

PACIFIC GAS & ELECTRIC COMPANY

SECTION 7

MITIGATION INITIATIVES

7. Mitigation Initiatives

7.1 Wildfire Mitigation Strategy

Describe organization-wide wildfire mitigation strategy and goals for each of the following time periods, highlighting changes since the prior Wildfire Mitigation Plan (WMP) Report:

1. *By June 1 of current year*
2. *By Sept 1 of current year*
3. *Before the next Annual WMP Update*
4. *Within the next 3 years*
5. *Within the next 10 years*

Pacific Gas and Electric Company's (PG&E) wildfire mitigation strategy focuses on three areas for the purposes of preventing catastrophic wildfires associated with electrical equipment: (1) reducing wildfire ignition risk, (2) enhanced wildfire risk situational awareness and (3) reducing the impact of Public Safety Power Shutoff (PSPS) events for our customers and communities. In alignment and support of these focus areas, we are working with regulators, communities, other utilities, and industry experts to get a better understanding of the wildfire problem and ways to address and limit wildfire risk. As an update to our 2020 WMP, the 2021 WMP reflects largely the same programs to reduce wildfire risk. However, as discussed in other sections of the 2021 WMP, including Section 4.1 on lessons learned, in 2020 we identified gaps in several programs where improvement is needed. These gaps are being addressed as part of the 2021 WMP. In addition, the scope of some programs is changing based on PG&E's 2021 Wildfire Distribution Risk Model and other risk modeling. For example, the number of miles targeted for system hardening in 2021 have been reduced as compared to 2020 based on the prioritization informed by these models.

Within the next year:

The deliverables PG&E is focused on for 2021 (by the next annual update) are outlined in Table PG&E-7.1-1, including those that are targeted to be completed earlier than the next annual update:

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE

| Plan Area | Unique ID | Section Reference | Activity | Commitment Description | Commitment Date |
|---------------------------------------|-----------|-------------------|---|--|-----------------|
| Risk Assessment and Mapping | A.01 | 7.3.1.5 | Match drop simulations (24 additional hours of forecast data) | Enhance the wildfire spread project in 2021 by expanding the forecast horizon from three to four days. | 12/31/2021 |
| Risk Assessment and Mapping | A.02 | 7.3.1.5 | Match drop simulations (update fuel model layers) | Update the fuel model layers on annual basis (Technosylva) | 12/31/2021 |
| Risk Assessment and Mapping | A.03 | 7.3.1.3 | Re-Train Vegetation Probability of Ignition and Equipment Probability of Ignition Models | In 2021, PG&E's Vegetation Probability of Ignition and Equipment Probability of Ignition Models will see more improvements with another year of data (2020) to be incorporated. | 12/31/2021 |
| Risk Assessment and Mapping | A.04 | 7.3.1.1 / 4.5.1 | Risk Mapping Improvements (Transmission) | Improve Transmission Risk Modeling to provide more standardized wildfire risk mapping/ranking between the various controls and mitigations. | 12/31/2021 |
| Risk Assessment and Mapping | A.05 | 7.3.1.1 / 7.3.1.4 | Risk Mapping Improvements (Distribution) | Improve Distribution Risk Modeling to include: 1) ability to compare wildfire risks for different risk drivers, 2) ability to measure the risk reduction of specific mitigations, 3) add wildfire risk values for distribution line locations beyond the HFTD and High Fire Risk Areas (HFRA) areas to include all of PG&E's distribution lines. | 12/31/2021 |
| Risk Assessment and Mapping | A.06 | 4.5.1 / 4.1 | Model PSPS customer impacts at circuit level | Develop a more granular, circuit level model, to assess PSPS customer impacts | 9/30/2021 |
| Situational Awareness and Forecasting | B.01 | 7.3.2.1.1 | Numerical Weather Prediction | Make enhancements to numerical weather prediction program | 12/31/2021 |
| Situational Awareness and Forecasting | B.02 | 7.3.2.1.2 | Enhancements to Fuel Moisture Sampling and Modeling efforts (Expand historical DFM and LFM climatology at 2 x 2 km) | Expand the historical Dead Fuel Moisture (DFM) DFM and Live Fuel Moisture (LFM) climatology at 2 x 2 km resolution to back-fill all of 2020. | 6/1/2021 |

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| Situational Awareness and Forecasting | B.03 | 7.3.2.1.2 | Enhancements to Fuel Moisture Sampling and Modeling efforts (24 additional hours of forecast data) | Evaluate extending the deterministic DFM and LFM forecast to provide another 24 hours of forecast data. | 6/1/2021 |
| Situational Awareness and Forecasting | B.04 | 7.3.2.1.3 | Enhancements to Weather Station Project (Installations and Optimization) | Install or optimize the location of 300 additional weather stations throughout PG&E's territory. | 12/31/2021 |
| Situational Awareness and Forecasting | B.05 | 7.3.2.1.3 | Enhancements to Weather Station Project (Wind Gust Model) | Develop a weather-station specific wind gust model based on machine-learning or statistical techniques. | 12/31/2021 |
| Situational Awareness and Forecasting | B.06 | 7.3.2.1.6 | Medium- to Seasonal-Range Diablo Wind Forecasting | Develop and deploy a seasonal Diablo wind event forecasting system based on statistical, machine learning and/or artificial intelligence techniques to obtain longer lead-times of an upcoming Diablo wind events in order to provide crucial preparation time for PG&E and potential communities impacted by these events. | 12/31/2021 |
| Situational Awareness and Forecasting | B.07 | 7.3.2.1.6 | Information Sharing | Make adjustments to the public 7 day forecast to provide more granularity and clarity around the potential for a PSPS event. This forecast is aimed at providing as much lead time as possible for the public to prepare for a possible PSPS event. | 6/1/2021 |
| Situational Awareness and Forecasting | B.08 | 7.3.2.2.2 | SmartMeters - Partial Voltage Detection | Implement expanded coverage of Partial Voltage Detection capabilities to the three phase meters during by end of June 2021. | 6/30/2021 |
| Situational Awareness and Forecasting | B.09 | 7.3.2.2.4 | Sensor IQ Pilot Deployment | Deploy Sensor IQ (SIQ) functionality on all planned SmartMeters (500,000) by 6/1/2021 and to complete the full evaluation for how to use the technology by 10/31/2021. | 10/31/2021 |
| Situational Awareness and Forecasting | B.10 | 7.3.2.2.6 | Distribution Arcing Fault Signature Library | By end of 2021, the Distribution Arcing Fault Signature Library project will have completed a 6-month minimum analytic stage capturing all events on the installed circuit (Half Moon Bay 1103) | 12/31/2021 |
| Situational Awareness and Forecasting | B.11 | 7.3.2.4 | Enhancements to Fire Potential Index (FPI) Model | Enhance the FPI Model by September 1, 2021 using additional data and an enhanced fire occurrence dataset. PG&E also plans to incorporate the new Technosylva fuel mapping | 9/1/2021 |

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| | | | | layer into FPI calculations if it provides more predictive skill of large fires. | |
| Situational Awareness and Forecasting | B.12 | 7.3.2.5 | Personnel monitoring areas of electric lines and equipment in elevated fire risk (Safety and Infrastructure Protection Team (SIPT) Staffing) | Maintaining SIPT staffing levels to support fire prevention and mitigation activities. | 12/31/2021 |
| Situational Awareness and Forecasting | B.13 | 7.3.2.5 | Personnel monitoring areas of electric lines and equipment in elevated fire risk (Technology Improvements to Field Automation System (FAS)) | Technology improvements to improve data capture in FAS system | 12/31/2021 |
| Situational Awareness and Forecasting | B.14 | 7.3.2.5 | Personnel monitoring areas of electric lines and equipment in elevated fire risk (New Technology to improve data capture) | Technology improvements to improve data capture for routine and emergency work: Develop and pilot ESRI Collector App (New technology development) | 6/30/2021 |
| Situational Awareness and Forecasting | B.15 | 7.3.2.6 | Enhancements to Outage Producing Wind (OPW) Model | Recalibrate the OPW Model using the 2 km climatology that will be extended to capture all events in 2020. This will include all 2020 sustained and momentary outages, as well as damages found in PSPS events of 2020. | 9/1/2021 |
| Situational Awareness and Forecasting | B.16 | 7.3.2.7 | Wildfire Safety Operations Center (WSOC) - Procedure Update | Update WSOC Procedural Documentation to include expansion of WSOC into All Hazards Center | 12/31/2021 |
| Situational Awareness and Forecasting | B.17 | 7.3.2.7 | Wildfire Safety Operations Center (WSOC) - Expand Active Incidents Visibility | Expand current Active Incidents Dashboard will for additional stability, incorporate new data streams and expand the number of viewers | 10/1/2021 |
| Situational Awareness and Forecasting | B.18 | 7.3.2.1.4 | HD Cameras | Install an additional 135 cameras by December 31, 2021 | 12/31/2021 |

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| Grid Design and System Hardening | C.01 | 7.3.3.8.1 | Assess Motorized Switch Operator (MSO) switches | Assess various alternatives to address the ignition risk with MSO switches. PG&E plans to explore several pilot options that will help inform which are the best alternatives and select the appropriate corrective action for MSO's for the next WMP update. | 12/31/2021 |
| Grid Design and System Hardening | C.02 | 7.3.3.11.1C | Generation for PSPS Mitigation (Temporary Distribution Microgrids) | For 2021, develop at least 5 additional distribution microgrid Pre-installed Interconnection Hubs (PIH). | 12/31/2021 |
| Grid Design and System Hardening | C.03 | 7.3.3.11.1B | Generation for PSPS Mitigation (Substation Distribution Microgrids) | Prepare at least 8 substations to receive temporary generation for 2021 PSPS mitigation | 8/1/2021 |
| Grid Design and System Hardening | C.04 | 7.3.3.11.3 | Emergency Back-up Generation – PG&E Service Centers & Materials Distribution Centers | Equip at least 23 PG&E Service Centers & Materials Distribution Centers to receive permanent or temporary generation by the end of 2021. Equip the 72 remaining PG&E Service Centers & Materials Distribution Centers to receive permanent or temporary generation by the end of 2022. | 12/31/2021 |
| Grid Design and System Hardening | C.05 | 7.3.3.17.5 | Remote Grid | Begin operations of the first Remote Grid project by the end of 2021. | 12/31/2021 |
| Grid Design and System Hardening | C.06 | 7.3.3.8.1 | Distribution Sectionalizing (automated devices) | During 2021, install at least 250 more distribution sectionalizing devices integrating learnings from 2020 PSPS events, 10-year historical look-back of previous severe weather events, and feedback from county leaders and critical customers. | 12/31/2021 |
| Grid Design and System Hardening | C.07 | 7.3.3.8.2 | Supervisory Control and Data Acquisition (SCADA) Transmission Switching (switches) | Install 29 SCADA transmission switches to provide switching flexibility and sectionalization for PSPS events | 9/1/2021 |
| Grid Design and System Hardening | C.08 | 7.3.3.9.1 | Distribution line legacy 4C controllers | Replace all remaining (~84) distribution line legacy 4C controllers that are located in Tier 2 and Tier 3 HFTD areas by the end of 2021. | 12/31/2021 |
| Grid Design and System Hardening | C.09 | 7.3.3.9.2 | Fuse Savers (Single phase reclosers) | Install 70 sets of single phase reclosers by the end of 2021 | 12/31/2021 |

