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

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The following questions relate to your 2023-2025 WMP submission.

QUESTION 002

Table 8-27 on p. 586 of PG&E's WMP summarizes grid operation monitoring systems, including Distribution Fault Anticipation (DFA) and Early Fault Detection (EFD).

a) Describe the types of faults, equipment failures, and/or other issues that DFA is capable of detecting.

b) Describe the types of faults, equipment failures, and/or other issues that EFD is capable of detecting.

c) Describe the types of faults, equipment failures, and/or other issues that DFA is capable of detecting, but EFD is not capable of detecting.

d) Describe the types of faults, equipment failures, and/or other issues that EFD is capable of detecting, but DFA is not capable of detecting.

e) Is DFA capable of locating problematic or failing equipment? Please explain your response.

f) Is EFD capable of locating problematic or failing equipment? Please explain your response.

g) Please summarize the results PG&E has seen from its DFA installations to date.

h) Please summarize the results PG&E has seen from its EFD installations to date.

ANSWER 002

a) Distribution Fault Anticipation (DFA) is designed to detect conditions that generate current and voltage anomalies including series arcing issues (elbows, splices, switches) and shunt arcing faults (line slap, vegetation contact, wire down). It can also detect loss of load caused by broken conductors.

b) Early Fault Detection (EFD) is designed to detect conditions that generate accumulation of Radio Frequency (RF) signal that are caused by partial discharge from equipment components including broken conductor strands, failing splices, broken/damaged/contaminated insulators, close vegetation, and failing windings in service transformers.

c) DFA is capable of detecting issues in which events are short and of low repeat occurrences, which are not detected by EFD. DFA, unlike EFD, can also detect issues that are more evident in power quality data (current, voltage, power factor, and harmonics).

d) EFD is capable of detecting issues which are very subtle and early within the failure mode that are not detectible by DFA. Examples of these issues include broken conductor strands, failing insulators, vegetation near conductors, and transformer windings.

e) DFA is capable of identifying issues in a circuit. It can locate issues when used in combination with faulted circuit impedance models and line sensors. SmartMeters in the future will be able to improve location accuracy. DFA is used to accurately classify the type of issue and the other tools (circuit impedance models, line sensors and SmartMeters) help reduce the issue area so that field investigations can be targeted to a small area.

f) EFD is capable of locating issues with high accuracy, to within a span on mainline and large tapline sections directly covered by EFD (with sensors on both ends of segment).

g) As of Dec 31, 2022, PG&E has 74 DFA devices deployed and is currently in the phase of Operational Development (pre-production). As a result of this work, the DFA system has been used to identify four arcing connections in underground equipment and detect one fault-induced conductor slap. Other use cases have not been fully developed.

h) PG&E has EFD deployed on four circuits as of Dec 31, 2022, and the technology is still in the pilot phase. As a result of this work, PG&E has been able to detect 11 damaged conductors (frayed or birdcaged), two arcing fuses, and one broken insulator.