.

4. **Commentary on Phase 2 Vision outlined in Article II Section 4**
    - Discuss if and how your views on the evolution of DERMS aligns with PG&E's. What should PG&E consider when planning for continued pilots and implementations of DERMS beyond Phase 1?

5. **Project Key Activities**
    - Describe key activities required to implement your proposal
    - Provide a proposed pilot deployment timeline with key milestone dates based on the milestones provided in the RFP

6. **Pricing Summary**
    - Provide an overview of the pricing you submitted per the Pricing Sheet Attachment C, including any clarifications, limitations, or other comments that PG&E should consider when reviewing your pricing for Phase 1.
    - Discuss any information relevant to the price of work and/or functionality beyond Phase 1.

7. **Collaboration, Partnerships, and Subcontractors**
    - Discuss any proposed partnership with PG&E to develop DERMS functionality.
    - If your proposal involves collaboration with other vendors, describe the role that each vendor plays in the joint proposal.
    - If you intend to use subcontractors, identify the subcontractors and briefly discuss the scope of work, qualifications and experience

| Attachment B – Detailed Questionnaire | | |
|---|---|---|
| **A. DERMS Approach and Capabilities** | | |
| | **Question** | **Response** |
| | (If capabilities listed below have not been implemented in the past, indicate how these capabilities will be incorporated into your DERMS platform and when they will be available) | |
| A1 | Provide a brief overview of your proposed DERMS platform, commenting on how it aligns with PG&E's Grid of Things Vision and phased DERMS pilot plan. | |
| A2 | Describe the elements that differentiate your company and your DERMS offering from the competitive field. | |
| A3 | Describe the major components of your platform (both hardware and software), distinguishing between those components that you own and provide, those that other companies/partners provide, and those that the utility would provide. | |
| A4 | Identify which components of your product/solution/platform and, as applicable of your commercial partners' product/solution/platform, are (a) commercial-off-the-shelf, (b) require minimal customization, (c) require customization or (d) require full development effort | |
| A5 | What is your company's general approach to optimization of DERs using DERMS? Is the control algorithm probabilistic, deterministic, or a combination? | |
| A6 | Describe what your DERMS control algorithm takes into account when deciding to dispatch a particular asset among a portfolio of assets? For example, what does DERMS take into account when trying to optimize decision making for lowest cost dispatch of resources? Provide examples and specific steps in a process diagram/flow chart. | |
| A7 | Describe the forecasting capabilities of your solution. What does the platform forecast? What are the inputs required to that forecast? How is that forecast used by the algorithm? | |
| A8 | Describe the simulation and modeling capabilities of your DERMS platform to perform what-if scenario analysis to meet a variety of needs such as testing, training and configuration. How can these | |

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| | simulation capabilities be used as inputs to distribution system modeling to understand power flows and voltage at different nodes on the system? | |
| A9 | Describe how your DERMS platform prioritizes and dispatches customer-owned behind the meter resources while accounting for customer priorities and constraints (e.g., customer objective is to minimize bill, utility's objective is to maximize grid benefits - these objectives may be incompatible at times). Provide examples and specific steps, if applicable. | |
| A10 | How does your DERMS platform translate economic signals (e.g., utility rates, market pricing) into control of DERs? How do you expect markets to evolve to further enable your approach? | |
| A11 | Describe how your DERMS platform will enable market participation of DERs either individually or in aggregate? Is this a present functionality or roadmap item? | |
| A12 | Describe how your DERMS platform monitors and/or controls Behind the Meter (BTM) DERs. | |
| A13 | Describe how your DERMS platform monitors and/or controls aggregator-controlled DERs. Also list the aggregators you've integrated with, and describe the integration method in detail. | |
| A14 | Provide details of how your DERMS platform will leverage Smart Inverters as they are introduced on PG&E's system in 2016, mapping your solution's capabilities to the 7 use cases presented in this RFP. Specifically address capabilities identified by of the first 2 phases of the CPUC Rule 21 Smart Inverter Working Group. | |
| A15 | Describe how your DERMS platform will be used to execute Energy Storage controls such as charge and discharge. Provide details of how your DERMS platform integrates with Energy Storage Management System vendors or aggregators? | |
| A16 | Does your DERMS platform include Demand Response management functions? Describe what Demand Response functions are essential from DER management perspective and how they can be achieved using your platform. | |
| A17 | Has your DERMS platform been integrated with other Demand Response Management System (DRMS) providers? If so, provide a list of Platforms with this integration already completed. Delineate | |

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| | between the functions provided by your DERMS platform and the DRMS in those instances | |
| A18 | Does your DERMS platform require integration with the DMS to obtain the system as-operated model? Does your platform require this information in real-time? What performance would be sacrificed if DERMS received this information in near-real time via "swivel chair" integration. | |
| A19 | Does your DERMS platform use power flow modeling as an input to the control algorithm? If so describe any differences in system performance could be expected by running balanced vs unbalanced power flow modeling. | |
| A20 | Identify all substation and field devices that are monitored and/or controlled to inform your DERMS logic (e.g., substation load tap changers, line regulators, capacitor banks, line sensors, smart meters, smart inverters, etc.). Identify the data points monitored for each device (e.g., voltage, amps, kvar, position, etc.). Does your DERMS platform send set points or commands to existing utility-owned equipment? | |
| A21 | Describe the data accuracy requirements for all measurements (i.e., field telemetry) fed into the DERMS platform's algorithm(s). Also, provide summary discussion of impact to DERMS if measurements fail to meet minimum accuracy requirements. | |
| A22 | If your platform presently incorporates Smart Meter (i.e., AMI) data into its DERMS logic, what Smart Meter data does your solution incorporate (e.g., kWh, Volts, etc.)? What is desired frequency of Smart Meter reads? What minimum frequency of Smart Meter reads is required? | |
| A23 | Describe how your DERMS platform limits excessive equipment operations that could potentially reduce equipment life span and/or create power quality problems for sensitive customers. | |
| A24 | Describe how your DERMS platform responds to momentary outages on all or part of a feeder. | |
| A25 | Describe how your DERMS platform responds to sustained outages on all or part of a feeder. | |
| A26 | Describe how your technology integrates with and responds appropriately to self-healing automated switching systems (i.e., Fault | |

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| | Location Isolation Service Restoration or FLISR schemes), and describe if there are any modifications or system integrations required to capture circuit changes created by FLISR schemes. | |
| A27 | Describe how your DERMS platform enables DER management and control to be integrated with other grid operations applications such as FLISR, and Integrated Volt/VAR Control (IVVC)? | |
| A28 | Does your DERMS platform include or support customer-facing applications? (e.g., Energy Managers, Customer Dashboards, Building Energy Management Systems). Which DERs are supported in the customer facing application? | |
| A29 | If you provide or support customer-facing applications, provide examples of integration or support of customer facing applications with your DERMS product at other utilities. | |
| A30 | If you provide or support customer facing apps, describe your target customer segment or segment(s). | |
| A31 | If you provide or support customer facing applications, can you describe the user experience and the customer value proposition? (include screenshots if necessary) | |
| A32 | List all Quality Assurance related certifications that your DERMS platform has received. | |
| A33 | Describe how your solution will help PG&E avoid Distribution system overloading conditions resulting from DER. How will the real0time kW measurements from SCADA, Line Sensors, Smart meters etc. be utilized to deviation with respect to the forecasted load? | |
| A34 | Describe how your solution help PG&E Distribution Operations prevent distribution back-feed in the conditions where Distributed Generation will exceed Distribution System Load? | |
| A35 | Describe potential methods to derive, estimate, calculate, ingest and/or meter the energy produced and/or stored by DERs. Describe how you would calculate the cost of dispatching DERs. | |
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| **B. Business Process** | | |

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| B1 | Who are the utility users (i.e., job function) of the DERMS platform? What are the various roles and responsibilities? What are the typical skills and backgrounds required of users in each role? | |
| B2 | What is your approach to training users prior to implementing your DERMS platform? Identify training activities including functional support, technical support, train-the-trainer training, and end user training. | |
| B3 | Describe the process of configuring and commissioning the DERMS platform. How much time does this take in a typical installation? What are the key factors driving the time and complexity (e.g., number of feeders, number of DERs under control)? Who is involved? | |
| B4 | Describe the process of reconfiguring the DERMS platform when the connectivity of the distribution system changes (i.e., switching occurs and DERs are connected to different feeders or substations). How much time does this take? Who is involved? | |
| B5 | Describe the process for adjusting DERMS schemes to include newly installed field devices or DERs. How much time does this take? Who is involved? | |
| B6 | What periodic maintenance is needed to manage the DERMS platform and/or individual circuit schemes? What data needs to be regularly refreshed (e.g., telemetry/measurement points, asset and connectivity data, etc.) Provide recommended frequency of refresh for each category. | |
| B7 | Describe your offered support and maintenance options, including training and general help-desk support availability. | |
| B8 | Describe how workstations (i.e., operating stations) are deployed in an initial implementation of your DERMS system and how additional work stations will be integrated into your system. Include any considerations for how workstations switch between areas of responsibility and how any user-specific tailoring is done. | |
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| **C. Visualization, Analytics and Reporting** | | |

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| C1 | Describe the visualization capabilities of your DERMS platform as they relate to real-time situational awareness of electric grid; including but not limited to geospatial representation of DERs and other gird-connected devices, real-time status, and scenario planning. | |
| C2 | Describe any other UI and visualization solutions your platform has interfaced with in the past. | |
| C3 | Describe the standard reporting and business intelligence capabilities of your solution. Describe who the end users of these reports are at the utilities where your platform is presently deployed. | |
| C4 | What capabilities does your DERMS platform provide to evaluate its performance and the benefits it is delivering? | |
| C5 | Describe capabilities to export reporting data into analytical tools including but not limited to Excel, Access, R, SAS, Tableau, PI, and any others that may support performance analysis and benefits measurement & verification. | |
| C6 | Does your solution have functionality (e.g., embedded in user interface, standalone module, etc.) to monitor the status / health of the DERMS platform? If so, describe. | |
| C7 | Describe how your solution will be used to visualize net load at various granularities (e.g., substation, feeder, lateral, service transformer, etc.)? | |
| C8 | Describe geoprocessing capabilities such as searching of specific resource on the map by location such as: address, longitude, altitude, or any other attribute. | |
| C9 | Can your DERMS platform be used on mobile devices (i.e., tablets and phones)? If so, provide details. | |
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| **D. Existing Installations and Future Roadmap** | | |
| D1 | Describe your largest deployment to date. Include number of DERs monitored/controlled, number of distribution circuits, total number of “points”, MW being monitored and/or under control, and/or other figures to quantify the scale of deployment. | |

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| D2 | Provide names and contact information for three (3) reference customers that are presently using your DERMS platform. | |
| D3 | Provide the following information for utilities using your DERMS platform:<br>A) Utility name<br>B) Brief overview of the components of the DERMS platform deployed<br>C) Number and types DERs being monitored and being controlled<br>D) Specific use cases the DERMS is addressing<br>E) Approximate date you began working with this customer to implement your DERMS platform<br>F) Approximate date the DERMS went live (i.e. into production) | |
| D4 | Describe any existing or planned partnerships or alliances with other technology vendors or service providers | |
| D5 | Describe your DERMS product roadmap for the next 3-5 years. Include any committed enhancements to your solution and subsequent delivery dates. Map your roadmap items to the capabilities outlined in the Phase 2 DERMS Vision section of this RFP. | |
| D6 | List all upgrades / releases, including the type and level of enhancement or upgrade, for your DERMS platform issued over the past 3 years. | |
| D8 | Describe your Software Development Lifecycle (SDLC), specifically your Quality Assurance (QA) program, release management, and patch management/control. | |
| D9 | Describe the release management process and interaction with customization, if applicable. | |
| **E. Platform Architecture and Integration** | | |
| E1 | Provide the preferred architecture of your DERMS platform including which utility applications/systems are typical integration points. Provide a description of areas in which your preferred architecture differs from PG&E's present view of a DERMS Reference Architecture provided in Appendix A (Not Included in DERMS Demo Report). | |