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| Grid Design and System Hardening | C.10 | 7.3.3.17.4 | Rapid Earth Fault Current Limiter (REFCL) Pilot | PG&E plans to have the final results from this pilot project by September 2021. The result of the pilot project will drive the longer-term REFCL strategy. | 9/1/2021 |
| Grid Design and System Hardening | C.11 | 7.3.3.7 | Expulsion Fuse Replacement (non-exempt equipment) | Replace approximately 1,200 fuses/cutouts, and other non-exempt equipment identified on poles in Tier 2 and Tier 3 HFTD areas in 2021 | 12/31/2021 |
| Grid Design and System Hardening | C.12 | 7.3.3.17.3 | System Protection (surge arrester) | Replace at least 15,000 of the remaining 21,400 Tier 2 and Tier 3 non-exempt surge arresters, by the end of 2021. | 12/31/2021 |
| Grid Design and System Hardening | C.13 | 7.3.3.17.1 | System Hardening (line miles) | System Hardening; 180 miles in 2021 | 12/31/2021 |
| Grid Design and System Hardening | C.14 | 7.3.3.17.6 | System Hardening (Butte County Rebuild) | Butte County Rebuild; 23 miles in 2021 | 12/31/2021 |
| Grid Design and System Hardening | C.15 | 7.3.3.17.2 | System Hardening - Transmission Conductor | Replacement of approximately 92 miles of conductor on lines traversing HFTD, including associated asset hardware, is planned to be in-service in 2021. | 12/31/2021 |
| Asset Management and Inspections | D.01 | 7.3.4.1 | Distribution HFTD Inspections (poles) | For 2020 through 2022, PG&E plans to complete enhanced detailed inspections of overhead distribution assets in the following recurrence intervals: (1) Tier 3 – annually; and (2) Tier 2 – every three years. PG&E will schedule these inspections to be completed by July 31, 2021, barring exceptions due to physical conditions or landholder refusals which delay or hinder PG&E access to facilities. | 7/31/2021 |
| Asset Management and Inspections | D.02 | 7.3.4.15 | Substation HFTD Inspections (substations) | For 2021, PG&E intends to complete supplemental ground and aerial inspections of 100 substations: 42 in HFTD Tier 3, 38 in HFTD Tier 2; and 20 in substations adjacent to Tier 2 and 3 HFTD areas. | 7/31/2021 |
| Asset Management and Inspections | D.03 | 7.3.4.2 | Transmission HFTD Inspections (structures) | In 2021, 100 percent of overhead transmission poles in HFTD Tier 3, one third of poles in HFTD Tier 2 will be subjected to detailed enhanced inspections and some form of aerial assessment (helicopter, drone, aerial lift, climbing). PG&E will schedule these inspections to be completed by July 31, 2021, barring exceptions due to physical conditions or landholder refusals which delay or hinder PG&E access to facilities. | 7/31/2021 |

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| Asset Management and Inspections | D.04 | 7.3.4.5 | Infrared Inspections of Transmission Electric Lines and Equipment | For 2021, we plan to conduct Infrared inspections on 100% of transmission circuits in Tier 3 HFTD areas, 33% of transmission circuits in Tier 2 HFTD areas, and 20% of transmission circuits in non-HFTD areas. Circuits supporting Diablo Canyon Power Plant (DCPP) and Morro Bay Power Plant, and the tie lines for the Western Electric Coordinating Council (WECC) will be inspected by Infrared. The planned scope of Transmission Infrared Inspections in 2021 is approximately 8,000 miles. | 12/31/2021 |
| Vegetation Management and Inspections | E.01 | 7.3.5.2 | EVM (line miles) | Complete 1,800 circuit miles and mitigate approximately 190,000 trees in both 2021 and 2022, for the EVM program. | 12/31/2021 |
| Vegetation Management and Inspections | E.02 | 7.3.5.1 | Additional Efforts to Manage Community and Environmental Impacts | Expansion of the month ahead workplan reports to the Regional Water Quality Control Board Representatives in 2021 | 12/31/2021 |
| Vegetation Management and Inspections | E.03 | 7.3.5.3 | VM Transmission Right of Way Expansion | Approximately 200 miles of Transmission ROW expansion are planned within HFTD areas in 2021 | 12/31/2021 |
| Grid Operations and Protocol | F.01 | 7.3.6.3 | Personnel Work Procedures and Training in Conditions of Elevated Fire Risk | Incorporate learnings from pilot quality control audit into expansion of Quality Control (QC) program and adjust findings. | 9/1/2021 |
| Data Governance | G.01 | 4.4.1 | Research Proposals (Open Innovation Challenge) | Initiate an "Open Innovation Challenge" to identify novel technologies that could potentially reduce PG&E-caused wildfire risk. | 9/1/2021 |
| Data Governance | G.02 | 4.4.1 | Research Proposals (Cal Poly Wildland Urban Interface (WUI) Fire Information Research and Education (FIRE) Institute) | Partner with, and advise on the direction of research and associated activities by the FIRE Institute as it embarks on the development of solutions for sustainable fire resilient communities and safer and more effective fire-preparedness and response operations through applied research and incorporation of technology. | 12/31/2021 |
| Emergency Planning and Preparedness | I.01 | 7.3.9.1 | Staffing to Support Service Restoration | Hire approximately 40 Linemen and 100 Apprentices | 12/31/2021 |

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|--|------|--------------------|--|---|------------|
| Emergency Planning and Preparedness | I.02 | 7.3.9.1 | Adequate and Trained Workforce for Service Restoration | All required personnel to complete all trainings to improve PSPS event execution (Phase I SEMS training, Phase III SEMS training, Integrating Access and Functional Needs training, PSPS-0001WBT PSPS Restoration Overview Trainings, and PSPS-0002WBT DCC Operator Trainings) | 12/31/2021 |
| Stakeholder Cooperation and Community Engagement | J.01 | 7.3.10.1 / 8.4 | Community Based Organizations (CBOs) Coordination | Partner with CBOs in targeted communities to increase their capacity to serve AFN communities, such as medically sensitive customers, low-income, limited- English speaking and tribal customers. | 12/31/2021 |
| Stakeholder Cooperation and Community Engagement | J.02 | 7.3.9.2 / 7.3.10.1 | Community Engagement | Engage community stakeholders through holding/offering: Wildfire Safety Working Sessions, workshops that review PG&E's PSPS Policies and Procedures document, listening sessions, Energy and Communications Providers Coordination Group meetings | 2/1/2022 |
| Stakeholder Cooperation and Community Engagement | J.03 | 7.3.9.2 / 7.3.10.1 | Customer and Community Outreach | Continue to enhance communications and engagement efforts with a focus on wildfire safety and preparedness for PSPS events - including Webinars/Community Meetings, Direct-to-Customer Outreach, developing and delivering informational video resources | 12/31/2021 |
| Protocols on Public Safety Power Shutoff | K.01 | 8.4 / 8.2.4 | Customer and Agency Outreach During PSPS Events | Improve Customer and Agency Outreach During PSPS Events by: developing opt-in address alerts, conducting new message testing, promoting enrollment, hosting briefings, hosting cooperator calls. | 12/31/2021 |
| Protocols on Public Safety Power Shutoff | K.02 | 8.2.1 | Mitigation Impacts on De-Energized Customers | Work with partner organizations to provide outreach and support to vulnerable customers through programs such as the Disability Disaster Access and Resources Program (DDAR) and the Portable Battery Program (PBP). Eligible customers will receive support that may include emergency planning assistance, a back-up battery, and/or in-event resources such as hotel accommodations, accessible transportation, etc. | 12/31/2021 |

**TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE
(CONTINUED)**

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

TABLE PG&E-7.1-1 2021 WMP COMMITMENTS DUE BY NEXT ANNUAL UPDATE (CONTINUED)

Within three years:

Beyond the current three-year WMP period (which concludes at the end of 2022), PG&E's focus areas are anticipated to remain the same: (1) reducing wildfire ignition risk, (2) enhanced wildfire risk situational awareness; and (3) reducing the impact of PSPS events. However, ongoing learning and analysis will inevitably result in changes in some of the tactics, initiatives, or programs within these focus areas. As one example, PG&E has established specific situational awareness targets by the end of the current WMP period including having one weather stations for every twenty circuit miles in HFTD areas and having ninety percent visual coverage of the HFTD areas with High-Definition Cameras. After those goals are accomplished, PG&E will analyze what further situational awareness enhancements will add value in supporting the complementary focus areas of reducing wildfire risk and reducing PSPS impacts. Some examples of what solutions could be identified as adding value may include deploying more devices, adding different sensing devices, or integrating new software or technologies to leverage existing sensing data.

In addition to the analysis and adjustments that we already know will be necessary, given the volume of learnings and adjustments made during the first two years of the WMP process, PG&E will learn more which will shape our long-term plans for the three and ten year time horizons by undertaking the following.

- *Incorporate future climate change into risk models and increase granularity of ignition risk reduction to below the circuit level, including integration of fire spread consequences. Future improvements to PG&E's risk models are discussed in more detail in Section 4.5.1.*
- *Continue to drive PSPS events to be smarter, smaller and shorter based on further improved tools, processes and understanding of wildfire risk and weather patterns.*
- *Identify, implement, evaluate and test new technology and tools to bolster operational capabilities, increase the flexibility of the grid and enable greater system resiliency. Develop and implement new wildfire mitigation programs using promising new technology and tools. (See Section 7.1.D below for some of the technologies currently being explored.)*
- *Pursue California-based training programs to increase the population of trained Pre-Inspectors and tree crew personnel.*
- *Test and pilot clean temporary generation technologies in controlled and field environments.*
- *Work towards integrations of an Enterprise Data Management Program, enterprise strategy, enterprise governance and operating model, Electric Operations' implementation plan, and key performance indicators to track progress against said plan.*

Within ten years:

PG&E's grid architecture, lines, equipment, and processes will need to change over the next 10 years to support our objectives. PG&E's long-term WMP effort seeks to optimally-reduce wildfire risk and the impact of PSPS events, while supporting other objectives, including maintaining overall reliability, improving resiliency, and advancing grid capabilities to integrate distributed energy resources and support decarbonization goals. The regulatory, technological, and customer dimensions around these other objectives are unclear, and the appropriate, precise architecture of the grid in 10 years is uncertain. However, PG&E's long-term plan will make significant progress on risk mitigation activities like Enhanced Vegetation Management, System Hardening, Fire Risk Component Replacements, and grid operational technologies and tools.

