PACIFIC GAS AND ELECTRIC COMPANY
Wildfire Mitigation Plans Discovery 2023
Data Response

PG&E Data Request No.:	CalAdvocates_011-Q008		
PG&E File Name:	WMP-Discovery2023_DR_CalAdvocates_011-Q008		
Request Date:	April 5, 2023	Requester DR No.:	CalAdvocates-PGE-2023WMP-11
Date Sent:	April 10, 2023	Requesting Party:	Public Advocates Office
DRU Index #:		Requester:	Pui-Wa LI

The following questions relate to your 2023-2025 WMP submission and also the following documents:

- PG&E's 2022 WMP, Section 7.1.E, Attachment 1 (Attch_Q3.pdf),
- PG&E's presentation during the 2021 EPIC Symposium (Attch_Q6_EPIC_Presentation.pdf),
- PG&E's Electric Preliminary Statement Part FY (Tariff Sheet No. 52259-E), and
- PG&E's Test Year 2023 GRC, Application 21-06-021, Exhibit PG&E-04 and Exhibit PG&E-17.

TOPIC: RAPID EARTH FAULT CURRENT LIMITER (REFCL)

QUESTION 008

PG&E's 2023 WMP, at page 275, states that:

> While PG&E is looking at opportunities for REFCL deployments in our distribution substations to mitigate wildfire risk and evaluating combinations of REFCL with EPSS and other mitigations, implementing it would require significant and costly changes to the grid.

a) Please state the earliest date when PG&E reached the conclusion that "implementing [REFCL] would require significant and costly changes to the grid."

b) Why did PG&E not foresee "significant and costly changes" earlier than the date provided in part (a) of this question?

c) Please provide all available documentation, analyses, or studies evidencing PG&E's response to subpart (b) of this question.

d) How did PG&E reach the conclusion that "implementing [REFCL] would require significant and costly changes to the grid"?

e) State the basis of the conclusion that "implementing [REFCL] would require significant and costly changes to the grid".

f) How did the Calistoga REFCL pilot demonstration contribute to or support the conclusion stated in the quotation above?

g) Please provide all available documentation, analyses, or studies evidencing PG&E's response to parts (d) and (e) of this question.

h) What "significant and cost changes to [PG&E's] grid" would REFCL require for its implementation?

i) For each "change" to PG&E's grid, what is the cost estimate?

j) What are the cost estimates for each "change to the grid" at the substation level?

k) What are the cost estimates for each "change to the grid" on a per circuit-mile basis?

ANSWER 008

a) Implementing REFCL requires significant and costly changes to the grid relative to DCD and Partial Voltage detection. PG&E first understood the deployment cost of REFCL in early 2021.

b) PG&E needed to complete the field construction of the demonstration project to determine the cost to deploy REFCL at a substation.

c) Please refer to PG&E's Test Year 2023 GRC, Application 21-06-021, Exhibit PG&E-04 and Exhibit PG&E-17, which contain the requested information.

d) PG&E reached this conclusion through experience gained from the Calistoga REFCL demonstration project.

e) PG&E encountered distribution equipment failures during 2022 REFCL testing, indicating further costs to integrate REFCL technology.

f) The Calistoga REFCL demonstration project unveiled integration challenges of REFCL technology corresponding to greater costs.

g) Please see: Rilery, Roger and Jon Bernardo. "JA8648-0-0 REFCL Functional Performance Report." October 14, 2020. This document can be accessed through the following link: https://www.esv.vic.gov.au/sites/default/files/2022-12/REFCL-Functional-Performance-Review.pdf. Please refer to page 29 of this document.

h) Some of the major costs of implementing this technology are identified below:

- Replacing voltage regulators in closed delta;
- Installing new, matched sets of feeder breaker current transformers (CTs);
- Replacing bus potential transformers (PTs);
- Replacing substation service transformer with line-line connection;
- Isolating bank neutral bus and install neutral bus grounding recloser;
- Modifications to 12 kV bus structure for new switches and reclosers;
- Installing Ground Fault Neutralizers;
- Upgrading station battery capacity;
- Upgrading feeder breaker protection and automation package to current standard;
- Grounding grid improvements based on grounding study;
- Replacement of auto boosters with closed delta voltage regulator banks;
- Replacement of open delta voltage regulators with closed delta;

- Replacement of line reclosers and controllers for sensitive earth fault detection;
- Isolation transformer for primary connected customers;
- Replacing three-phase fuse arrangements with FuseSavers;
- Phase connection swaps for capacitive current balancing; and
- Replacement of old, direct bury underground cable.

i) Each change is dependent on the specific location and constructability. The previous cost forecasts for REFCL deployment in the 2022 WMP are approximate cost estimates for each REFCL deployment including supporting grid changes.

j) The cost estimate varies from substation to substation but is on the order of $5,000,000 to $10,000,000 per installation.

k) The cost estimate for REFCL distribution changes on a per circuit-mile basis and is difficult to quantify due to REFCL being installed in the substation and each distribution circuit being unique. A reasonable assumption would be a REFCL deployment protecting 100 circuit miles with a distribution construction cost of approximately $15,000,000. The per circuit mile cost for only distribution changes would then be approximately $150,000 per mile.