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| E2 | List the most common utility applications (e.g., SCADA, DMS, DRMS, OMS, MDM, Data Historian, EMS, etc.) to which your DERMS platform can presently interface. List the vendors of those applications with which your DERMS platform has successfully interfaced with in the past. What is the typical time required for each of these integrations? | |
| E3 | In your Phase 1 proposal list the existing utility applications/systems you propose integrating with the DERMS platform. Indicating which of these integrations is required to deliver the DERMS functionality described in the 7 Use Cases presented in this RFP. Differentiate which specific use cases are enabled by specific integrations (if applicable). | |
| E5 | How does your system interface with other applications? Describe the usage of a published application programming interfaces (APIs) or other approach. | |
| E6 | List the industry standard protocols supported by your DERMS platform. (e.g., CIM IEC 61968 or 61970, SEP 2.0, Open ADR, or other open standards). Describe any present activities towards providing standards-based interfaces. | |
| E7 | Indicate if your DERMS platform complies with Smart Grid Interoperability Standards for DERMS implementation. Indicate which one(s). | |
| E8 | Describe the implementation of IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems related standards in your platform, both present as well as roadmap. | |
| E9 | What information is required for the DERMS platform to function (e.g., data models, data elements, etc.)? Indicate the time scale required for this data (real-time or non-real-time). | |
| E10 | Describe how your DERMS platform can scale up to enable PG&E to manage, monitor and control hundreds of thousands of DERs. Describe how your platform's computational capabilities enable this. | |
| E11 | Describe the system architecture (e.g., networking, server needs, etc.). Include how your system will scale to accommodate more users, data points, and throughput. Describe any scalability limitations, and the largest system deployed to date. | |

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| E11 | Provide architectural drawings including IT hardware and software required for the production system. | |
| E12 | What Operating system(s) do you support? What is your preferred OS? | |
| E13 | PG&E requires non-production (i.e., Development, Test, QA) environments. Do you offer non-production environments and simulators that can be used for testing? | |
| E14 | If the client software is browser based, include versions and required plug-ins (i.e., software downloaded to the client). What Internet Browser(s) are supported and certified for your solution (e.g., IE, Firefox)? | |
| E17 | Describe the DBMS platform used for application development. | |
| E18 | Provide methodology and typical timeline for database updates and synchronization for DERMS software solutions in the different potential environments (i.e., Development, Test, QA, Production). Describe any differences in timeline for a small pilot (such as 1-2 substations, 5-10 feeders) versus a wide scale deployment. | |
| E20 | Provide a description of any high availability option(s) (e.g., alternate site architectures, farms, etc.). | |
| E21 | How is the DERMS platform configured to support failover? | |
| E22 | Indicate how quickly can the proposed production environment backup system be made operational? What is the process for making it operational? | |
| E24 | Describe the mechanism for standard archiving and retrieval of data. | |
| E27 | Describe what redundancy is available to the database. | |
| E28 | Describe the system's implementation of referential integrity and how it impacts the ability to perform updates to the database (i.e., implemented in the DBMS, implemented in the application, or both). | |
| E29 | Can the DERMS platform import and/or export data and models using CIM-XML format? Other formats? If other formats, specify which formats. | |

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| E30 | Describe your solution's performance specifications for caching, concurrent sessions, response times for page loads and basic queries vs. complex database queries. | |
| E32 | Describe your solution's ability to support remote users at different locations than the location where the DERMS platform is located (e.g., multiple control centers, other PG&E offices). | |
| E33 | Have you previously integrated with DC Systems' RT SCADA platform? If so, describe the nature of the integration (e.g., view of telemetry, ability to control devices, etc.). Describe any capabilities that allow for efficient synchronization with a third-party SCADA database (e.g., ability to import the third-party SCADA systems database, etc.). | |
| E34 | Have you previously integrated with an ESRI GIS application? If so, describe the nature of the integration. | |
| E35 | If applicable, what is the recommended frequency of GIS "refreshes" to the DERMS model (e.g., hourly, nightly, weekly, monthly, etc.)? Describe any performance dependencies or limitations imposed by particular refresh rates. | |
| E36 | Have you previously integrated with OSI Soft PI Historian? If so, describe the nature of the integration. | |
| E37 | Have you previously integrated with ABB's Network Manager DMS application? If so, describe the nature of the integration. | |
| | | |
| **F. Network and Communications** | | |
| F1 | Describe how your technology accounts for periods where communication to field devices is lost. Describe how communication losses impact the performance of your DERMS platform. | |
| F2 | Describe your hosting options (e.g., on premise, cloud, appliance-based). | |
| F3 | Does your product offer an integrated communications solution? If so, describe the network/communications architecture design. | |
| F4 | Provide an overview of any field communications equipment integrated with your communications approach, including space | |

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| | requirements, mounting options, and preferred mounting locations (e.g., wood poles, towers, tubular steel poles). | |
| F5 | If you don't have an integrated communications approach, do you have a preferred communication approach (e.g., point-to-point, point-to-mesh, mesh)? Do you work with a preferred partner/vendor for communication? If so, describe. | |
| F6 | Provide an overview of any communications requirements, including bandwidth needs, network protocols supported (e.g., DNP3, etc.), hardware/device connections, RF-band requirements, RF power out (RF watts and dBm), receiver sensitivity, expected ranges/distances, power requirements, and antenna type requirements. | |
| F7 | What are the different types of communication systems that are compatible with your DERMS platform (e.g., RF narrowband, RF broadband, mesh, etc.)? Are there any common communications approaches that would not work with your solution? | |
| F8 | Describe how your DERMS platform is capable of adapting to future/evolving communications requirements and systems, including how you will maintain interoperability with existing technologies and how you will accommodate other vendor communication products. | |
| F9 | Please indicate if any of your DERMS has any other requirements or limitations on the communications technologies used to communicate with DERs? | |
| F10 | What client-server network requirements must be met if the DERMS platform access is through a firewall? Include details regarding the effects of packet filters, proxies, and address translation, as applicable. | |
| F11 | What methods are used to maintain the connectivity session (e.g., cookies, dynamic URL, other)? | |
| F12 | If using cookies, what methods are used to prevent tampering with the cookie data? | |
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| **G. Security** | | |
| G1 | Provide a brief overview of security features of your DERMS platform. | |

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| G2 | Describe your security architecture. Include user management, user authentication (e.g., Active Directory, LDAP, etc.), generic usernames and passwords, system administration roles/capabilities, and system audit functions. | |
| G3 | Describe the components used in field devices. Describe the security architecture of these components. | |
| G4 | Describe the security protection applied to device firmware (if applicable). | |
| G5 | Describe the secure coding practices (if any) followed for software and product development. | |
| G6 | Describe your DERMS platform's compliance with NERC-CIP security requirements. | |
| G7 | Describe user authentication to all system components (i.e., devices, operators, processes, between system components) | |
| G8 | Describe how you support intrusion detection/notification system mechanisms for field devices. | |
| G9 | What encryption methods are supported for storage and transmission of data and User ID/Password? | |
| G10 | Provide a description of the security framework for system integration with external systems/processes. | |
| G11 | Describe what platform capabilities (e.g., update/modify/delete data, view data, execute macros, invoke functions, navigate screens) can be restricted, and what level it can be restricted at (e.g., user level, group level, other). | |
| G12 | Describe your test system as applied to large scale deployments Describe the process that goes from change, to test to staging and to deployment | |
| G13 | Explain how your system supports Disaster Recovery | |
| G14 | Describe how your system supports Independent Alarm Processor | |
| G15 | Describe how your system supports Security Status Monitoring | |
| G16 | Describe how your system supports Change Controls | |
| G17 | Describe how your system supports Backup and Restore | |

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| G18 | Describe how your system supports Backup Media Testing | |
| G19 | Describe how your system supports Access Controls | |
| G20 | Describe how your system supports Security Patch Management | |
| G21 | Describe how your system supports Malicious Software Prevention | |
| G22 | Do you provide Cyber Vulnerability Assessments? | |
| G23 | Describe how your system supports Operator Actions Logging | |
| G24 | Is your system being tested at the INL NERC Security Test Bed? If so, would you provide copies of the reports if requested? | |
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| **H. Additional Vendor Company Information** | | |

Advanced DER functionality, use the object models from IEC 61850-7-420 and IEC 61850-90-7 mapped to different protocols as follows:

| **J. Interoperability & Cyber Security Standards** | | | | | |
|---|---|---|---|---|---|
| | **Protocol** | **Cyber Security Provided by** | **Purpose** | **Compliance Y or N** | **Roadmap? (If Compliance='N')** |
| | 61850-8-1 | IEC 62351 | Manufacturing Messaging Specification | | |
| | DNP3 | IEEE1815 | IED interface | | |
| | 61850-8-2 | WS-Security, HTTPS | Web services, REST, Web-Sockets, DPWS | | |
| | SEP 2.0 | SEP 2.0 | Smart Energy Profile 2.0 (Devices connected with wireless link) | | |
| | OpenADR | No implicit | For pricing signals | | |
| | BACNet | No implicit | Building Automation and control network | | |
| | Modbus | No security | Legacy device control | | |
| | OASIS EMIX | No implicit | Energy Interop | | |
| | NAESB Req 18,21,22 | No explicit | Customer Energy Usage to 3$^{rd}$ parties | | |
| | IEC 61968/61970(CIM) | IEC 62541 | Comm. bet electrical distribution systems | | |

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| | Multispeak | Multispeak ver. 4 | Enterprise application interoperability for Utilities | | |
| | OpenGIS | No implicit, can use IEC 62541 | XML based comm. | | |
| | ANSI  C12.19 | encryption | Metering Model | | |
| | IEC 61850-90-7,10 | IEC 62351 | Electric Vehicles | | |

REQUEST FOR PROPOSAL No. 52150

# DISTRIBUTED ENERGY RESOURCE MANAGEMENT SYSTEM (DERMS) for DISTRIBUTED ENERGY (DG) Enablement

# Supplemental Questionnaire

Date: September 30, 2015

# SUPPLEMENTAL QUESTIONNAIRE

## 1.0 SUPPLEMENTAL QUESTIONNAIRE BACKGROUND & OVERVIEW

As a recipient of this Supplemental Questionnaire, your Company has been selected as a finalist for the PG&E's Distributed Energy Resource Management System (DERMS) Pilot Project. PG&E is seeking qualified vendors to provide a DERMS technology platform that will support grid, market, and customer operational capabilities in order to enable higher penetration of Distributed Generation (DG) onto the grid. DERMS will support PG&E's long term Grid of Things™ vision, where the grid is a platform that enables customer choice by connecting devices that produce, store, and consume energy.

The DERMS will provide PG&E with an advanced software based system, potentially consisting of multiple components and subsystems, capable of sensing grid conditions, and monitoring and controlling the operation of DERs to maintain electricity delivery to loads during all operating modes. The DERMS platform is expected to enable PG&E to integrate a wide variety of flexible DERs into real-time operations. DERMS should be able to optimize DER performance at multiple layers in the system hierarchy (i.e., customer, feeder, substation) in order to provide optimal power system performance based on local or regional requirements. This includes local optimization as well as distribution area, regional and system wide power system optimization applications delivered through DER portfolio optimization. The ability to optimize for multiple grid services with the same infrastructure enables a lower cost of ownership. For additional background on PG&E's DERMS strategy and vision please refer back to the original RFP document (RFP52150 DERMS for DG Enablement).

The purpose of the Supplemental Questionnaire is to provide an opportunity for candidate vendors to expand on certain topics, provide additional information, or specifically address PG&E information needs about general or technical aspects of the proposed solution.