Progress on the three WMP areas of focus described above also aligns with the WSD's Wildfire Mitigation Maturity Model, which defines 52 capabilities across 10 categories. The capabilities are themselves enabled by essential functional attributes that are often common across multiple capabilities. Key capabilities, resources and tools we anticipate developing over the 3 and 10-year time horizons (that run beyond the 2021 WMP period) include the following.

- *Track and assess performance of implemented wildfire risk mitigation activities over an extended period of time to validate effectiveness. Based on observed performance, continue, modify and improve elements of wildfire mitigation programs for as long as these measures are cost-effective in reducing the risk (frequency, scope and consequences) of wildfires, given the evolving threat of climate change in California.*
- *Develop "real-time" risk models that incorporate condition of asset, environmental factors, weather conditions, and potential fire spread.*
- *Full-scale implementation and operations of remote grids based upon site selection framework; construct permanent generation solutions at relevant substations*
- *Incorporate improving research, information, data, technologies and other tools into wildfire risk reduction efforts including PSPS targeting and minimization activities.*
- *Incorporate technology such as integrated communications and data sharing platforms to support better partnership with fire suppression and first responder agencies.*
- *Gain deeper insight into asset condition through advanced technologies, data management, and analytical capabilities; increase ability to identify asset problems before they result in failure*
- *Develop data access Application Programming Interfaces to enable increased partnerships and transparency with researchers, regulators, and state and local governments; establish and enforce comprehensive governance patterns for the collection and storage of new data; refine analytics operating model and organization structure to further develop high-quality predictive and prescriptive*

analytics for risk informed decision making.

7.1.A. PG&E's Approach to Managing Wildfire Risk

- A. *Discuss the utility's approach to determining how to manage wildfire risk (in terms of ignition probability and estimated wildfire consequence) as distinct from managing risks to safety and/or reliability. Describe how this determination is made both for (1) the types of activities needed and (2) the extent of those activities needed to mitigate these two different groups of risks. Describe to what degree the activities needed to manage wildfire risk may be incremental to those needed to address safety and/or reliability risks.*

In this section, PG&E addresses how wildfire risks are evaluated and managed differently than other public safety (non-wildfire) and reliability risks.

PG&E uses the Safety Model Assessment Proceeding (SMAP) principles to implement the methodologies adopted in the SMAP Settlement which was approved by the Commission in Decision (D.) 18-12-014. Our risk management program enables PG&E to: (1) identify those risks that could lead to catastrophic safety consequences, (2) implement the actions that have the highest and most cost-effective potential to reduce risk, and (3) transparently monitor and report results.

Through the SMAP process, PG&E developed the Corporate Risk Register, presenting each risk event with definitions, risk bowtie analyses, and data. For each risk on the Corporate Risk Register, PG&E assessed the likelihood of a risk event, and the consequence of a risk event (CoRE) attributed to Safety, Reliability and Financial. In combination, PG&E calculates the level of risk through the Multi-Attribute Value Function framework to calculate a Multi-Attribute Risk Score. This, in total, allows PG&E to assess the level of risk and the level of risk reduction between Wildfire and other risks that focus other safety and/or reliability risks. Given the vast difference in risk scores between Wildfire and other risks, mitigation programs that mitigate ignition or wildfire consequence show significantly higher risk reduction than non-wildfire mitigation programs. **Figure PG&E-7.1-1** below presents how Wildfire compares to other enterprise risks, like Failure of Electric Distribution Overhead Assets.

FIGURE PG&E 7.1-1: 2023 BASELINE RISK RANKING (2020 RAMP REPORT)¹

| Rank | LOB | Safety Risks | 2023 Baseline Score | |
|------|------|---|---------------------|----------------------------|
| | | | Safety Risk Score | Multi-Attribute Risk Score |
| 1 | EO | Wildfire | 9,856 | 25,127 |
| 2 | SHED | Third Party Safety Incident | 887 | 944 |
| 3 | GO | Loss of Containment on Gas Transmission Pipeline | 128 | 281 |
| 4 | SHED | Contractor Safety Incident | 94 | 94 |
| 5 | SHED | Employee Safety Incident | 86 | 90 |
| 6 | GO | Loss of Containment on Gas Distribution Main or Service | 72 | 99 |
| 7 | SS | Real Estate and Facilities Failure | 69 | 97 |
| 8 | PGEN | Large Uncontrolled Water Release (Dam Failure) | 41 | 70 |
| 9 | EO | Failure of Electric Distribution Overhead Assets | 18 | 525 |
| 10 | SHED | Motor Vehicle Safety Incident | 16 | 17 |
| 11 | EO | Failure of Electric Distribution Network Assets | 6 | 7 |
| 12 | GO | Large Overpressure Event Downstream of Gas M&C Facility | 5 | 13 |

After performing the risk analysis on the Wildfire risk, PG&E focuses on understanding each mitigation programs' benefit in managing and mitigating that risk, either by reducing the likelihood of occurrence or by reducing the consequences of an event. This is detailed in [Table 12](#) in "Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx" for the initiatives assessed. PG&E's risk assessment process to identify the top drivers of Wildfire risk are detailed in Section 4.2.

As described in the 2020 RAMP Report, over 99 percent of PG&E's wildfire risk is located in the HFTD Tier 3 and Tier 2 areas, despite only accounting for approximately 30 percent of risk events (ignitions). The largest drivers of wildfire risk are vegetation contact and conductor failure. As such, PG&E developed two probability of ignition models, together with a fire consequence model, collectively called the 2021 Wildfire Distribution Risk Model, that helped delineate wildfire risk within HFTD areas at a circuit segment level. Details of the model are provided in Section 4.5.1.

7.1.B. Major Investments and Implementation of Wildfire Mitigation Initiatives

B. Include a summary of what major investments and implementation of wildfire mitigation initiatives achieved over the past year, any lessons learned, any changed circumstances for the 2020 WMP term (i.e., 2020-2022), and any corresponding adjustment in priorities for the upcoming plan term. Organize

¹ FIGURE PG&E-7.1-1 is based on post-2020 RAMP CPUC workshop, as shown on July 30, 2020.

summaries of initiatives by the wildfire mitigation categories listed in Section 7.3.

PG&E's 2021 WMP builds upon the successes achieved and lessons learned in 2020. Similar to the 2019 and 2020 WMPs, PG&E's 2021 WMP has three overarching goals: (1) reducing wildfire ignition risk, (2) enhancing wildfire risk situational awareness, and (3) reducing the impact of PSPS events. In alignment with those goals, our major investments for 2021 and 2022 remain very similar to those outlined in the 2020 WMP. The broader population of major investments are captured in the list of commitments being made in this WMP which is provided above in Section 7.1 and organized by the wildfire mitigation categories. In Table PG&E-7.1-2 below the major unitized commitments are provided, including the volume of work completed in 2020.

The primary update and adjustment to PG&E's wildfire risk mitigation efforts in 2021 is in the updated risk modeling and prioritization leveraged to inform the targeting of those investments, as discussed in Sections 4.5.1 and 7.1.A. PG&E has updated its wildfire risk assessment capabilities to a more precise, technology-based approach to measure and mitigate wildfire risk. Our updated risk-modeling for the 2021 WMP benefits from both historical data (weather patterns, detailed information on previous ignitions, outages and other risk events, etc.) as well as state-of-the-art tools such as fire-spread technology that shows the locations where specific infrastructure failures can lead to ignitions that cause the most catastrophic fires. Leveraging this new risk model, going forward at least 80 percent of our largest wildfire mitigation investments, System Hardening and Enhanced Vegetation Management, will be performed in the top 20 percent of the highest risk circuit segments or in fire rebuild areas. This will be executed within the governance of our newly formed Wildfire Risk Governance Steering Committee which has direct oversight over key WMP workstreams.

TABLE PG&E-7.1-2: SUMMARY OF 2020 AND 2021 WILDFIRE MITIGATION ACTIVITIES

| | PROGRAM | 2020 PROGRESS* | 2021 TARGETS* | 2021 WMP SECTION REFERENCE |
|--|------------------------------------|--|---|----------------------------|
| Reduce Wildfire Ignition Potential | Enhanced Veg Mgmt (EVM) | 1,878 line miles | 1,800 high risk line miles | 7.3.5 |
| | Asset Inspections | Transmission – 100% of Tier 3 & Zone 1 and 33% of Tier 2 structures | Transmission – 100% of Tier 3 & Zone 1 and 33% of Tier 2 structures, plus additional higher risk structures by July 31 ^(a) | 7.3.4.2 |
| | | Distribution – 100% of Tier 3 & Zone 1 and 33% of Tier 2 | Distribution – 100% of Tier 3 & Zone 1 and 33% of Tier 2, plus high consequence Tier 2 structures by July 31 ^(a) | 7.3.4.1 |
| | | Substations – 100% of Tier 3 & Zone 1 and 33% of Tier 2 | Substations – 100% of Tier 3 & Zone 1 and 33% of Tier 2 by July 31 | 7.3.4.15 |
| | Miles Hardened | 342 line miles | 180 high risk miles | 7.3.3.17 |
| | Butte County Undergrounding | 30 line miles | 23 line miles | 7.3.3.17 |
| | Asset Replacement | 643 non-exempt fuses replaced | 1,200 non-exempt fuse replacements | 7.3.3.7 |
| | Public Safety Power Shutoff (PSPS) | Reduced catastrophic wildfire risk through 6 PSPS outages that were over 50% smaller and 40% shorter after the weather cleared than they would have been in 2019 | Reduce catastrophic wildfire risk during severe weather conditions while continuing to take actions to make each 2021 PSPS event smaller, shorter and smarter | 8 |
| Situational Awareness | Weather Stations | 404 weather stations | 300 weather stations to complete long-term goal of 1,300 total | 7.3.2.1 |
| | High-Def Cameras | 216 high-def cameras | 135 high-def cameras, in alignment with long-term goal of 600 total (90% visual coverage of HFTD areas) by the end of 2022 | 7.3.2.1 |
| (a) Excluding Can't Get In (CGI) locations where external factors including environmental restrictions, inability to access or other issues prevent the scheduled inspection, which may extend beyond July 31st. | | | | |

* All data are for activities and assets within California Public Utilities Commission (CPUC or Commission)-designated HFTDs unless otherwise indicated; 2020 actual results and 2021 targets as of February 5, 2021.

**TABLE PG&E 7.1-2: SUMMARY OF 2020 AND 2021 WILDFIRE MITIGATION ACTIVITIES
(CONTINUED)**

| | PROGRAM | 2020 PROGRESS* | 2021 TARGETS* | 2021 WMP SECTION REFERENCE |
|--|---------------------------------------|---|--|-----------------------------------|
| Reduce Impact of PSPS Events | Distribution Sectionalization | 603 devices | At least 250 devices | 7.3.3.8 |
| | Transmission Line Switching | 54 switches | 29 switches | 7.3.3.8 |
| | Distributed Generation and Microgrids | 6 temporary microgrids (3 via pre-installed interconnection hubs) and 62 substations operationally ready to leverage temporary generation during PSPS events | Deploy 5 additional microgrids with pre-installed interconnection hubs and have Temporary Generation on standby to reduce impacts of PSPS events in 2021 | 7.3.3.8 |
| | Community Resource Centers (CRC) | Had over 300 sites prepared to open as a CRC if called upon, activated 245 CRCs supporting ~50,000 customers | Partner with counties to improve targeting of CRCs and remain flexible to various regulations and conditions related to COVID | 8.4 |
| | Communication and Outreach | Shifted customer outreach to virtual in response to COVID, engaged with over 5,500 attendees to virtual open houses; partnered with over 250 Community Based Organizations (CBOs) to support and communicate with customers | Deploy customer outreach, engagement and measures, including with in-language resources and further engagement with CBOs | 8.4 |
| | Website and Call Center | Increased pre-season planning, pre-event communications and staffed up single points of contacts to keep communities prepared, engaged and informed for PSPS events | Grow partnerships with community organizations to further preparedness and execution of PSPS events | 8.4 |
| * All data are for activities and assets within CPUC-designated HFTDs unless otherwise indicated; 2020 actual results and 2021 targets as of February 5, 2021. | | | | |

7.1.C. Challenges Associated With Limited Resources

C. List and describe all challenges associated with limited resources and how these challenges are expected to evolve over the next 3 years.

Limited resources are a significant execution risk facing WMP implementation. PG&E learned a number of lessons from the execution of our first WMP in 2019 when some one-time activities (like the Wildfire Safety Inspection Program) and a ramp-up of new efforts created a significant peak of work to be performed over a limited window of time. We found that there is limited ability to rapidly scale up skilled resources to support such a peak in a short amount of time. PG&E successfully incorporated the lessons learned from that experience by executing a more sustainable and even workplan in 2020 to deliver on our 2020 WMP commitments without significant swings in our workforce. We maintained and supported a stable workforce to deliver on our 2020 WMP plans despite the logistical challenges created by the COVID-19 pandemic. PG&E is planning a similarly stable and sustainable workplan in 2021 and anticipates managing the needed workforce accordingly.

As workload volumes in some key areas, including System Hardening, grow in 2022 and beyond, we will closely monitor available resource levels in order to complete our wildfire mitigation work. At the same time, we recognize that resource limitations will likely remain a challenge in areas like vegetation management given the volume of work to be performed and the need for skilled and experienced individuals to address the inherent hazards of the job. In addition, recently revised regulations like Senate Bill 247 may influence changes in the available vegetation management companies and employees in California. It is difficult to forecast how the labor market and resource capacity/availability within California and the Western United States will change over the next several years given the increased wildfire risk experienced in the Pacific Northwest over the last few years. It is likely that the demand for trained resources will increase. Further, the ongoing COVID-19 pandemic creates uncertainty related to the availability of contract resources who often travel across states or regions throughout the year. Overall, PG&E appreciates that getting additional, talented individuals into critical positions now and providing them with experience and training will provide significant benefits in the future. Therefore, PG&E is working with community colleges and the IBEW to establish training programs to increase the size of our skilled workforce, most notably in vegetation management. PG&E also continues to focus on hiring additional qualified employees to support our wildfire risk mitigation workload over the long-term.

Beyond the in-field deployment of wildfire risk mitigation activities, PG&E is closely monitoring resource limitations related to key “support” functions as well. A primary example is Geographic Information System (GIS) resources. There are a limited number of these highly skilled, and often very experienced, employees or contractors who can quickly and efficiently navigate utility GIS systems and gather/integrate data from these systems. In light of the GIS data reporting requirements that have substantially increased and evolved over the past six months, PG&E is assessing if it has, or can acquire, enough qualified,

efficient GIS resources to support the critical needs of (1) ongoing operations, (2) system improvements and enhancements to support more efficient operations, and (3) data reporting requirements and submissions. PG&E is also assessing the necessary and appropriate staffing levels for GIS resources as compared to other resources we have available.

PG&E is continually monitoring our resource levels to ensure that we have the resources we need to perform, and support, critical wildfire risk mitigation work. Over the next three years, we anticipate that the COVID-19 pandemic, public health requirements, and other regulations will continue to impact the vegetation management and overall resource availability. We will adapt to those impacts as we strive to mitigate wildfire risk across the State.

7.1.D. New or Emerging Technologies

D. Outline how the utility expects new technologies and innovations to impact the utility's strategy and implementation approach over the next 3 years, including the utility's program for integrating new technologies into the utility's grid. Include utility research listed above in Section 4.4.

In this section, PG&E addresses new and emerging technologies.

7.1.D.1 Impact on Strategies

PG&E actively explores new or emerging technologies that can mitigate wildfire risk and associated potential impact on public safety. Section 7.1.D details technology-driven innovations focused on wildfire mitigation consistent with the following definitions:

- *New: Technologies or analytical methods enabled through technology that were new to PG&E after the release of its 2019 WMP (i.e., February 6, 2019), exclusive of 'emerging' technologies*
- *Emerging: Pre-commercial technologies or analytical methods, including Technology Demonstration & Deployment projects²*

These technologies or analytical methods hold significant promise to advance PG&E's wildfire risk mitigation, bolster operational capabilities, increase the flexibility of the grid, and allow for greater system resiliency. Capabilities targeted through new or emerging technologies include, but are not limited to:

- *Situational awareness and forecasting: New or emerging technologies can enable more accurate forecasting and identification of environmental events and operating conditions that pose a risk to the grid so that critical*

² The Technology Demonstration and Deployment demonstration project definition was approved by the CPUC in D.12-05-037, p.37: "The installation and operation of pre-commercial technologies at a scale sufficiently large and in conditions sufficiently reflective of anticipated actual operating environments, to enable the financial community to effectively appraise the operational and performance characteristics of a given technology and the financial risks it presents."

issues may be dealt with as quickly as possible to avoid the risk of catastrophic wildfires.

- Grid design and hardening: New or emerging technologies can enable innovative system hardening techniques (e.g. new grid topologies or new resilience and PSPS avoidance technologies or techniques) to mitigate the risk of fire ignition and potential impacts on public safety.
- Asset management and inspections: New or emerging technologies can enable automated and improved methods to identify asset or system issues so that high risk items can be addressed prior to failure.
- Vegetation management and inspections: New or emerging technologies can enable more timely and accurate insights on vegetation health, density and proximity to assets allowing PG&E to implement risk-based vegetation management work practices to further ensure high risk areas are efficiently addressed.
- Asset Analytics and Grid Monitoring: New or emerging technologies can leverage data to enable greater insights on asset health to optimize system maintenance and implement proactive measures to reduce the risk of asset failure.
- Foundational Enablement: New or emerging technologies, including grid communication tools and control networks, can enable greater exchange of information required to provide real or near-real time operational visibility across the grid for enhanced decision-making. These foundational items can also increase the flexibility of the grid, providing fundamental capabilities to advance system resiliency.

The projects included in this section are arranged according to these targeted capability areas above and are referred to as Program Areas in the project reports below.

The impacts of new or emerging technologies on utility strategy will vary by project. Information on the strategic enablement of these technologies is detailed further in Sections 7.1.D.2 and 7.1.D.3 below. The scope and implementation of these projects are subject to change due to the evolving nature of technology and business needs. There will likely be technologies that develop or mature over the reporting timeframe (2021-2023) which PG&E may pursue that are not described in Section 7.1.D.3. Projects that newly meet the inclusion criteria after the filing of the 2021 WMP update will be added to the Condition Guidance-9 quarterly reports.

7.1.D.2. Implementation Approach and Integration of New or Emerging Technologies

The projects included in this Section 7.1.D are managed as a portfolio of wildfire mitigation-related new or emerging technology projects. Currently eight of the projects in this portfolio are also administered under PG&E's Electric Program Investment Charge (EPIC) Program.

The EPIC program, established in 2011 by the CPUC in D.11-12-035, provides PG&E with an opportunity to demonstrate the value of emerging technologies that could advance a broad array of objectives including wildfire safety, grid safety, resiliency and reliability as well as customer enablement, and integration of renewable and distributed energy resources. The CPUC has established rules that guide the EPIC program through its various rulings within the program docket. PG&E administers the EPIC program to comply with the CPUC rules and effective use of the program funding. In selecting emerging technologies for demonstration, we assess criteria that may inform project value and successful implementation, including: (i) alignment to key program objectives, (ii) technology novelty, (iii) technology readiness, (iv) sponsorship and clear path to production, (v) obstacles to implementation, and (vi) potential benefits at demonstration and full deployment stages. PG&E also assesses alignment to utility strategic priorities and customer needs to ensure that technologies, if successfully demonstrated, will enable PG&E (and potentially other utilities) to better serve its customers and deliver on program objectives, including enhancements to safety and grid resiliency.

EPIC demonstration projects aid in identifying key requirements and insights to inform broader deployment in a manner that strategically aligns the integration of technologies with existing operations. Given the rapidly evolving energy landscape and the impact of climate change in California, the continuation of technology innovation programs like EPIC is critical to the continued advancements of grid capabilities to enable advancements on safety and resiliency.

Consistent with CPUC guidance, PG&E has relied primarily upon the EPIC program to demonstrate emerging technologies to improve our ability to mitigate wildfire risk, although the wildfire mitigation new or emerging technology portfolio, as reported on in this section, also includes new technology projects that are not pre-commercial in nature. These projects are funded and managed separately from the EPIC portfolio according to standard (non-EPIC) business planning processes.

The EPIC 3 Program cycle now underway is the final triennial cycle in the current EPIC program. The CPUC is currently contemplating in the EPIC successor program proceeding, Rulemaking 19-10-005, whether the investor-owned utilities (IOU) will continue to administer their respective portions of the EPIC Program to develop capabilities that reduce wildfire risk and address other critical California objectives.

PG&E will continue to seek funding and authorization to pursue demonstration projects for new and emerging technology related to wildfire mitigation through the EPIC Successor Program (if authorized), through its 2023 General Rate Case request (if the CPUC does not authorize continued IOU administration of the EPIC program), or through other funding mechanisms.

7.1.D.3. New or Emerging Technologies – Project Details

This section provides an overview of 18 mitigations that leverage new or emerging technologies, including 16 projects that were previously included in Section 5.1.D New or Emerging Technologies in the 2020 WMP. On June 11, 2020, the CPUC issued Resolution WSD-003 approving the Wildfire Safety Division's recommendation for a Conditional Approval of PG&E's 2020 WMP. In the Conditional Approval recommendation, the WSD identified in Condition Guidance-9 that PG&E had an "insufficient discussion of pilot programs" and recommended quarterly reporting on these projects. As this was identified as a deficiency of the 2020 WMP, these projects are reported herein according to the Condition Guidance-9 reporting criteria, in addition to being reported in the ongoing quarterly reports.

In addition to the New or Emerging criteria (listed in Section 7.1.D.1) for inclusion in this section, the project must also at least be in the Planning phase (as described below) with an approved business case and a planned budget. Projects that newly meet the inclusion criteria after the filing of the 2021 WMP will be added to PG&E's next quarterly report.