The Supplemental Questionnaire consists of the following sections:

- **2.0 DER Asset Life-Cycle management** - The purpose of this section is for vendors to walk through the full life-cycle management of integrating and operating individual and aggregated DER assets in DERMS.
- **3.0 Optimization** – The purpose of this section is to gain a better understanding of how the DERMS solution makes decisions, what inputs are required and the outputs produced based on the given scenarios and constraints.
- **4.0 Roles Management** - Different users will have different access levels to information within DERMS. This section explores the hierarchy of roles within the DERMS solution and how capabilities and responsibilities are handled at each level.
- **5.0 Control or Coordination with Demand Response Resources** - Though not likely to be included in Phase 1 of the DERMS pilot, Demand Response/Load Control is considered an important DER asset moving forward. The purpose of this section is to get the vendor's vision on integration of DR resources and existing DR programs into DERMS including a view of DERMS – DRMS system integration.
- **6.0 IT/OT Supplemental Questions** - The purpose of the following section is to fill in any gaps from the original RFP Questionnaire about the proposed system architecture and how it will enable the DERMS to operate in concert with other

software and hardware systems, including those owned and operated by PG&E, as well as external systems (e.g., aggregator head-end systems).

**7.0 Vendor Specific Follow up Questions** – To be sent separately

All responses to this questionnaire are **due on 10/23/2015 at 6PM PST** ("Due Date"). Any response received after the Due Date may not be considered. Vendors are cautioned that no extensions will be given beyond the Due Date. Please ensure you have enough time to address any technical difficulties you may encounter to answer this questionnaire prior to the Due Date. If you have specific questions about individual elements of the questionnaire please reach out to the PG&E project team via Power Advocate.

**General guidelines for completeness of questionnaire**:
1) Vendors are advised that every answer must address each core business requirement and discuss its implementation if such functionality is already part of your DERMS. If there is no such capability in your DERMS as of today then please state this fact. Your response should accurately describe your current capability.

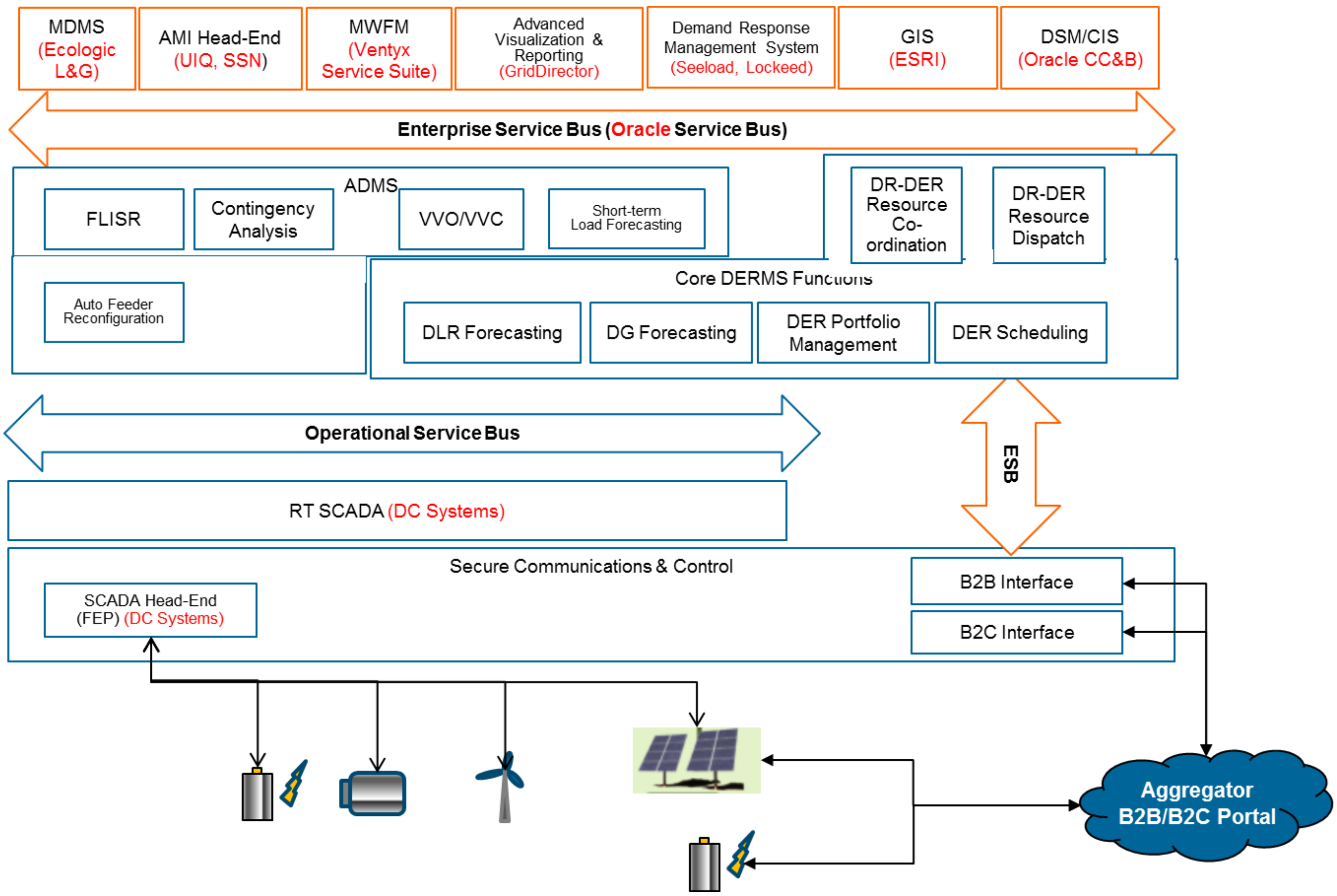
The term "Current State" refers to present capability, such as that being delivered for a pilot which can be demonstrated during the onsite demonstrations, and implemented during the implementation of Phase 1 of the DERMS Pilot as described in the document "RFP52150 DERMS for DG Enablement".

Your response should also describe how you plan to transition from the current capabilities to those required to fulfill Phase 2 as described on PG&E's RFP, including a detailed roadmap of milestones for the required capabilities, and whether the milestones being described are funded for completion. "Future State" refers to the enhancement of "Current State" activities, and includes the expansion of features, advantages, and benefits for the system that will fulfill the requirements describe in the aforementioned RFP document.

2) The responses should indicate all Vendors' assumptions regarding any of the project requirements. If a requirement cannot be met or is considered to be part of another system functionality, it should be clearly stated in the response.

3) The Vendor shall, therefore, include in the answers all the work which is normally considered part of the Vendor's scope, as well as what work is considered part of PG&E or a 3rd party.

**Reference Architecture:**
It is envisioned that a number of data sources will be required in order to implement the Phase 1 vision of the system. To this end the following reference architecture at PG&E is provided, with a high-level representation of presently-configured vendors (in red text) indicated.




As you complete your responses, please use your industry knowledge of different vendor products to indicate specifics surrounding integration points, including exact data tags/streams, data freshness/synchronization requirements, and other important external system requirements.

## 2.0 ASSETS LIFE-CYCLE MANAGEMENT

The purpose of the following section is to provide context as well as questions surrounding life-cycle management of integrating DER assets into DERMS. It is the intention of this section to better understand both the current capabilities and future roadmap elements of your solution. One goal of the on-site demonstration will be to evaluate the readiness of the proposed DERMS implementation to support the life-cycle of integrating and managing various distributed energy resource (DER) assets as described in the following sections.

### 2.1 Provisioning of Assets

Auto provisioning refers to the ability for an asset to register itself as a resource in DERMS when it comes online. Nameplate data and key parameters surrounding the asset are typically provided during the provisioning sequence, as is latitude and longitude information, if available. This process also establishes electrical associations by control area, substation, feeder, segment, transformers, and other related equipment, and this association function may be internal to DERMS or external, depending upon available interfaces.

For Phase 1 manual provisioning of assets is acceptable. However, in order to ensure long-term scalability, auto provisioning is a requirement for Phase 2.

| **2.1. Provisioning of Assets** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.1.1 | Please detail existing provisioning of assets within your DERMS. If there is no provisioning capability in your DERMS as of today then so state this fact. Your response should accurately describe your Current State implementation. | |
| 2.1.2 | Please specify the asset attributes (e.g. nameplate data) and parameters that are configurable within your DERMS as of today. If there is no ability to do this, then so state this fact. | |

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| 2.1.4 | Please provide all characteristics by asset. Use a table if it makes the response clear and concise. If the characteristic is user defined, describe examples of implementation (e.g. statistical coincidence, equivalent ramp rates, etc.) | |
| 2.1.3 | Please detail how an asset is assigned or associated by characteristics, and whether those characteristics are electrical, physical, and/or user-defined. | |
| 2.1.5 | Please detail your vision for auto-provisioning of assets within your DERMS and describe how it aligns with PG&E Phase 2 needs. | |
| 2.1.6 | Please detail your knowledge of how hardware/asset vendors are addressing auto-provisioning capabilities, and how DERMS specifically aligns with soon-to-be-available hardware. Your response should describe how you transition from manual/minimal registration (Phase 1) to auto-provisioning (Phase 2 and beyond), including a detailed roadmap of milestones with capabilities, and whether the milestone being described is funded for completion. | |
| 2.1.7 | Please detail your knowledge and vision of automatically registering and verifying interconnection requirements/ agreements as new DER is brought on line. While this is not anticipated to be a demonstrable component of the Phase 1 activities, automatic registration and verification is highly desired in a scaling environment so that errors are reduced, timeliness is accelerated, and that the resource is made available as soon as possible. | |
| 2.1.8 | Please detail your knowledge and vision of how aggregator assets will be provisioned within your DERMS implementation, as contrasted with individual visibility and provisioning of end-point assets. We are specifically looking for leadership on how aggregators will be providing registration information of dynamically | |

| | | |
|---|---|---|
| | varying levels of aggregated assets under their control to which PG&E would not have individual device visibility. | |

## 2.2 Constraint Registration

Assets will have constraints that typically fall into five categories The provided constraint classes are meant to be non-prescriptive, so please suggest your own taxonomy if the provided taxonomy does not address your Current State.

- **Operational constraints** include resource availability which can be driven by asset owner dispatch restrictions or by asset performance (e.g., if the state of charge of a battery is below dispatch limits). Additional operational constraints include ambient temperature limits and contractual obligations for the operation of a resource.
- **Contractual constraints** include concepts involving the number of times an asset can be recruited within a season, or the total number of hours that an asset can be used within the contract period, etc. Constraints involved in service-level agreements (SLAs) would typically be related to the contractual class of constraints.
- **Electrical constraints** include parameters associated with charging, discharging, ramp rates, throttling limits, etc.
- **Temporal constraints** include limitations on operations, such as generators only being able to be dispatched between the hours of 8 a.m. to 5 p.m., M-F.
- **Economic constraints** are generally determined through economic analysis such that if operation results in positive net revenue, then the unit is recruited; if operation would result in a loss then the unit is removed from the availability pool.

Assets will have non-exclusive associations with the constraints, meaning, a temporal constraint could exist due to contractual requirements, etc.

Contractual constraints exist due to contract obligations and are largely driven in the customer/asset recruitment process. It is envisioned that service level agreements (SLAs) which represent a specific performance of the asset, e.g. nameplate registration and performance, would also fall into this class of constraints, as the asset owner or contractee is obligated under the terms of the SLA. Tracking of compliance to constraints, and reporting is anticipated as a function/role in this document under the Reporting/Logging & Playback Role (Section 4.0).

Operational, electrical and temporal considerations are the primary constraints and are required in some form to safely operate an asset. Economic constraints are secondary early in the asset lifecycle, but is envisioned to become dominant in later stages of asset operation. Economic constraints are generally related to thresholds and triggers above/below these thresholds, and these thresholds are often determined by operating the asset in a manner that results in a positive value for a single or multiple stakeholders. Consequently, baseline activities are often required to determine economic constraint thresholds and to determine whether an asset can economically participate in a specific event.