The portfolio of projects addressed in this section begins with the projects included in the 2020 WMP, and accounts for the removal of projects that have been closed and the addition of newly launched projects.

The following projects included in the New or Emerging Technology section of the 2020 WMP have been removed from the New or Emerging Technology section of the 2021 WMP. The first four projects below are either now in production or in the process of entering production and continue to be included in other sections of the 2021 WMP. The last project has completed and is not planned to be taken to production. They are:

- *5.1.D.3.1 Wildfire Spread Models. The wildfire spread model is now in production with over 70 million virtual fires simulated by the technology each day every 200m along PG&E's overhead assets in the HFTDs.*
- *5.1.D.3.2 Satellite Fire Detection. The data and workflows of this project are now in production and are providing detection of potential wildfire conditions to inform operational response. In addition, PG&E also sends automated email fire alerts to various partners and has developed a public facing web page where these detections are available.*
- *5.1.D.3.3 Weather Model and Fire Potential Index – Model Expansions. The 2 km model pipeline of weather, fuels, OPW model, and FPI are now in production in the external cloud environment. These models and tools inform daily fire danger risk, Public Safety Power Shutoff decision-making frameworks, and outage potentials which can be modeled through PG&E's Storm Outage Prediction Project Model.*
- *5.1.D.3.19 EPIC 2.34: Predictive Risk Identification with Radio Frequency Added to Line Sensors (Distribution Fault Anticipation Technology). The technology demonstration project was completed. For more information on how this project is continuing into production and wider deployment, see Section 7.3.2.2.3 Distribution Fault Anticipation Technology and Early Fault Detection.*
- *5.1.D.3.11 Ultrasonic Technology. This project was removed because Ultrasonic Technology (UT) defect detection was found to be unreliable at this time. Additional project details from the last project quarterly report prior to removal can be found in the 2020 WMP Conditional Approval Guidance Item 9 Second Quarterly report available from the CPUC website.*

For the 2021 WMP, PG&E has newly included the EPIC 3.41: Drone Enablement and Operational Use and EPIC 3.43: Momentary Outage Information projects in this section.

Below are four EPIC projects that PG&E may pursue to demonstrate additional wildfire risk reduction capabilities, subject to CPUC approval of Advice Letter 6043-E to conduct these proposed projects as part of the current EPIC 3 investment cycle:

- *Project 44 – Advanced Transformer Protection: Demonstrate and evaluate the use of negative sequence transformer differential protection to provide high sensitivity fault detection and prevent transformer winding failures.*
- *Project 45 – Automated Fire Detection from Wildfire Alert Cameras: Demonstrate an automated fire detection model using machine learning, computer vision, or Artificial Intelligence (AI) techniques that accurately detects fires based on visual and infrared camera data streams; optimize for automated fire detection alerts.*

- *Project 46 – Advanced Electric Inspection Tools – Wood Poles: Demonstrate and evaluate the use of a nondestructive examination method (Radiography Testing) to detect flaws and prevent potential failures on electric distribution wood poles.*
- *Project 47 – Operational Vegetation Management Efficiency Through Novel Onsite Equipment: Demonstrate new technologies and onsite processes that can materially lower vegetation management costs by (a) small scale mobile torrefaction, and (b) wood baling technologies.*

The New or Emerging Technology projects included in this 2021 WMP are summarized in **Table PG&E-7.1-3**. Comprehensive details of each of the projects follow this table.

TABLE PG&E-7.1-3: NEW OR EMERGING TECHNOLOGIES

| Section | Project Name | Program Area | Approximate 2021 Project Financial Forecast (\$K) ^(a) |
|--|--|-------------------------------------|--|
| 7.1.D.3.1 | SmartMeter Partial Voltage Detection | Situational Awareness & Forecasting | \$331 |
| 7.1.D.3.2 | Line Sensor Devices | Situational Awareness & Forecasting | \$6,420 |
| 7.1.D.3.3 | EPIC 3.15: Proactive Wires Down Mitigation Demonstration Project (Rapid Earth Fault Current Limiter) | Grid Design & System Hardening | \$3,030 |
| 7.1.D.3.4 | Distribution, Transmission, and Substation: Fire Action Schemes and Technology (DTS-FAST) | Grid Design & System Hardening | \$30,000 |
| 7.1.D.3.5 | Remote Grid | Grid Design & System Hardening | \$1,382 |
| 7.1.D.3.6 | EPIC 3.11: Multi-Use Microgrid | Grid Design & System Hardening | \$1,440 |
| 7.1.D.3.7 | Enhanced Asset Inspections – Drone/AI (Sherlock Suite) | Asset Management and Inspections | \$7,753 |
| <p>(a) Financial forecasts for emerging technology assessment or deployment projects are highly tentative as uncertainty regarding costs and functionality is very high for new technologies. The forecast shown reflects project costs only (not production costs if the results of the project lead to production), are estimates as of January 2021, and are subject to change, including but not limited to the fact that several of the project estimates remain to be discussed at this time. Costs beyond 2021 have not yet been defined given this level of uncertainty.</p> | | | |

TABLE PG&E-7.1-3: NEW OR EMERGING TECHNOLOGIES (CONTINUED)

| Section | Project Name | Program Area | Approximate 2021 Project Financial Forecast (\$K)^(a) |
|----------------|--|---------------------------------------|--|
| 7.1.D.3.8 | Below Ground Inspection of Steel Structures (Steel Transmission Structure Corrosion Assessment and Mitigation Pilot) | Asset Management and Inspections | TBD |
| 7.1.D.3.9 | EPIC 3.41: Drone Enablement | Asset Management and Inspections | \$1,583 |
| 7.1.D.3.10 | Mobile LiDAR for Vegetation Management | Vegetation Management and Inspections | TBD |
| 7.1.D.3.11 | EPIC 3.13: Transformer Monitoring via Field Area Network (FAN) | Asset Analytics & Grid Monitoring | \$1,267 |
| 7.1.D.3.12 | EPIC 3.20: Maintenance Analytics | Asset Analytics & Grid Monitoring | \$541 |
| 7.1.D.3.13 | EPIC 3.32: System Harmonics for Power Quality Investigation | Asset Analytics & Grid Monitoring | \$761 |
| 7.1.D.3.14 | Sensor IQ | Asset Analytics & Grid Monitoring | \$533 |
| 7.1.D.3.15 | EPIC 3.43: Momentary Outage Information | Asset Analytics & Grid Monitoring | \$1,358 |
| 7.1.D.3.16 | Wind Loading Assessments | Asset Analytics & Grid Monitoring | \$1,715 |
| 7.1.D.3.17 | EPIC 3.03: Advanced Distribution Energy Resource Management System | Foundational | \$1,496 |
| 7.1.D.3.18 | Advanced Distribution Management System (ADMS) | Foundational | \$1,000 ^(b) |

(a) Financial forecasts for emerging technology assessment or deployment projects are highly tentative as uncertainty regarding costs and functionality is very high for new technologies. The forecast shown reflects project costs only (not production costs if the results of the project lead to production), are estimates as of January 2021, and are subject to change, including but not limited to the fact that several of the project estimates remain TBD at this time. Costs beyond 2021 have not yet been defined given this level of uncertainty.

(b) This figure represents the portion of this project related to wildfire mitigation.

In accordance with Condition Guidance-9, the standardized project information is provided in the following format arranged according to the five Condition Items noted in that deficiency, with expansion by PG&E into multiple targeted, detailed responses:

| | |
|--|---|
| Condition Item (i): All pilot programs or demonstrations identified in WMP. | |
| The projects are summarized in the table above and the following is the template for the detailed reporting that is provided for each project, below. | |
| <i>Information Type</i> | <i>Description</i> |
| (i).A: Project Type | Either New Technology (Commercially Available Offering) or Emerging (Pre-commercial) Technology according to the definition provided in Section 7.1.D.1 above. |
| (i).B: Additional References in the 2021 WMP | Other sections where this project is also significantly detailed within the WMP. |
| (i).C: Section in the 2020 WMP | If applicable, the section number of this project in the New or Emerging Technologies section of the 2020 WMP. |
| (i).D: Project Objective and Summary | A summary of the project, including its wildfire mitigation-related objective and an indication of whether the project is progressing toward broader adoption, if known. For many new or emerging technology projects, it is not clear until late in the project lifecycle whether the results indicate that the technology is appropriate to be broadly adopted. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | PG&E is providing one or more UWMMM Categories and Capabilities potentially impacted, where anticipated. Due to the nature of new and emerging technology project developments, these potential Categories and Capabilities are subject to change. |
| Condition Item (ii): Status of the pilot, including where pilots have been initiated and whether the pilot is progressing toward broader adoption. | |

| <i>Information Type</i> | <i>Description</i> | | | | | | | | | | | | | | | | |
|--------------------------|---|---------------|------------|------------|--|----------|---|------------------------|--|---------|---|------------|--|----------|---|------------------------|--|
| (ii).A: Project Phase | <p>The project phase is reported according to the following definitions:</p> <table border="1"> <thead> <tr> <th>Project Phase</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>Initiation</td> <td>Project purpose and benefits defined Initial scope, schedule, budget Sponsor, stakeholders, project team defined</td> </tr> <tr> <td>Planning</td> <td>Business case including refined scope, schedule, budget and approvals Benchmarking for non-duplication, lessons learned, and industry best practices</td> </tr> <tr> <td>Design/ Engineering</td> <td>Detailed design, technical requirements, coordination Contracting</td> </tr> <tr> <td>Staging</td> <td>Review and confirmation of project alignment with purpose, benefits, scope, budget, schedule Key success factors defined</td> </tr> <tr> <td>Build/Test</td> <td>Build, test and demonstration Evaluation to defined metrics</td> </tr> <tr> <td>Closeout</td> <td>Path to production revised Lessons learned documented Decommissioning completed Final report</td> </tr> <tr> <td>Continuous Improvement</td> <td>Optional phase that some projects progress to when there is project-related continuous improvement activity post Closeout.</td> </tr> </tbody> </table> | Project Phase | Definition | Initiation | Project purpose and benefits defined Initial scope, schedule, budget Sponsor, stakeholders, project team defined | Planning | Business case including refined scope, schedule, budget and approvals Benchmarking for non-duplication, lessons learned, and industry best practices | Design/ Engineering | Detailed design, technical requirements, coordination Contracting | Staging | Review and confirmation of project alignment with purpose, benefits, scope, budget, schedule Key success factors defined | Build/Test | Build, test and demonstration Evaluation to defined metrics | Closeout | Path to production revised Lessons learned documented Decommissioning completed Final report | Continuous Improvement | Optional phase that some projects progress to when there is project-related continuous improvement activity post Closeout. |
| Project Phase | Definition | | | | | | | | | | | | | | | | |
| Initiation | Project purpose and benefits defined Initial scope, schedule, budget Sponsor, stakeholders, project team defined | | | | | | | | | | | | | | | | |
| Planning | Business case including refined scope, schedule, budget and approvals Benchmarking for non-duplication, lessons learned, and industry best practices | | | | | | | | | | | | | | | | |
| Design/ Engineering | Detailed design, technical requirements, coordination Contracting | | | | | | | | | | | | | | | | |
| Staging | Review and confirmation of project alignment with purpose, benefits, scope, budget, schedule Key success factors defined | | | | | | | | | | | | | | | | |
| Build/Test | Build, test and demonstration Evaluation to defined metrics | | | | | | | | | | | | | | | | |
| Closeout | Path to production revised Lessons learned documented Decommissioning completed Final report | | | | | | | | | | | | | | | | |
| Continuous Improvement | Optional phase that some projects progress to when there is project-related continuous improvement activity post Closeout. | | | | | | | | | | | | | | | | |
| (ii).B: Project Status | A summary of the current state of the project, with activity indicative of whether the project is progressing toward broader adoption. For many new or emerging technology projects, it is not clear until late in the project lifecycle whether the results indicate that the technology is appropriate to be broadly adopted. | | | | | | | | | | | | | | | | |
| (ii).C: Project Location | For field-based projects the general location is provided. For software or analytics-only projects, the area the project applies to is provided, such as to High Fire Threat Districts (HFTD) or systemwide. | | | | | | | | | | | | | | | | |

| Condition Item (iii): Results of the pilot, including quantitative performance metrics and quantitative risk reduction benefits. | |
|---|---|
| <i>Information Type</i> | <i>Description</i> |
| (iii).A: Results to Date | Results of pilot projects are provided through Q4 2020. Project results for prior quarters are included, either labeled by quarter or as Prior Results that may extend to the origin of the project. Results for pilot projects in phases preceding the Closeout phase, as defined in (ii).A, are preliminary and subject to change. |
| (iii).B: Lessons Learned | Lessons learned for pilot projects are technological learnings, findings, and key takeaways to inform a path to production. Lessons learned can also be barriers, issues, risk, or obstacles that if not solved could jeopardize the path to production. Lessons learned provided for projects in phases preceding the Closeout phase, as defined in (ii).A, are preliminary and subject to change. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field for each project listed in this section in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Quantitative performance metrics are provided, as they are known, and used in the evaluation of a technology including for whether a technology is effective and progressing toward broader adoption. PG&E acknowledges the need for, and value of, establishing quantitative performance metrics at the beginning of a project, and is continuing to improve these quantitative performance metrics for all of the projects included in this section.</p> |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field for each project listed in this section in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Quantitative risk reduction benefits that may result from adoption of the technology are provided, as they become better understood. Especially for the pre-commercial technology projects that are a part of this new or emerging technology portfolio, there is inherent uncertainty in the assumptions and estimates that are developed to create the quantitative risk reduction benefit. PG&E acknowledges the need for, and value of, establishing anticipated quantitative risk reduction benefits at the beginning of a project, and is continuing to improve these quantitative risk reduction benefits for all of the projects included in this section.</p> |

| | |
|---|---|
| Condition Item (iv): How the electrical corporation remedies ignitions or faults revealed during the pilot on a schedule that promptly mitigates the risk of such ignition or fault and incorporates such mitigation into its operational practices. | |
| <i>Information Type</i> | <i>Description</i> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | If the project, in any phase, identifies a potential ignition or fault risk condition (e.g., an in-field asset condition or configuration issue, or a vegetation issue), the potential condition is reported and validated against current PG&E preventive and corrective maintenance guidelines and treated in accordance. In addition, a general statement of such activity is provided in this response. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | Typically, methods to incorporate ignition or fault risk mitigation findings into operational practices are revealed toward the end of the projects as part of the lessons learned and other recommendations in the Closeout documentation. However, if PG&E identifies such risk mitigation methods to inform proposed changes to operational practices, including prior to the conclusion of the project, they will be included in this response. |

| | |
|---|---|
| Condition Item (v): A proposal for how to expand use of the technology if it reduces ignition risk materially. | |
| <i>Information Type</i> | <i>Description</i> |
| (v).A: 'End Product' at 'Full Deployment' and Location | For this response PG&E is providing the anticipated use of the technology, including anticipated locations, should the technology be proven to be successful and subsequently put into production. Given that the projects are in varying phases of development and precommercial technologies are inherently uncertain, this response is based upon our current understanding of the technology and its applicability to PG&E operations, and subject to change. Early stage projects may not have a clear strategy for the 'end product' at 'full deployment', while others such as those in the Continuous Improvement phase may have already been deployed. |

Forward-looking statements detailed through this section, including but not limited to project next steps, expected results, and potential quantitative risk reduction benefits, are subject to change due to the evolving nature of technology and drivers of system and public safety risk.

The projects described below are organized by Program Areas.

Program Area: Situational Awareness and Forecasting – New or Emerging Technologies

PG&E is deploying a set of complementary tools to better assess and more accurately locate, often in near real time, environmental events and grid conditions that pose a danger to the grid so that critical issues may be dealt with as quickly as possible to avoid the risk of catastrophic wildfires. Below are potential mitigations leveraging new or emerging technologies; for additional information please see Section 7.3.2.

7.1.D.3.1 SmartMeter Partial Voltage Detection

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | This project is described in Section 7.3.2.2.2: Situational awareness and forecasting - SmartMeter Partial Voltage Detection (Formerly Known as Enhanced Wires Down Detection) |
| (i).C: 2020 WMP Section | 5.1.D.3.4 |
| (i).D: Project Objective and Summary | <p>PG&E’s EPIC 1.14: Next Generation SmartMeter Telecom Network Functionalities project demonstrated that the SmartMeter Telecommunications Network (SMN) can support a variety of both present and future smart grid applications and devices, including using multiple types of outage reporting data from the SmartMeter network to better identify and differentiate wire down type outages and share information with distribution management systems more effectively. The SmartMeter Partial Voltage Detection (formerly known as Enhanced Wires Down Detection) project builds on this work to assess the ability to use SmartMeter technology to locate and identify partial voltage conditions to enable faster response to grid issues.</p> <p>A partial voltage condition can indicate the occurrence of a potentially hazardous distribution grid condition, including hazards that can contribute to wildfire risk. PG&E has enabled Single-Phase SmartMeters to send real-time alarms to the Distribution Management System under partial voltage conditions (25-75 percent of nominal voltage). Prior to implementation, SmartMeters electric meters could only provide real-time alarms for the outage state. For Three-Wire distribution systems, the partial voltage condition indicates one phase feeding the transformer has low voltage or no voltage. This enhanced situational awareness can help detect and locate the area boundaries between meters encountering normal voltage and those encountering partial voltage. This allows operators to detect and locate partial voltage line sections more quickly to enable faster response to potential wires down, open jumpers, or loss of phase(s) due to ungangued fuse operation. Phase 1 partial voltage detection technology has proven successful on 3-Wire distribution systems where transformers are connected line-to-line, and loss of phase results in a partial voltage condition whereby the communication card can detect and then send alerts to the Distribution Management System (DMS) during the event. Phase 1 of this project completed in 2019 included implementation on 4.5 million single phase SmartMeter electric meters covering 25,597 line miles of Tier 2 and Tier 3 HFTD areas. Phase 2 of this project is underway. It applies to ~365K 3-phase SmartMeter electric meters and relies upon the implementation of firmware detection of partial voltage conditions. The Phase 2 technology is intended to alert on partial voltage conditions on 4-Wire systems where transformers are connected line-to-neutral.</p> |

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| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | F. Grid operations and protocols: 27. Protective equipment and device settings |
| (ii).A: Project Phase | Phase 1: Closeout (~4.5 million single-phase meters have been in production since 2019). Phase 2: Design/Engineering (~365K three-phase meters in scope). |
| (ii).B: Project Status | Phase 1 is in production and has been deployed to ~4.5M meters. Phase 2 is in a development phase with the intent of deployment to 365K meters in Tier 2 and Tier 3 HFTDs by the end of Q2 2021, though this deployment intent is at risk due to a vendor product issue that is currently being assessed. |
| (ii).C: Project Location | Phase 1: Tier 2 & 3 HFTDs were initially targeted; now deployed system-wide. Phase 2: Targeting system-wide deployments. |
| (iii).A: Results to Date | Q3 2020/Q4 2020 Phase 2 Project Results: - Meter firmware vendor contract finalized. - Design of Distribution Management System (DMS) data presentation for operator use. - SmartMeter firmware functionality testing complete - SmartMeter firmware deployment planning complete |
| (iii).B: Lessons Learned | - In Phase 1, it was discovered that some abnormal SmartMeter electric meter conditions (e.g. failed power supply) can produce false positive partial voltage alerts. PG&E had to address these false positives by applying filtering strategies to prevent presentation to operators through the Distribution Management System (DMS). |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - Ability to detect open jumpers, partial operation of ungangled fuses, and wire down events (proven for 3-Wire systems in Phase 1; to be validated for 4-Wire systems in Phase 2). - Ability to incorporate partial voltage detection functionality into the DMS and operational processes. |
| (iii).D: Quantitative Risk Reduction Benefits | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - Improved visibility to distribution operators and dispatchers through DMS and Outage Management Tool (OMT) of situations where there is a possible partial voltage and/or wire down condition. - Improved locational identification of partial voltage outages to the DMS and OMT, and ultimately enabling more timely resolution of these issues, which can result in lower risk of wildfire ignition and/or spread. |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | Phase 1 - Currently in production. Phase 2 - None at this time. |

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| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | The methodology is to display filtered partial voltage alerts on transformers in DMS maps, which allows operators to be alerted of partial voltage conditions and visualize the boundaries between full voltage, partial voltage and complete outage sections of the distribution system. Integration into the Outage Management Tool will summarize SmartMeter partial voltage alert counts in an informational table presentation for current outages. The enhanced situational awareness can help operators detect and locate partial voltage line sections more quickly to enable faster response to potential wires down, open jumpers, or loss of phase(s) due to ungangged fuse operation. |
| (v).A: 'End Product' at 'Full Deployment' and Location | The end product is that the partial voltage detection firmware will be deployed to all compatible PG&E SmartMeter electric meters system-wide, with system optimization completed, and functionality integrated into the Distribution Management System and Outage Management Tool, as described in (iv).B above. |

7.1.D.3.2 Line Sensor Devices

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| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | Section 7.3.2.2.5: Situational Awareness & Forecasting – Line Sensor Devices |
| (i).C: 2020 WMP Section | 5.1.D.3.5 |
| (i).D: Project Objective and Summary | Line Sensors are primary conductor-mounted devices that continuously measure current in real-time and report events as they occur, and in some cases the current waveform of grid disturbances. These line sensors are next-generation fault indicators with additional functionality and communication capabilities. Line Sensor technology can reduce wildfire risk and improve public safety by continuous monitoring of the grid, performing analytics on captured line disturbance data, identifying potential hazards, and when necessary dispatching field operations to proactively patrol, maintain, and repair discovered field conditions or assets on the verge of failure. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | F. Grid operations and protocols: 27. Protective equipment and device settings |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | Line sensors have been deployed on 60 feeders covering a total of 4,898 circuit miles in Tier 2 & 3 HFTDs. On a daily basis, the data from these sensors are being used to investigate the source of unknown cause outages. |
| (ii).C: Project Location | Tier 2 & 3 HFTD in the North Bay, Sonoma, North Valley, Humboldt, Yosemite, and Sierra divisions. |