Manual input of constraints is acceptable for Phase 1 but for Phase 2 a method to automatically update default constraints is required. In both Phases some form of human-machine interface (HMI) is required to standardize data entry, and to facilitate the editing and viewing of constraints.

| **2.2. Constraint Registration** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.2.1 | Please detail constraint registration within your DERMS. This should accurately describe your Current State. If your system does not have the ability to associate constraints with an asset then so state this fact. | |
| 2.2.2 | Please specify the catalog of constraints that can be specified within your system using the four categories of constraints (see text for examples of operational, electrical, temporal, and economic constraints). Detail with diagrams or figures as applicable (e.g. ramp rate, dwell, exclude time frames, etc.). Specify by asset type in addition to the categories, e.g., solar inverter constraints include X, Y, Z; energy storage systems (ESS') constraints include A, B, C. Please present your response in a table if it makes understanding the taxonomy easier. The response should accurately describe your Current State implementation. | |
| 2.2.3 | Please detail your roadmap for constraint registration beyond the present –Current State- implementation. Include established milestones with capabilities at each milestone, and whether the milestone being described is funded for completion. Be specific to describe existing initiatives within your organization and how they align with known industry initiatives. Please describe how it aligns with PG&E Phase 2 needs. | |

| 2.2. Constraint Registration | | |
|---|---|---|
| | **Question** | **Response** |
| 2.2.4 | Please provide any details surrounding the remote entry of constraints by the asset owner, as well as any reporting functions that are being contemplated regarding validation of acceptance of constraint rules by the DERMS. If an asset-owner constraint methodology is not being considered and is not on any funded roadmap or part of a milestone, then so state this fact. | |
| 2.2.5 | As stated in the descriptive text, economic constraints could require baseline activities to determine whether an asset could be economically dispatched for a future event. Presuming that this is the desired approach, describe in detail your methods to establish the baseline as well as the economic constraints/triggering mechanisms surrounding the dispatch or throttling/limiting of a particular asset. The error associated with forecasting, as a function of future time measured from "right now", is of specific interest. | |
| 2.2.6 | Please detail your Current State concerning constraint registration of aggregated assets (as contrasted with directly controlled assets). We are specifically looking for leadership on how aggregators will be providing constraints of dynamically varying levels of aggregated assets under their control to which PG&E may not have individual device visibility. | |

## 2.3 Provisioning Test/Availability

Once asset provisioning and constraint registration is complete, subsequent testing ensures that the asset meets minimum performance criteria prior to enabling their availability within the system. For solar assets this could be as simple as monitoring production and verifying that values are within an acceptable range of the asset's nameplate capacity. For storage assets this could be a simple command to discharge for a set period and subsequently recharge at a prescribed later time. Contrasting this simple approach, it could be possible with any asset class to walk through all known functionality with the asset so that all available parameters are exercised and validated. This latter approach is being considered so that a baseline of operational performance can be recorded at provisioning time. This latter approach suggests the development of robust test harnesses to test all asset classes and possible modes of operation and to test the range of parameters within each mode. This data could be valuable with respect to ensuring contract compliance as well as documenting life-cycle degradation of performance.

Manual testing and performance validation is acceptable in Phase 1, but this must be fully automated in Phase 2 in order to ensure scalability.

| **2.3 Provisioning Test/Availability** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.3.1 | Please detail existing tests that can be run on a specific asset. This should accurately describe your Current State implementation. If your system does not presently have the ability to perform provisioning tests once a resource is registered, or script a series of commands into a sequence that can be interpreted as a provisioning test, then so state this fact and describe how your DERMS implementation ensures that a newly provisioned asset is fully operational within the DERMS environment without this provisioning test functionality. | |
| 2.3.2 | As stated in the descriptive text, provisioning tests can be superficial (“light touch”) to ensure basic operation/compliance or all modes of the asset could be tested in order to baseline performance. Please describe your roadmap beyond the present Phase 1 manual implementation of provisioning tests, noting those tests by asset class that you consider imperative and would comprise the “light touch” version as described above. | |
| 2.3.3 | Please contrast this with those tests that you would consider comprehensive and would perform during a complete provisioning test.  If there are comprehensive tests that are better suited for troubleshooting/ maintenance, then so state this fact. | |

| 2.3 Provisioning Test/Availability | | |
|---|---|---|
| | **Question** | **Response** |
| 2.3.4 | Please include established milestones with capabilities at each milestone, and whether the milestone being described is funded for completion. | |
| 2.3.5 | Once a provisioning test has been completed data will be interpreted in order to determine if an asset is performing to specification. While it is permissible in the Phase 1 implementation to evaluate the test results manually, beyond Phase 1 this is not an acceptable path due to a failure to adequately scale. Please detail your methodology for autonomous evaluation of test results so that an asset is automatically registered within the DERMS and is available for event recruitment. If your DERMS implementation does not consider this automatic evaluation of test results, please detail your scaling methodology to ensure that large numbers of newly provisioned assets are performing as designed or as contractually represented by the asset owner. | |
| 2.3.6 | Please detail your Current State concerning the provisioning and testing of aggregated assets (as contrasted with directly controlled assets). We are specifically looking for leadership on how aggregators will be providing verification that they can meet system performance representation of aggregated assets under their control to which PG&E may not have individual device visibility. | |

## 2.4 Integration into the Resource Pool and Visualization

Once the DER passes the Provisioning Test, it is added to the available pool of assets within the DERMS environment. Subject to constraints, assets are recruited according to some dispatch logic, as determined by an operator or pre-established mode of operation. Presentation of the available assets, at individual, user-aggregated, and system aggregated levels is required for all phases. Relevant parameters associated with each asset type can be displayed, e.g., for solar production with throttle capability this might be the amount of available remaining throttle capability; for storage resources this might be the charge state and associated parameters of those assets. These are simple display concepts and are not intended to be fully encompassing of visualization of DERs in the asset pool.

Phase 1 requirements in this area are to have the ability to view operational parameters for the asset (specific to type or class), as well as the parameters surrounding the aggregated asset (again, type or class). This information needs to be available to all authorized users of the system. Phase 2 will require additional capabilities providing greater flexibility and granularity to view individual assets data, as well as the ability to select assets for aggregation and recruitment by various characteristics. [Note: The integration functionality is not meant to specify the HMI for DERMS. Separate HMI and Application Program Interface (API) requirements documents will be prepared in collaboration with the selected vendor.]

| **2.4 Integration into the Resource Pool and Visualization** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.4.1 | Please detail your existing methodology to integrate a newly-provisioned and tested resource into the broader resource pool. For Phase 1 manual integration into the resource pool is acceptable, but for Phase 2 and beyond, manual insertion into the resource pool is not acceptable due to the inability to scale. This methodology should fully describe your Phase 1 implementation. | |
| 2.4.2 | Please detail how the resource pool, which is comprised of aggregated but individual assets, is visualized in your Current State implementation. | |
| 2.4.3 | Detail the electrical parameters and grouping characteristics that are available at the fully-aggregated system level display, as well as at the group-aggregated and individual asset levels in your Current State implementation. | |
| 2.4.4 | Detail whether in your Current State implementation assets can be simultaneously displayed in terms of their groupings so that aggregate power levels, constraints, etc. can be viewed/visualized. Provide screen shots if available. | |

| 2.4 Integration into the Resource Pool and Visualization | | |
|---|---|---|
| | **Question** | **Response** |
| 2.4.5 | Please detail how individual assets, which are outside of the resource pool due to being newly introduced or have been removed due to a maintenance action, are introduced into specific groupings within the resource pool. As previously discussed during the provisioning step, groupings could be physical, electrical, or user-defined. Does this (re)introduction require manual intervention to assign the asset to groups in the resource pool, or is this automatically performed? | |
| 2.4.6 | Please detail your vision for your implementation of integrating and visualizing assets in the resource pool beyond the Phase 1 implementation. Detail various parameters that are available at the fully-aggregated system level, as well as at the group-aggregated and individual asset levels. Detail whether assets can be simultaneously displayed in terms of their groupings so that aggregate power levels, constraints, etc. can be simultaneously viewed/visualized. | |
| 2.4.7 | Provide thought leadership on the Phase 2 and beyond human-machine interface (HMI) as well as the machine-machine interface (MMI) for integration and visualization of assets within the resource pool. | |
| 2.4.8 | Please provide a roadmap regarding the aforementioned features. Please Include established milestones with capabilities at each milestone, and whether the milestone being described is funded for completion. | |
| 2.4.9 | Please detail your Current State concerning integration and visualization of aggregated assets in the resource pool (as contrasted with directly controlled assets). We are specifically looking for leadership on how aggregators will be providing notification of the | |

| 2.4 Integration into the Resource Pool and Visualization | | |
|---|---|---|
| | **Question** | **Response** |
| | availability of dynamic levels of aggregated assets under their control to which PG&E would may have individual device visibility. | |

## 2.5 Exception/Maintenance Operation

Exception/Maintenance Operation refers to the ability of the DERMS to take an asset offline and individually query/test it to remotely determine if an individual asset can participate in the DERMS asset pool. The system will need to periodically take assets offline for corrective or preventive maintenance. This also requires the system to be able to re-register the asset into the asset pool following any preventative or corrective maintenance actions.

In a mature implementation, the system will also be capable of automatically moving malfunctioning devices into an offline mode and notifying appropriate parties. For the Phase 1 implementation, some minimal manual intervention to facilitate this functionality would be acceptable.

| **2.5 Exception/Maintenance Operation** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.5.1 | Please detail your existing methodology to detect abnormal behavior and remove a suspect asset from the resource pool and perform tests to ensure that it is meeting operational requirements. This should accurately describe your Current State implementation. If your DERMS does not presently have the ability to detect abnormal behavior and/or perform exception/maintenance tests for a suspect asset, then so state this fact and describe how assets are removed from the asset pool without impacting operations. | |
| 2.5.2 | The questions and concepts regarding the aforementioned Provisioning Test/Availability section are a subset of Exception/Maintenance Operation in that if a unit is taken off-line it must be confirmed ready to join the asset pool once the corrective or preventative maintenance has been completed. Please detail any additional information not presently covered in the Provisioning Test/Availability response that would be applicable to Exception / Maintenance Operations. | |

## 2.6 Decommissioning

Decommissioning refers to the ability to remove an asset from the resource pool permanently such as for asset end-of-life considerations. This will most likely be manual in Phase 1 because the effect is permanent. For Phase 2 the process is envisioned to be semi-automatic, with asset removal being verified and approved by the appropriate role.

| **2.6 Decommissioning** | | |
|---|---|---|
| | **Question** | **Response** |
| 2.6.1 | Please detail your existing methodology to permanently remove an asset from the resource pool. This should accurately describe your Current State implementation. Manual disassociation from the resource pool and removal from the DERMS asset list is acceptable for Phase 1 activities. If your DERMS does not presently have the ability to remove assets from the resource pool then please describe the behavior of the system once assets no longer communicate or respond to DERMS commands. | |
| 2.6.2 | As the system scales it is envisioned that DERMS will provide a periodic list of assets that are no longer responding or are failing resource pool requirements, requiring their removal from the system. Please detail this functionality, with a specificity to roles and responsibilities for all stakeholders. | |
| 2.6.3 | Please provide thought leadership on the accidental removal of a resource from the pool – e.g. how the resource is removed such that historical data is preserved, etc. | |
| 2.6.4 | Please provide details on your Current State with respect to data persistence after an asset is permanently removed from the system. We're specifically attempting to understand how the asset and time-series data are represented within your system, and if the device is | |

| | | |
|---|---|---|
| | specifically replaced due to some action (maintenance, upgrade, etc.), how is data continuity before and after assured for all stakeholders? | |

## 3.0 DERMS OPTIMIZATION

The following section is to gain further understanding of the proposed DERMS optimization methodology and the required inputs to the system. There is a high likelihood that the initial implementation of the DERMS system will address the following scenarios, or comparable scenarios. Consequently, we are evaluating your system's performance when given the scenarios and constraints that are listed.

### 3.1 General Guidance for the Optimization Scenarios

The vendor response should contain descriptions of all required data flows for each of the provided scenarios. Please read through all of section 3 before answering questions in 3.1.

| **3.1 General Optimization Questions** | | |
|---|---|---|
| | **Question** | **Response** |
| A swim-lane or logical diagram of a proposed sequence, for each of the scenarios would be considered a bonus to the response. The intent of specifying your required data flows is to establish the amount of integration necessary at PG&E for your optimization processes to function. | | |
| 3.1.1 | What information is required from PG&E to address the use case (internal inputs) and what system interface are you anticipating? Be explicit and detailed in your response. | |
| 3.1.2 | What information is required from 3rd parties (e.g. outside vendors) to address the use case (external inputs)? | |
| 3.1.3 | What are the output values? | |
| 3.1.4 | Where does the input data originate? | |
| 3.1.5 | What process acts upon the data source(s)? | |
| 3.1.6 | What are the outputs? What are the output actions for downstream processes? | |
| 3.1.7 | For the input/output data descriptions that you have provided above, describe the temporal requirements of the data. For example, if commercial weather data is used, the fact that the service may not be updated except on the hour boundary and at the top of the hour | |

| | | |
|---|---|---|
| | should be reflected in the response. Another example is that DER equipment status and operating parameters/constraints may not be provided in real-time or may be updated in an ad-hoc manner, so describe the impact of temporal requirements in the data source and what this means for your process. | |
| 3.1.8 | It is acknowledged that required data flows (inputs and/or outputs) may not be synchronized and may exhibit time skew. To the extent possible, specify any requirements on data with respect to time skew and/or synchronization. | |
| 3.1.9 | Fully describe dependencies of data flows and temporal requirements on optimizer availability/output. For example, if weather data is needed but the service goes down, is the system taken offline or is there a mode to operate degraded until the service is restored? | |
| 3.1.10 | To what extent is the optimization able to reflect locational value tied to system topology? | |
| 3.1.11 | At what level of spatial granularity do you envision locational value being determined and at what frequency can those inputs be updated in response to changing conditions on the distribution system? | |
| 3.1.12 | We fully acknowledge that a full-implementation of the optimization capabilities will most likely result in a high level of data integration with multiple sources, and will provide the greatest value, but we also expect that early implementation of the system integration will result in basic optimization capabilities. As integration matures, what value-add capabilities will be created? | |

### 3.2 Subsystem Topology, Constraints, and Resources

The following describes a subsystem at PG&E where there is significant interest to use the DERMS optimization capabilities. There is one primary consideration: the system has a transmission tie which has a 20 MW limit due to thermal limitations. This is the overriding constraint for the system. Additionally, there is a concern regarding voltage issues on small conductors at the end of the circuit, substantially separated from the substation and generation resources.

Figure 1 shows the one-line of the proposed subsystem.

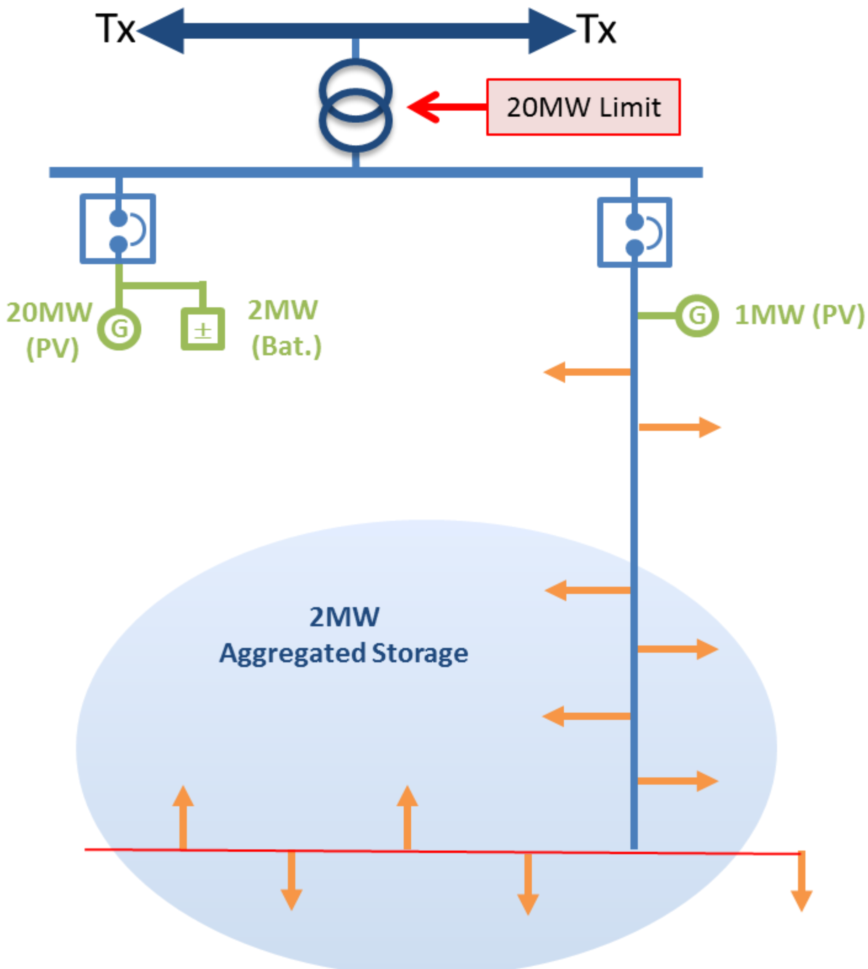
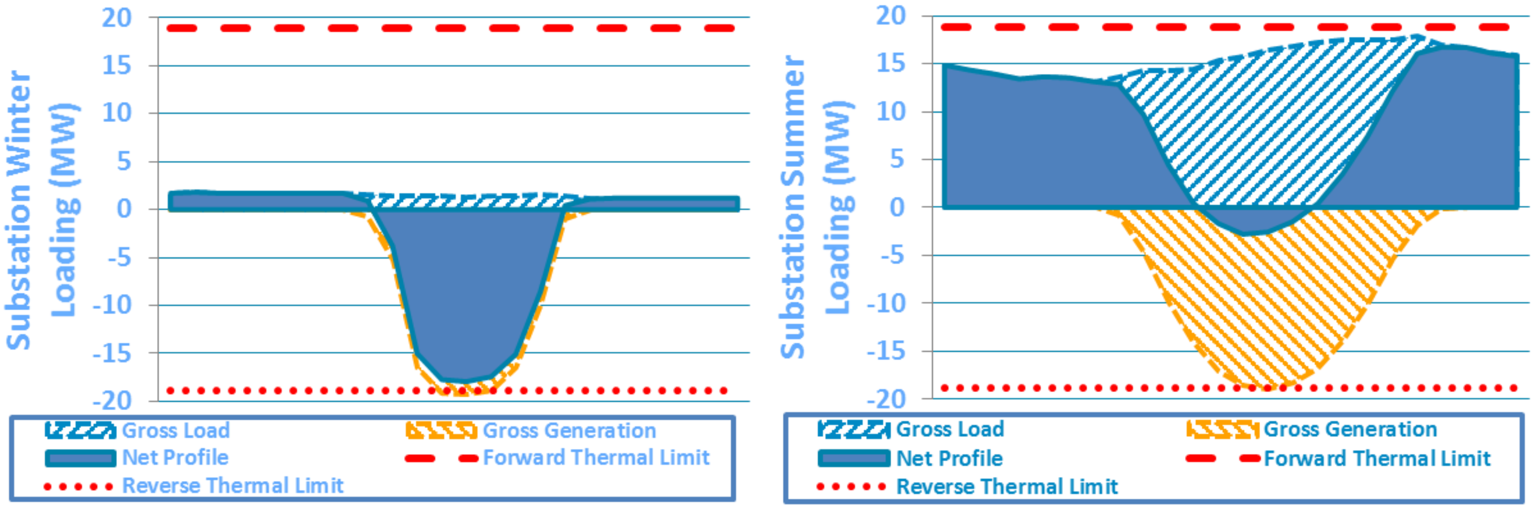



*Figure 1. Proposed subsystem topology for the optimization use case scenarios.*

There are a number of generation resources available within the subsystem:

- 20 MW Wholesale Solar near the Substation
- 2 MW (5 MWhr) Wholesale Battery near the Substation
- 1 MW Retail PV on the Circuit
- 2 MW Dispersed Aggregated Behind-the-Meter (BTM) Storage on the Circuit
  - The aggregated BTM storage resources are not within PG&E's SCADA
  - PG&E has the right to control the BTM storage resources, either through an aggregator or individually

The following diagram show the load/generation profile. The load is seasonal.




### 3.3 DERMS Illustrative Phase 1 Use Case Scenario

Resources are as listed above. The 2 MW wholesale battery serves distribution needs to include reducing feeder loading, mitigating over-generation, and managing voltage fluctuations. The 20 MW wholesale solar and the 2 MW wholesale battery are on PG&E's SCADA system. The behind-the-meter (BTM) resources are being used for customer's purposes to include backup power, rate arbitrage, and demand response, and are ***not*** on PG&E's SCADA system but available for utility control.

| **3.3 Phase 1 Use Case Scenario** | | |
|---|---|---|
| | **Question** | **Response** |
| 3.3.1 | How would your system prioritize the use of all these resources within the system constraints provided and, when necessary, execute controls for these resources? Please respond in context of the guidance directives (inputs/outputs/temporal requirements/data dependencies). Please provide a logic diagram. Answer in the context of questions 3.1.1 – 3.1.12 above. **Note this is a question of high importance by PG&E** | |

## 3.4 DERMS Potential Phase 2 Use Case Scenarios

| Phase 2 Scenarios | | |
|---|---|---|
| **Scenario Phase 2.1:** For a future Phase 2 deployment, take the above Phase 1 scenario, but now the resources are participating in the CAISO day-ahead and real-time markets for energy and ancillary services. For some resources, the utility is acting as aggregator. | | |
| | **Question** | **Response** |
| 3.4.1 | How would your DERMS system determine how to aggregate resources? | |
| 3.4.2 | How would your DERMS control a DERMS aggregated resources (i.e. the aggregated storage in figure 1)? Be as explicit as possible. | |
| 3.4.3 | How would your DERMS manage changes to the aggregation solution as conditions dictate (for example, one storage device in the aggregation trips offline so another has to be added)? For some systems, a 3rd party is acting as the aggregator. | |
| 3.4.4 | How would your system interface with that 3rd party's aggregation platform? Again, be as explicit as possible, describing any existing application specific interfaces (APIs), any existing interface control definitions (ICDs), or equivalent specifications to your DERMS implementation. | |
| 3.4.5 | How does/will your DERMS system manage the acquisition of Automated Dispatch System dispatches and Automatic Generator Control System signals from CAISO and the subsequent dispatch of those resources? | |
| 3.4.6 | How does/will the DERMS system monitor whether the resources are responding as instructed and, if not, what does it do? *Please answer for both utility-aggregated and 3rd party-aggregated resources.* | |
| **Scenario Scenario 2.2:** The aforementioned Scenario 2.1 applies. For this scenario, a number of individual and aggregated resources are participating in CAISO day-ahead and real-time markets, and there is a localized distribution problem that can be addressed by storage resources in that local area. | | |

| | Question | Response |
|---|---|---|
| 3.4.7 | How does/will the DERMS system prioritize distribution versus market needs when given an operational constraint? | |
| 3.4.8 | How does your DERMS manage the dispatch of relevant local storage resources to serve the distribution system needs yet still manage the portfolio of storage to deliver on CAISO awards? *Again, please answer for both utility-aggregated and 3rd party-aggregated resources.* | |
| 3.4.9 | Please describe how DERMS monitors the health and status of market participating assets and handles various operation status measurements such as SOC, operating limits, on AGC or not status etc... | |
| 3.4.10 | Please describe how your DERMS handles de-rate and outage identification for market-participating resources when an asset is removed from market participation/awards due to an asset outage/de-rate, or other local requirements that prioritize dispatch for localized use cases. Please include capabilities for communicating to external parties such as the CAISO, resource owners, and scheduling coordinators, and the total expected time from detection to notification. | |
| 3.4.11 | Please describe market integration at the CAISO level in terms of what system should be responsible for submitting bids to the CAISO, i.e., PG&E's systems or DERMS. Please support your answer and list all the functionalities supported by your solution in this category. In case this is a future functionality to be implemented in your system, please provide a roadmap regarding the aforementioned features. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements. | |
| 3.4.12 | Please describe market integration at the CAISO level in terms of what system should be responsible for receiving market awards from the CAISO, i.e., PG&E's systems or DERMS? Please support your answer and list all the functionalities supported by your solution in | |

| | | |
|---|---|---|
| | this category. In case this is a future functionality to be implemented in your system, please provide a roadmap regarding the aforementioned features. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements. | |

## 4.0 DERMS ROLES MANAGEMENT

Different users will have different access levels to information within DERMS. The following is a suggested taxonomy of roles with suggested responsibilities. The roles and associated responsibilities are not meant to be prescriptive, but are provided for guidance on separation of actions that users will have to make within the system. In all cases roles can be manual, e.g. human roles, and in advanced functionality, automated roles.