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| (iii).A: Results to Date | <p>Q3 2020/Q4 2020</p> <ul style="list-style-type: none"> - Developed line risk evaluations based on line sensor and other data for select HFTD circuits to calculate location of potential issues. Informed field operations for further inspection/assessment/maintenance. - Continued device deployment to circuits in HFTDs in the Humboldt, Stockton, Yosemite, and Sierra divisions. - Improved analytics methods and automation. |
| (iii).B: Lessons Learned | <ul style="list-style-type: none"> - When combined with other data sources, line sensor devices contribute valuable data to enable proactive condition detection. - Inputs from other sensors and systems as well as analytics are required to improve accuracy and results. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - Effectiveness in detecting incipient faults with a low level of false positives. |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Line sensors are being used to identify unresolved outage sources such as suspected momentary vegetation contact or other outages that generate momentary or sustained outages where a problem is not found during patrol. By using the line sensor data, we can use the improved locational information and fault type to generate more specific investigation patrol information. By addressing these outage types more proactively, we can resolve many of the conditions prior to fire season and high fire threat days.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | <p>When a suspected high-risk condition is found by the Line Sensor Device team, the local restoration team is alerted and dispatched to patrol and rectify the situation as needed.</p> |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <p>PG&E is using data provided by line sensor technologies to bolster asset health and performance through a three-step process: (i) Collecting line sensor data attributes on disturbances to create a database of disturbance signatures for disturbance evaluations; (ii) Detecting disturbance information from Tier 2 and Tier 3 HFTDs and matching the captured disturbance data against the signature database to determine if a distribution line risk is likely to materialize as a hazard; (iii) Matching line sensor data attributes on line risks in a manner in which they can be evaluated in the distribution network model software to estimate the location of the line risk for proactive field patrol, inspection, and repair, if necessary, before failure to reduce risk and improve system safety.</p> |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | <p>This product is one component of a set of grid sensor technologies (as described in 7.3.2.2 Continuous Monitoring Sensors) that, as a set, are optimized to support and complement each other. This product would be deployed to circuits in Tier 2 & 3 HFTDs and would be integrated into Distribution Control Center, Maintenance, and Field Operations functions to support faster fault identification (including location data) for proactive maintenance prior to high fire risk periods.</p> |

Program Area: Grid Design and System Hardening—New or Emerging Technologies

PG&E is reducing the risk of fire ignition and potential impacts on public safety through the adoption of system hardening methods enabled through innovative technologies (e.g. new grid topologies or new resilience and PSPS avoidance technologies or techniques). Mitigations leveraging new or emerging technologies include the following:

7.1.D.3.3 EPIC 3.15: Proactive Wires Down Mitigation Demonstration Project (Rapid Earth Fault Current Limiter)

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | 7.3.3.17.4 |
| (i).C: 2020 WMP Section | 5.1.D.3.6 |
| (i).D: Project Objective and Summary | The EPIC 3.15 Proactive Wires Down Mitigation demonstration project seeks the ability to automatically and rapidly reduce the flow of current and risk of ignition in single phase to ground faults through the use of Rapid Earth Fault Current Limiter (REFCL). REFCL works by moving the neutral line to the faulted phase during a fault, which significantly reduces the energy available for the fault. This significantly lowers the energy for single line to ground faults by reducing the potential for arcing and fire ignitions, as well as better detection of high impedance faults and wire-on-ground conditions. REFCL technology is applicable to three-wire unit-grounded circuits, which make up the majority of PG&E's distribution circuits within HFTDs. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid design and system hardening: 14. Risk-based grid hardening and cost efficiency 15. Grid design and asset innovation |
| (ii).A: Project Phase | Design/Engineering |
| (ii).B: Project Status | All of the REFCL system equipment has been installed and initially tested. Further commissioning of the system is ongoing (as of late January) and a comprehensive testing program will begin in March 2021, with the project completed by July 2021. Based on feedback from Australian utilities who have leveraged this technology, ongoing observation and adjustment of various system parameters may be needed to “fine-tune” the REFCL system going forward. Evaluation of additional substations for suitability of REFCL installations has begun but is pending results and learnings of the Calistoga pilot project before design or field work starts on additional sites. |
| (ii).C: Project Location | Substation in a Tier 3 HFTD in the North Bay. |

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| (iii).A: Results to Date | <p>Q4 2020</p> <ul style="list-style-type: none"> - Completed substation construction and all the distribution field installations in Q4 2020. |
| (iii).B: Lessons Learned | <ul style="list-style-type: none"> - The Ground Fault Neutralizer (GFN) adds on another layer of system protection with greater sensitivity to ground faults than traditional system protection schemes commonly used in the USA which utilize solid grounding. In digital simulation testing, the GFN showed the capability to detect high impedance ground faults upwards of 16K ohms, which is in the typical range for vegetation contact faults. The GFN also shows promise of detecting reverse earth faults resulting from specific wires-down situations, which are especially challenging to detect and pose a public safety risk. - A key lesson learned is the need for balancing the line to ground capacitance of each phase on the distribution circuits where a GFN is deployed. A detailed review was performed in the project and it highlighted the need for capacitive balance units to have precise control over the balancing and achieve the greatest fault sensitivity. Group tapping for line voltage regulators was also determined to be required, so a new multiphase regulator controller was tested and verified for this function. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - Performance as compared to fault response time performance standards <ul style="list-style-type: none"> - Faulted conductor voltage < 1,900 V within 85 ms - Faulted conductor voltage < 750 V within 500 ms - Faulted conductor voltage < 250 V within 2,000 ms - Identifying faulted circuit |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>REFCL may be able to reduce the likelihood of ignitions for certain types of single line to ground faults. This reduction in ignition likelihood would reduce the wildfire risks for those lines that have REFCL installed.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | <p>The GFN will be operational in the North Bay substation to add another layer of system protection to the two connected distribution circuits. If a ground fault is detected, the GFN will autonomously mitigate the fault current and identify which circuit the fault is on. Pre-defined criteria will determine how the fault is cleared, whether through recloser tripping or cutover to solid grounding depending on ambient conditions.</p> <p>The plan for additional production implementations of the technology is in development.</p> |

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| <p>(iv).B: Methods to Incorporate Project Findings Into Operational Practices</p> | <p>A Substation Earth Fault Management relay interface controller is currently in development and is needed to integrate the GFN into operational practices and the SCADA system. Operators will have visibility into the status of the GFN and make control decisions if a fault is detected.</p> <p>Training sessions with operations personnel are being scheduled showing how the REFCL technology works and the associated controls.</p> |
| <p>(v).A: 'End Product' at 'Full Deployment' and Location</p> | <ul style="list-style-type: none"> - The end product is that the REFCL system would be deployed to substations in Tier 2 and 3 HFTDs, including substation components (arc suppression coil, GFN control cabinet, residual current compensator, and potentially upgraded CTs and relays) and field work (capacitive balancing, upgraded line reclosers, and upgrades to regulators, capacitor banks, and insulation levels as needed). - Capacitive planning incorporated into annual distribution planning cycle. - Capacitive operational analysis incorporated into planning and analysis of planned and unplanned outages. - Annual training for field personnel who would interact with the system, distribution operations, and distribution engineering. - Annual testing of circuit and REFCL system to check reliability/sensitivity of REFCL system operations and insulation tests to detect equipment that is overly stressed and likely to fail during REFCL operation. |

7.1.D.3.4 Distribution, Transmission, and Substation: Fire Action Schemes and Technology

1. Note: Due to the sensitive nature of the experimental, proprietary technology, PG&E is unable to disclose extensive details about the DTS-FAST pilot project in public filings. Upon request, PG&E can provide further information under confidentiality protections.

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | 8.1 |
| (i).C: 2020 WMP Section | 5.1.D.3.7 |
| (i).D: Project Objective and Summary | DTS-FAST is an internal PG&E development and is currently in pilot phase. This technology pilot aims to use fraction-of-a-second technologies to detect objects approaching energized power lines and respond quickly to shut off power before object impact. PG&E is implementing a pilot to engineer, construct, install and monitor a new technology on a PG&E transmission circuit to assess the technology's efficacy at mitigating PG&E's wildfire and safety risks. Next steps and potential operationalization of this technology is dependent on an assessment of pilot findings. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid design and system hardening: 12. Grid design for minimizing ignition risk 15. Grid design and asset innovation |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | Pilot construction on a 115 kilovolt (kV) transmission circuit is 70 percent completed. |
| (ii).C: Project Location | Proof of concept completed at San Ramon, CA. Pilot being constructed on a 115kV transmission circuit. |
| (iii).A: Results to Date | Q3 2020/Q4 2020 - Engineering and construction details completed for pilot on 115kV transmission circuit. |
| (iii).B: Lessons Learned | - Proof of concept model was tested and retested to confirm the technology, as designed, would meet the detection, speed and signal confirmation requirements for subsequent testing through a pilot. |

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| <p>(iii).C: Quantitative Performance Metrics</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - Ability to provide real-time signals from field demonstrating detection and/or non-detection. - All equipment with DTS-FAST must withstand harsh environmental conditions and remain operable. - Displays representing field conditions must accurately reflect equipment-health conditions between the field and points monitored. - The location and type of equipment failure must be detected at high level of accuracy. - Visual cameras must work under high voltage and high EMF conditions. - DTS-FAST must detect failure conditions in scope for project. |
| <p>(iii).D: Quantitative Risk Reduction Benefits</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Wildfire risk reduction benefits, as described in (i).D above, are dependent upon assessment of pilot findings.</p> |
| <p>(iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices</p> | <ul style="list-style-type: none"> - Assess optimal locations for technology implementation. - Engage technology vendors for hardware needs. - Secure resourcing required for targeted implementation, including mitigation strategy for potential COVID-19 impacts. |
| <p>(iv).B: Methods to Incorporate Project Findings Into Operational Practices</p> | <ul style="list-style-type: none"> - Leverage pilot findings for operational implementation. - Monitor new installations and assess success criteria to ensure technology is working optimally. - Assess impacts on asset inspections enabled through real time sensor data. - Assess impacts on ability to reduce PSPS events and expedite restoration times. |
| <p>(v).A: ‘End Product’ at ‘Full Deployment’ and Location</p> | <p>Full deployment plans will be dependent on findings of pilot. If successful, PG&E will consider a targeted approach to post-pilot implementation to help ensure high impact areas are first addressed, taking into account risk-based and feasibility assessments.</p> |