The following roles, with an outline of their anticipated scope, are as follows:

- **Architect:** The Architect role is the system creator and maintainer. The Architect role is a primary role – the actions of other personnel depend on the data created/entered by this role.
- **Operator:** The Operator role is the system operator. Once the Architect has created the system, the operator is responsible for the day-to-day operations of DERMS.
- **Maintainer:** The Maintainer role has the ability perform a comprehensive maintenance test on assets to determine their status and whether or not they meet the required specifications to be included in the DERMS resource pool.
- **Reporting/Logging & Playback:** Reporting/Logging refers to the ability to log all system actions, generally as performed by each of the described roles.
- **Executive:** The Executive role is a read-only role that uses much of the summary display and reporting functions of the DERMS.

The roles and high-level functions **are not to be prescriptive**. PG&E is requesting expansion of roles and capabilities within the context provided below. Please adjust or add to the table as it pertains to your Current State solution.

| High-Level Functions | Architect | Operator | Maintainer | Reporting/Logging & Playback | Executive |
|---|---|---|---|---|---|
| Addition/removal of assets from the system | X | | | | |
| The addition or modification of nameplate data for assets (ramp rates, maximum dispatch power, maximum demand, etc.), | X | | | | |
| The ability to associate geographical, electrical, and physical or other user-defined attributes (latitude, longitude, control area, substation, feeder, segment, transformer, coincidence, asset type, etc.) | X | | | | |

| High-Level Functions | Architect | Operator | Maintainer | Reporting/Logging & Playback | Executive |
|---|---|---|---|---|---|
| The ability to create network topologies and place the assets onto the electrical network (create one-lines and associate resources) | X | | | | |
| The ability to select registered assets, configure assets, and assign assets to specific events | | X | | | |
| The ability to create groups of assets or disassociate an asset from a group | X | X | | | |
| The ability to query status of a resource | X | X | | | |
| The ability to remove the asset from the primary resource pool | | X | | | |
| The ability to perform limited diagnostics on resources | | X | X | | |
| If not already offline, remove an asset from the operational resource pool by placing it in offline status | | X | X | | |
| Perform diagnostics using any existing built-in-test-equipment (BITE) that is associated with the DER | | | X | | |
| Configure a single DER such that various operational modes can be tested, e.g., have full capability to reset and test a DER | | | X | | |
| Lock out assets according to internal failures of performance, or place assets in degraded modes of operation (set operational limitations which supersede nameplate configuration data) | | | X | | |
| Restore an off-line asset to full functionality by removing test constraints, configurations, and other operational limitations | | | X | | |
| Add an asset to the operational resource pool (or release it so that the operator can add it to the operational pool) | | | X | | |
| Log all system actions initiated by all roles as well as the response of all assets | | | | X | |
| Playback of the state of all systems as a function of recorded time or other criteria | | | | X | |
| Validation of service level agreement (SLA) compliance and appropriate system notifications | | | | X | |

| High-Level Functions | Architect | Operator | Maintainer | Reporting/Logging & Playback | Executive |
|---|---|---|---|---|---|
| Access to configure and visualize performance metrics of DERMS or various asset classes in terms of electrical and financial return on investment | X | X | | | X |

| 4.0 Roles Management | | |
|---|---|---|
| | **Question** | **Response** |
| | For each role please provide the following? Please describe the role such that we have a good understanding of how capabilities and responsibilities are handled at each level. Please highlight any differences between your Current State hierarchy and the reference roles above. | |
| 4.0.1 | Architect | |
| 4.0.2 | Operator | |
| 4.0.3 | Maintainer | |
| 4.0.4 | Reporting/Logging and Playback | |
| 4.0.5 | Executive | |
| 4.0.6 | If a type of role-based hierarchy is not implemented in your DERMS, please describe the details of the hierarchy or roles that exists in your Current State solution. | |
| 4.0.7 | Please provide your vision regarding future roles and functions of those roles as additions to the table in this section. | |

## 5.0 COORDINATION OR CONTROL OF DR RESOURCES

Demand Response/Load Control is considered an important DER asset moving forward. However PG&E recognizes that DR has unique considerations related to existing DR programs and significant customer interaction which adds complexity to its near-term use by a DERMS. Therefore we expect to have limited DR inclusion during Phase 1 of the DERMS pilot while integration is scoped out for Phase 2. The purpose of this section is to get the vendor's Current State and forward looking vision on the integration of DR resources and existing DR programs into DERMS including a view of DERMS – DRMS system integration.

| **5.0 Coordination or control of DR resources** | | |
|---|---|---|
| | **Question** | **Response** |
| 5.0.1 | Please describe how your DERMS solution treats load control (DR), and based on your experience, how and what functionalities may overlap those performed by a DRMS. | |
| 5.0.2 | If overlap between your DERMS and a DRMS is envisioned, please provide your vision in terms of defining what should be the System of Record and what information should be recorded in each system. | |
| 5.0.3 | Please detail the typical integration touch points between your DERMS solution and a 3rd party DRMS. Please list the assumptions as to what functionalities are expected from the DRMS. Please list all of the data inputs expected from the DRMS, as well as the temporal requirements of each data input. | |
| 5.0.4 | Please detail the level of aggregation required for visibility and control, i.e., customer-level or some other level of aggregation (by feeder, by substation, etc.)? Note that it is the preferred to have asset-level visibility and control. | |
| 5.0.5 | Please detail the type of monitoring / visibility that the DERMS needs for each resource, e.g., real-time telemetry, co-located power meters, or virtual metering. If physical meters are required, please provide requirements on granularity and frequency of data. | |

| 5.0 Coordination or control of DR resources | | |
|---|---|---|
| | **Question** | **Response** |
| 5.0.6 | Please state your perspective about where resource optimization should occur (DRMS or DERMS) in order to determine whether a resource should be bid into the market vs. held for grid needs. | |
| 5.0.7 | Please state your perspective about where resource optimization should occur (DRMS or DERMS) in order to determine whether to dispatch a resource as per the market award or whether it should be adjusted for grid needs (held, change quantity or hours, etc.). | |
| 5.0.8 | Please describe market integration at the CAISO level in terms of what system (DERMS or DRMS) should be responsible for resource management (e.g., registration, settlement, etc.). Please support your answer and list all the functionalities supported by your Current State solution in this category. For planned future functionality to be implemented in your system, please provide a roadmap regarding the aforementioned features. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements. | |
| 5.0.9 | Based on your response to questions 3.4.11and 5.0.8 please describe what system is responsible for tracking utilization from a programmatic perspective. Should this be a direct action by the system receiving the market award? Please provide a detailed dataflow and/or swim lane diagram describing how information/controlling actions flows between the involved systems. | |
| 5.0.10 | Electric Vehicle Charging is seen as a subset of DR/Load Control assets with its own unique characteristics. Please describe how Electric Vehicle | |

| 5.0 Coordination or control of DR resources | | |
|---|---|---|
| | **Question** | **Response** |
| | Charging is treated in your “Current State” DERMS and give examples of existing implementations. In case this is a future functionality to be implemented in your system or future enhancements are planned, please provide a roadmap regarding the what features are envisioned. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements. | |

## 6.0 IT/OT

The purpose of the following section is to provide questions surrounding the proposed system architecture and how it will enable the DERMS to operate in concert with other software and hardware systems, including those owned and operated by PG&E, as well as external systems (e.g., aggregator head-end systems). These questions will also provide PG&E information on vendor's proposal on how the different interfaces with these systems shall support data exchange, supervisory control, event management, etc., as well as what data must be acquired, exchanged, stored, and retrieved such that it enables the desired DERMS functionalities, including forecasting and reporting, while complying with prescribed privacy and security standards as described in the document "RFP52150 DERMS for DG Enablement".

### 6.1 Platform Architecture and Integration

| **6.1 Platform Architecture and Integration** | | |
|---|---|---|
| | **Question** | **Response** |
| 6.1.1 | Please provide clear articulation of the component architecture of proposed solution to PG&E. Please provide logical dataflow diagrams, include all communication to and from all solution components. | |
| 6.1.2 | Please provide a matrix of information describing the technologies that are part of and/or support your solution. Detail whether you provide the technology or if you will require PG&E to provide that technology. Where options exist, list them (see sample at the end of this section) | |
| 6.1.3 | Please detail the specific information that is required from PG&E to enable vendor-provided solutions for both Phase 1 and Phase 2 implementations. Detail via logical dataflow diagrams the "as built" as well as the intended "to be built" DERMS, including associated technologies. | |
| 6.1.4 | Please define integration points; upstream and downstream of PG&E applications plus any external data sources required to fulfill PG&E use cases | |

| 6.1 Platform Architecture and Integration | | |
|---|---|---|
| | **Question** | **Response** |
| 6.1.5 | Please articulate details on interface requirements. Provide details regarding data flows may include PG&E enterprise service bus. Detail interface technologies (API, WEB service, REST JSON, synch/asynch/batch) and communication protocols (TCP/UDP: ports). Please be specific and concise. | |
| 6.1.6 | It is PG&E preference to deploy a solution based on a software (binary distribution) installed in our data center on PG&E standard Operating System build. What are the installation and operating requirements and constraints? | |
| 6.1.7 | What graphical resolution does your solution support? Anticipate potential large screen high resolution deployment (4K resolution) | |
| 6.1.8 | PG&E prefers to enable remote support through a user authenticated VPN connection, as opposed to a B2B VPN. Does this fit within your support model? If not please provide details on your support model. | |
| 6.1.9 | Please detail what testing tools and methods are available to ensure PG&E infrastructure (proposed solution) is built and operating correctly. How do these methods operate without impacting production systems? | |

| Proposed Application Components - Technology stack | | | | | |
|---|---|---|---|---|---|
| **Solution Component "A"** | **Provider** | **Solution Component "B"** | **Provider** | **Solution Component "B"** | **Owner** |
| X86 Server frame; bare metal or Vmware (ESXi 5.x) | PG&E | | | | |
| Red Hat Enerprise Linux (ver 6.x) | PG&E | | | | |
| Apache Tomcat vx.x | PG&E | | | | |
| Jboss 7.1.1 | PG&E | | | | |
| ActiveMQ 5.10.x | PG&E | | | | |
| Shell Scripting tools | vendor | | | | |
| Java Runtime | vendor | | | | |
| JVM, JDK | PG&E | | | | |
| Java Runtime | PG&E | | | | |
| Cryptography | vendor | | | | |
| Integrated Dev Environment tools | vendor | | | | |
| Browser parameter / add-ons if any | PG&E | | | | |
| Database with version | PG&E | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## 6.2 Security

| 6.2 Security | | |
|---|---|---|
| | **Question** | **Response** |
| 6.2.1 | If your solution provides communications and/or field equipment, please detail what services / features ensure the authenticity, reliability and integrity of sensor data and command execution?<br>If your solution does NOT provide communications or field equipment, please detail what capabilities or services do you expect to leverage to ensure these characteristics?" | |
| 6.2.2 | Please detail what controls or mechanisms are in place to detect anomalous behavior either in sensor readings or control outputs. If there is no such capability in your DERMS as of today then so state this fact. Your response should accurately describe your Current State implementation. | |
| 6.2.3 | PG&E has both macro and micro segmentation between network security zones. Please describe what is your solution's dependency on specific segmentation and conduits between them? | |
| 6.2.4 | Key and Certificate Management are operational burdens and risks to reliability. Please detail what services does your solution provide, or expect / require, with regards to symmetric key and PKI (certificate) management? If there is no such capability in your DERMS as of today then so state this fact. Your response should accurately describe your Current State implementation. | |
| 6.2.5 | Please detail what techniques does your solution provide, or expect/require, to secure communications (both data acquisition and control functions) assuming | |

| 6.2 Security | | |
|---|---|---|
| | **Question** | **Response** |
| | these are to traverse untrusted networks. Your response should accurately describe your Current State implementation. In case this is a future functionality to be implemented in your system, please provide a roadmap regarding the aforementioned features. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements. | |
| 6.2.6 | Is Secure DNP3 interfaces as per IEEE 1815-2012 available within the proposed product stack? | |

## 6.3 DERMS interaction with Advanced Distribution Management System (ADMS)

PG&E envisions that the mature implementation of DERMS will be tightly coupled with a number of internal systems, including the Advanced Distribution Management System (ADMS). Specifically, DERMS has the potential to work in close collaboration with the ADMS through integrated volt-VAR control (IVVC) as well as specific volt-VAR optimization (VVO) programs. The same assets that will comprise an integral component of DERMS for example Rule 21 compliant smart inverters which can play an important rule within IVVC/VVO applications and as such, will need to be jointly controlled. Consequently, close communications between systems potentially sharing the same assets for utility and customer benefit will have to be implemented. In this section PG&E is looking to understand vendor perspectives on the relationship between ADMS and DERMS and the path toward future integration.

Following diagram depicts example interaction (as anticipated by PG&E) between DMS and DERMS:

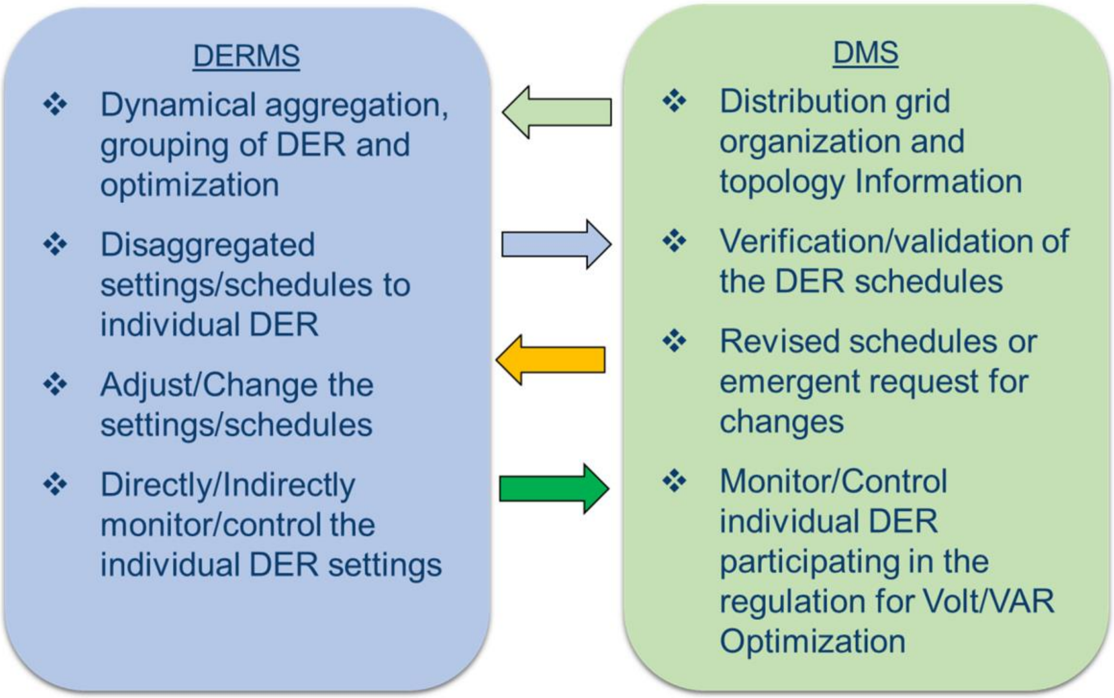



**Figure: Example Interaction between DERMS and ADMS**

| 6.3 ADMS Integration | | |
|---|---|---|
| | **Question** | **Response** |
| 6.3.1 | Please describe the ADMS functions (if any) that your DERMS solution is dependent on. If one or more of the ADMS functions depicted in the PG&E's reference architecture are provided by your DERMS solution then indicate how will they co-exist with any other ADMS? | |
| 6.3.2 | Please describe what data exchanges are anticipated by your solution with ADMS? Also provide the frequency of such data exchange (e.g. daily, weekly, real-time, near real-time, monthly, one-time etc.) | |
| 6.3.3 | Please describe how your DERMS solution will co-ordinate scheduling and dispatch of utility owned DER assets monitored and managed under the purview of DMS/PG&E's Distribution Control Center via SCADA? | |
| 6.3.4 | Please indicate if your DERMS solution will need integration with VVO applications? If yes then please describe the use case(s) from your DERMS platform which require integration with a VVO application. | |
| 6.3.5 | If the answer to question 6.3.4 is yes then, please describe how your DERMS platform would interface with VVO Applications? | |
| 6.3.6 | Irrespective of the answer to question 6.3.4 above, please describe how does your DERMS accounts for the dynamic changes of distribution network topology in its operational model while organizing its dynamic DER groups and optimizing the operation schedules of the groups? | |

# Onsite Demo Agenda

for
REQUEST FOR PROPOSAL No. 52150

## DISTRIBUTED ENERGY RESOURCE MANAGEMENT SYSTEM (DERMS) for DISTRIBUTED ENERGY (DG) Enablement

Date: October 15, 2015

**DERMS VENDOR DEMONSTRATION OVERVIEW**

The purpose of the DERMS Supplemental Questionnaire issued on October 2 is to provide an opportunity for candidate vendors to tell us more about your DERMS while the purpose of the onsite demonstration is for vendors to show us the current capabilities of your DERMS.

Attending the demo will be a group of 20-30 PG&E DERMS stakeholders from Energy Policy & Procurement, Customer Care, Electric Transmission & Distribution, Electric Strategy & Asset Management, and IT and who represent groups responsible for merchant operations, demand response, distributed generation, energy storage, electrification and electric vehicles, as well as emerging grid technologies among other areas.

Please arrive early to set up and ensure that all you have everything you need for the demo. PG&E highly recommends that you bring a self-sufficient and reliable internet connection if needed for your demo.

**DEMO SCRIPT**

## 1.0 BRIEF COMPANY AND SOLUTION OVERVIEW

Please be very brief (no more than 10 minutes) in introducing your company and the DERMS solution. Of particular interest is how DERMS fits within your overall organization and solution set. Include any product or organization mission statements you have to help PG&E understand your company's vision and how DERMS fits into this.

Note: the Business Q&A topic for the afternoon will allow you to have a detailed conversation with PG&E about your company's background and capabilities.

## 2.0 PRODUCT DEMONSTRATION

Please note that the scenarios listed below are just a subset of potential scenarios and use cases that may be explored during Phase 1 of the DERMS pilot project. Vendors are encouraged to highlight other features that are currently available and may be of interest to PG&E. However please be sure to cover the scenarios below.

**Demo Base Scenario** (based on section 3 of the Supplemental Questionnaire)
The following describes a hypothetical subsystem at PG&E where there is significant interest to use the DERMS optimization capabilities. There are a number of Distributed Energy Resources available for DERMS to control within the subsystem:

- 20 MW Wholesale Solar near the Substation (SCADA connected)
- 2 MW (5 MWhr) Wholesale Battery near the Substation (SCADA connected)
- 1 MW Customer PV on the Circuit with Smart Inverter
- 2 MW Dispersed Aggregated Behind-the-Meter (BTM) Storage on the Circuit
    - PG&E has the right to control the BTM storage resources, either through an aggregator or individually.

The 2 MW wholesale battery serves distribution needs to include reducing feeder loading, mitigating over-generation, and managing voltage fluctuations. The 20 MW wholesale solar and the 2 MW wholesale battery are on PG&E's SCADA system. The behind-the-meter (BTM) resources are being used for customers' purposes including backup power, rate arbitrage, and demand response, and are ***not*** on PG&E's SCADA system but are available for utility control.

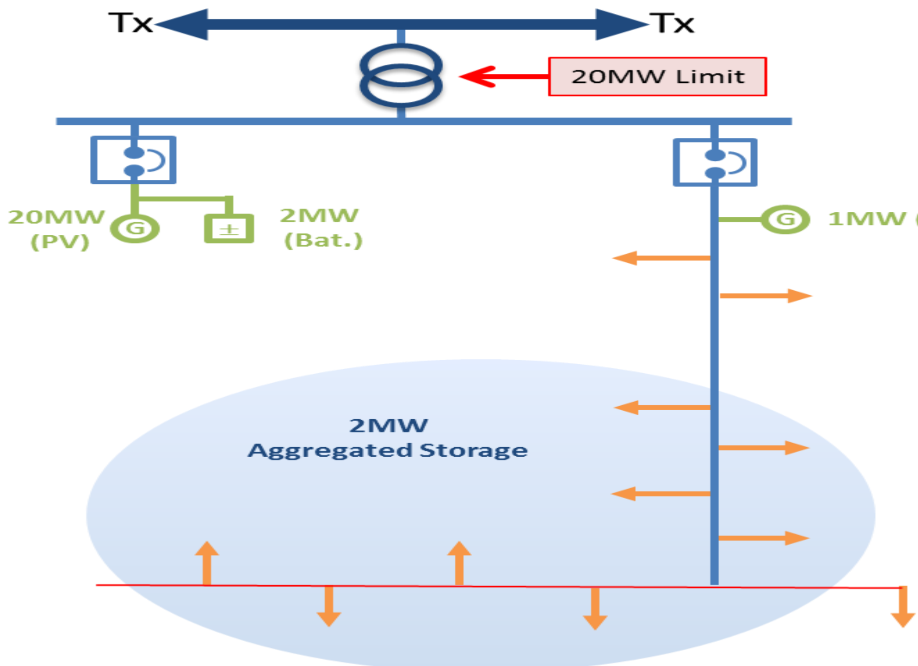



*Figure 2. Proposed subsystem topology for the optimization use case scenarios.*

## 2.1 **Day in the life of DERMS – Normal Operations** (Please refer to section 3 of the Supplemental Questionnaire)

For the Demo Base Scenario the primary consideration is that the system has a transmission tie that has a 20 MW limit due to thermal limitations. This is the overriding constraint for the system. Additionally, there is a concern regarding voltage issues on small conductors at the end of the circuit, substantially separated from the substation and generation resources.

Figures 2 and 3 show the typical load/generation profiles for the Demo Base Scenario.

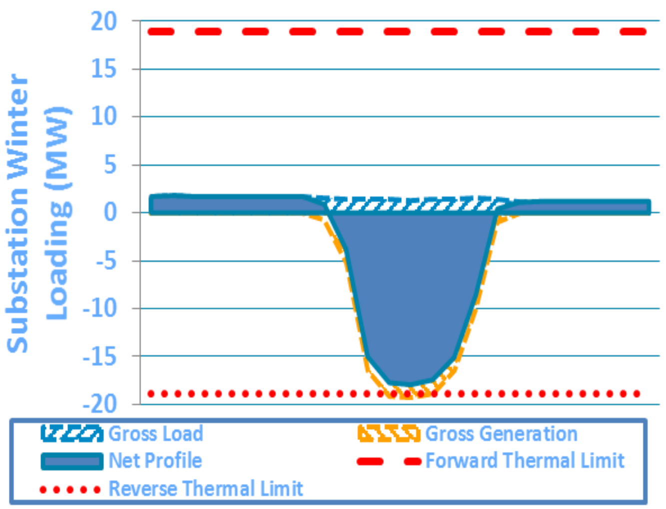



*Figure 2 Day Ahead Load/Generation Forecast - Winter*

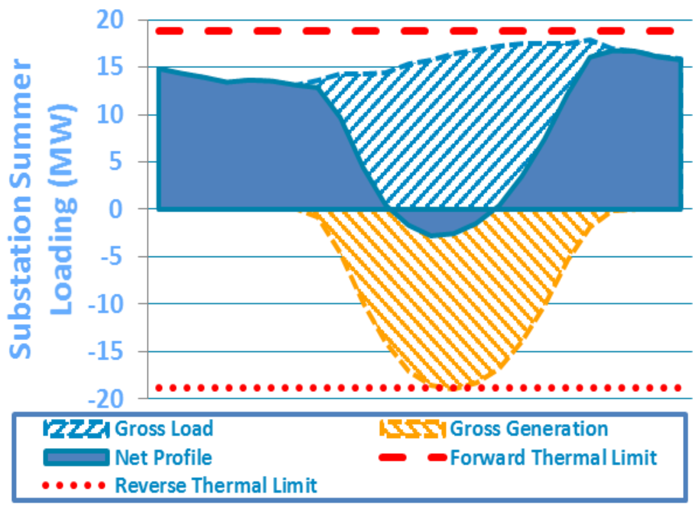



*Figure 3 Day Ahead Load/Generation Forecast Summer*

In the demonstration please address the following:

- Please walk us through a typical winter and summer day in the life of DERMS.
- As you run through the scenario, please highlight what control actions are taking place and pause when necessary to explain how dispatch decisions are made.
- Please demonstrate any day ahead scheduling done within DERMS.
- Please demonstrate the process of configuring optimization rules.
- Please demonstrate how your system prioritizes the use of each resource within the system constraints provided and, when necessary, executes controls for these resources.
- Please demonstrate how your DERMS controls aggregated resources (i.e., the aggregated storage in Figure 1).
- Please address how your DERMS manages changes to the aggregation solution as conditions dictate (for example, one storage device in the aggregation trips offline so another has to be added). For some systems, a 3rd party is acting as the aggregator.
- Please demonstrate how the DERMS system monitors whether the resources are responding as instructed and, if not, what does actions are undertaken. Please answer for both utility-aggregated and 3rd party-aggregated resources.
- Please demonstrate the visualization capabilities of your product (e.g., Geospatial, Tabular, Dashboards, Reports, etc…)
- Please demonstrate (if available) or talk through how DERMS does/will enable dual use of the assets (i.e., use of DERs for grid operational benefit and participation of the DERs in market).
- Please demonstrate (if available) or talk through how DERMS does/will prioritize distribution versus market needs when given an operational constraint.
- Please demonstrate (if available) or talk through how DERMS can/will ingest economic signals from the Utility wholesale markets or rate structures and translate those signals into control signals or communicate prices directly to DERs that are able to react to pricing signals.

- Please demonstrate (if available) or talk through how DERMS does/will manage the acquisition of Automated Dispatch System dispatches and Automatic Generator Control System signals from CAISO and the subsequent dispatch of those resources.

## 2.2 Abnormal Condition Scenarios

2.2.1 Assume the Demo Base Scenario. Now a fault trips the 2MW wholesale battery near the substation in Figure 1.The red square in Figure 4 below represents the time the battery is out of service.

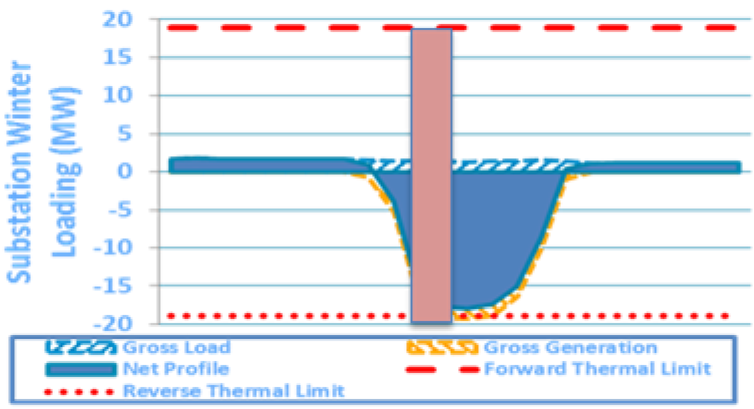



*Figure 4 2 MW Battery Faulted on a winter day.*

In your demonstration please address the following:

- How would your system respond to this condition?
- Please walk us through how the different components on your system react to the unexpected condition and describe handoffs between the components.
- How does your system prioritize the use of each resource within the system constraints provided and, when necessary, execute controls for these resources?
- Please describe the decisions taken pre-fault, during-the-fault, and post-fault conditions, as well as the DER asset condition in the aforementioned states.
- Please also describe the timeframe in which the decisions are taken and discuss the potential impact on other asset.

2.2.2 Assume the Demo Base Scenario. Now a temporary fault trips the feeder breaker and that the fault is successfully cleared after the first reclose. Assume circuit breaker recloses 5 sec after tripping.

In your demonstration please address the following:

- How would your system respond to this condition?
- Please describe the different interactions expected with other real-time systems as well as the reaction of the DER devices based on the assumed standard local settings for these types of devices.

- Please walk us through how the different components on your system react to the unexpected condition and describe handoffs between the components.
- Please describe the pre-fault condition, during-the-fault, and post-fault conditions and actions, as well as the DER asset condition in the aforementioned states.
- Please also describe the timeframe in which the decisions are taken and how long will take the system to fully recover to its normal conditions.

2.2.3 Assume the Demo Base Scenario. Now consider a situation where due to a re-configuration of feeders, one of the adjacent substations requires a transfer of 2 MW of load for 2 hours to mitigate a reliability related operational event. The moment for transferring the load is indicated in Figure 5 with a vertical dashed line. Additionally you may assume the same DERs were committed as peaking resource.

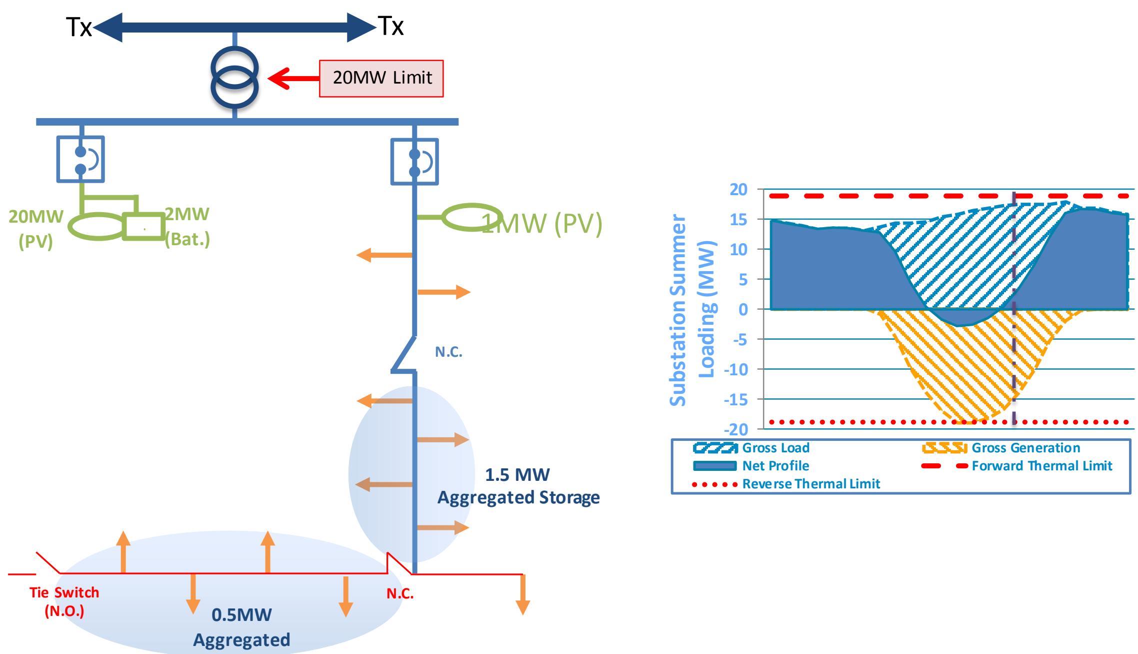



*Figure 5 – Change in Circuit Topology*

In your demonstration please address the following:

- Please discuss how would DERMS react to this situation assuming an automatic topology change in order to respond to this emergency grid situation.
- Please highlight any tools within your DERMS to support the distribution operator (DO) as he/she evaluates whether the load can be safely transferred to the demo circuit without compromising reliable operation?
- Please describe the sequence of events the DO would have to follow to analyze and transfer the load. Please describe the different interactions expected with other real-time systems as well as the reaction of the DER devices based on the assumed standard local settings for these types of devices.

- Please walk us through what components of your system will be required to support the decision and what are the handoffs between the components.
- Please describe the pre-event and post-event condition of the system and DER asset.

### 2.3 DER Asset Lifecycle Management - (Please refer to section 2 of the Supplemental Questionnaire).

PG&E will be evaluating the readiness of the proposed DERMS implementation to support the life-cycle of integrating and managing various distributed energy resource (DER) assets.

- Please walk us through DER asset management in your DERMS from cradle to grave including provisioning of assets, constraint registration and management, testing, monitoring and maintenance, and decommissioning.
- Please walk through the process of configuring rules for aggregation, grouping, disaggregation, ungrouping of DER assets based upon DER asset characteristics as well as operational parameters and any other criteria your product allows for such grouping
- Please demonstrate how assets are visualized and managed at an individual, aggregated/grouped, and portfolio level.

Vendors are encouraged to preload the Demo Base Scenario assets listed above and system topology (if relevant) into the DERMS Demo system, and also be ready to walk through the full lifecycle of at least one DER asset.

### 2.4 DERMS Roles Management – (Please refer to section 4 of the Supplemental Questionnaire)

- Please briefly demonstrate how various user groups access and/or operate various DERMS functions
  Please demonstrate off-the-shelf reporting/analytic features and its configurations

## 3.0 THREE YEAR VISION/ROADMAP PRESENTATION

Please provide a roadmap regarding additional DERMS capabilities and features that are under development and currently being planned. Please include established milestones with capabilities at each milestone, whether the milestone being described is funded for completion, and how it aligns to PG&E requirements and future vision as articulated in the DERMS RFP. Discuss what drives the prioritization of planned enhancements.

Of particular interest we would like to understand how you plan to add desired functionality related to Demand Response/Load Control and Participation in Market Operations in the context of the following:

- CAISO Energy Storage and Distributed Energy Resources (ESDER) Initiative
- CAISO Reliability Demand Response (RDR) and Proxy Demand Response (PDR) participation of DER backed DR resources
- Dispatch of DERs based economic optimization accounting for assets enrolled in multiple programs

- Please articulate your perspective on the future interaction or potential convergence between your DERMS and Demand Response Management Systems (DRMS).

Note that this is also an opportunity to highlight key functionalities that were not covered but you believe are relevant to PG&E as we choose a DERMS vendor and solution.

## 4.0 TECHNICAL Q&A

PG&E will ask questions on topics not covered in the demonstration but of interest such as voltage support and IT architecture as well as follow up technical questions from RFP Questionnaire and Supplemental Questionnaire.

## 5.0 BUSINESS/RISK Q&A

Discussion with a smaller group of PG&E stakeholders (including Director-level leadership) about your organizational ability to support PG&E and deliver the stated DERMS roadmap.