7.1.D.3.5 Remote Grid

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| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | 7.3.3.17.5 |
| (i).C: 2020 WMP Section | 5.1.D.3.8 |
| (i).D: Project Objective and Summary | <p>A “Remote Grid” is a new concept for utility service using standalone, decentralized energy sources and utility infrastructure for continuous, permanent energy delivery in lieu of traditional wires to small loads in remote locations at the edges of the distribution system. In many circumstances, the feeders serving these remote locations traverse through HFTDs areas. If these long feeders were removed and the customers served from a local and decentralized energy source, the resulting reduction in overhead lines could reduce fire ignition risk as an alternative to or in conjunction with system hardening. In addition to reducing wildfire risk, Remote Grid could be a cost-effective solution against expense and capital costs for the rebuild of fire-damaged infrastructure or for HFTD hardening infrastructure jobs to meet new HFTD build standards.</p> <p>PG&E’s Remote Grid Initiative will validate and develop Remote Grid solutions as standard offerings such that they can be considered alongside or as an alternative to other service arrangements and/or wildfire risk mitigation activities such as system hardening. The findings of other pilot or demonstration projects, including EPIC 3.03: Advanced Distribution Energy Resource Management System, which looks to develop increased situational awareness and control capabilities of DERs, will help to support the deployment of remote grid configurations.</p> |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>C. Grid design and system hardening:</p> <ul style="list-style-type: none"> 12. Grid design for minimizing ignition risk 13. Grid design for resiliency and minimizing PSPS 14. Risk-based grid hardening and cost efficiency |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | The projects are advancing through scoping, assessment, contracting, design, and permitting activities, building understanding of the many aspects required for a successful Remote Grid. The three leading projects (some comprising five remote grid sites) are in the permitting and construction stages. Initial projects have been delayed due to unforeseen permitting delays due to presence of threatened species. Additional sites under consideration are undergoing detailed feasibility assessment to address constructability and customer acceptance before down selecting to a complete set of initial projects. |
| (ii).C: Project Location | Three initial remote grid projects (some comprising multiple remote grid sites) are in Mariposa and San Luis Obispo counties. Additional projects in HFTDs in El Dorado, Madera, Fresno, Tulare, Santa Barbara, Yuba, and Sierra counties are currently being assessed. |

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| (iii).A: Results to Date | <p>Q2 2020</p> <ul style="list-style-type: none"> - Completed field site visits to identify additional projects to pursue for concept validation. - Completed first broad RFP solicitation which was received by more than 20 technology integration and construction vendors, delivering initial validation of commercial availability. <p>Q3 2020</p> <ul style="list-style-type: none"> - Developed and awarded major update of contract, including updated technical specification. - Documented detailed protocol to identify and evaluate potential projects. <p>Q4 2020</p> <ul style="list-style-type: none"> - Negotiated & executed a turnkey Purchase and Sale Agreement and a 10-year full-wrap Maintenance Agreement, forming a reusable template for future Standalone Power System procurements. - Drafted terms of service into a form of Supplemental Provisions to the Electric Rules, as a tariffed form agreement. - The majority of customers engaged to date have voiced positive initial interest in pursuit of service conversion from overhead line to a Remote Grid. - Filed the proposed form of Supplemental Provisions Agreement with the CPUC in Advice 6017-E^(a) on December 15, 2020. - Benchmarking with other utilities shows a point of validation in the advanced program now operational under Horizon Power in Western Australia. In California, Liberty Utilities has procured its first Standalone Power System for a similar application. |
| (iii).B: Lessons Learned | <ul style="list-style-type: none"> - PG&E identified the technology combination of Solar Photovoltaic Generation and Battery Energy Storage with supplemental Propane Generators as the most cost effective, reliable, and cleanest solution for initial Remote Grid sites. - PG&E found there was sufficient initial vendor interest and availability to engage in contracting to deploy systems with specifications and terms responsive to PG&E's requirements. - A number of site-specific conditions can reduce individual project feasibility or delay implementation. Examples include: customer acceptance, physical space constraints, shading and other constructability related considerations such as grading and geological conditions, permitting challenges such as presence of threatened species, cultural heritage, or adjacency to scenic highway. |
| <hr/> <p>(a) See Advice 6017-E "Remote Grid Standalone Power System Supplemental Provisions Agreement" https://www.pge.com/tariffs/assets/pdf/advicelatter/ELEC_6017-E.pdf.</p> | |

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| <p>(iii).C: Quantitative Performance Metrics</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>The project success criterion is the establishment of proof that a complete Remote Grid system can be installed and operated at an economically viable price point while meeting safety, performance, and reliability requirements.</p> <p>Potential metrics include:</p> <ul style="list-style-type: none"> - Cost of deployed stand-alone power system and forecasted future expense compared to the cost of other wildfire risk mitigations considered (e.g. undergrounding, overhead hardening). - Number of overhead line miles removed. -Stand-alone power system reliability (i.e. uptime). - CO₂ Emissions from Standalone Power Systems - Project cycle time duration (deployment speed from start to finish). |
| <p>(iii).D: Quantitative Risk Reduction Benefits</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>The anticipated benefit of Remote Grid is to reduce the wildfire ignition risks related to overhead distribution infrastructure. Remote Grid may be able to cost-effectively substitute for other options in an eventual volume of locations which could make a meaningful impact to the overall cost and risk reduction of the larger System Hardening portfolio. The more cost effective the solution turns out to be, the more locations it may reach, and the greater the benefit to the combined portfolio.</p> |
| <p>(iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices</p> | <p>The initial projects under way in 2020 are positioned as fully featured, long-term asset deployments with performance and reliability targets that will result in these projects eliminating segments of overhead line exposure. When these projects go online, an immediate ignition risk reduction can be realized upon de-energization of the infrastructure they replace.</p> |
| <p>(iv).B: Methods to Incorporate Project Findings Into Operational Practices</p> | <p>Standardization of to-be-proven Remote Grid site assessment and deployment processes, technical specifications, vendor contract templates, identification of qualified providers, and operational protocols (e.g. outage detection and response coordination) are needed to enable more rapid deployment of potential future Remote Grids. Further validation of the actual costs and lead time to deliver utility-grade performance and reliability will enable understanding of how widespread the benefits of this approach may be, relative to the occurrence of the requisite grid topology existing on the PG&E distribution system today. For instance, it is more likely that a Remote Grid would be appropriate at the end of an overhead distribution feeder with small numbers of customers.</p> |
| <p>(v).A: ‘End Product’ at ‘Full Deployment’ and Location</p> | <p>If this project is determined to be successful, the Remote Grid concept would be developed as a standard service offering and considered alongside other risk mitigations, such as overhead hardening and undergrounding, and deployed wherever it is cost effective and feasible. Possible appropriate deployment locations would be at the ends of overhead distribution feeders that serve small numbers of customers in HFTDs.</p> |

7.1.D.3.6 EPIC 3.11: Multi-Use Microgrid

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.9 |
| (i).D: Project Objective and Summary | The EPIC 3.11: Multi-Use Microgrid demonstration project develops and tests the technology, processes, and business models needed to deploy and operate multi-customer microgrids that are integrating third party-owned renewable energy generation assets to power the microgrid on a section of PG&E's distribution system. This includes the design and development of control specifications and SCADA integrations to maintain visibility and operational control of the microgrid in grid-connected and islanded modes. The findings of this project will help support microgrid growth to further resiliency and enhanced customer choice. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid design and system hardening: 13. Grid design for resiliency and minimizing PSPS |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | Functional design specification for the microgrid controller and the end to end integration network architecture and security approach have been finalized. Operational decisions for the microgrid including for communication and hardware fail-safes were evaluated in order to prepare the microgrid for integration at the Distribution Control Center. This specification along with the completed Concept of Operations (CONOPs) documentation is now being used to complete PG&E's advanced microgrid testbed. This pilot is progressing towards broader adoption, including creating standards and tariffs that would be needed to enable PG&E to partner with third parties (such as communities) and deploy microgrids. |
| (ii).C: Project Location | McKinleyville (Humboldt County). The project, the Redwood Coast Airport Microgrid, serves the Arcata-Eureka Airport business community incorporating 18 PG&E and Redwood Coast Energy Authority customers, including critical facilities such as the airport and a United States Coast Guard station. |
| (iii).A: Results to Date | <p>Prior Results</p> <ul style="list-style-type: none"> - Provided key feedback to microgrid controller manufacturers to inform the development of the Functional Design Specification document - Developed guideline questions for future microgrid controller testing beyond this project in order to support standardization. <p>Q3 2020</p> <ul style="list-style-type: none"> - Started SCADA design (in progress) - Refined Functional Design Specification. - Completed communication and hardware fail-safes decisions <p>Q4 2020</p> <ul style="list-style-type: none"> - Configuration of information points list and human-machine interface - Controller Test Plan aligned with third-party manufacturer - Utilized lessons learned from this project to publish a Community Microgrid Technical Best Practices Guide |

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| (iii).B: Lessons Learned | <ul style="list-style-type: none"> - In order to ensure reliability and mitigate customer power loss, circuits should be designed to allow microgrid mode transitions to be seamless. - Verify prior to system design that preferred communication systems, such as the FAN, are available - Ensure clear designation and separation of stakeholder responsibilities, particularly between the utility and the microgrid generation owner/operator. - Defining if microgrid will be allowed to operate under certain fail-safe conditions requires strong operator buy-in and participatory planning. The process used for this project can serve as a useful guide for future microgrid deployment. - Because each microgrid configuration is unique it may not be possible to fully standardize and streamline processes and technology to be applicable for all microgrids. Future frameworks will need to be flexible to accommodate unique project needs. - Future project economics will likely differ significantly from the EPIC-funded Redwood Coast Airport Microgrid project and could be a major barrier to future scalability of multi-customer microgrids. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>The pilot and broader deployment success criteria are:</p> <ul style="list-style-type: none"> - Successful operation of the project’s multi-customer microgrid (the Redwood Coast Airport Microgrid) to satisfy community demand for enhanced resilience including seamless transitions between normal grid-connected and islanded modes of operation. - Validation that this multi-use microgrid model is replicable, scalable, and can inform the design of other multi-customer microgrids. |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>This project’s wildfire risk reduction benefit is related to its replicability of future microgrids in HFTDs. The processes, standards, and tariffs developed and tested out in this project will directly inform the development of other microgrid supporting programs such as the Community Microgrid Enablement Program. Overall, Microgrids reduce the impact of PSPS by providing power to safe-to-energize regions during wildfire threats.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | <ul style="list-style-type: none"> - Controller testing in PG&E’s Microgrid Test Bed is being designed to be replicable and scalable to a wide range of microgrid controllers. This will facilitate the deployment of control schemes for future microgrid sites. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <ul style="list-style-type: none"> - This project is designing the microgrid to be visible and controllable from the PG&E control center. Its operational guidebook will be the basis for integrating future microgrids of this kind into the control center operations. - A microgrid operating agreement is being developed and will form the basis of similar agreements for future community microgrids. |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | <p>Full deployment for this project is a permanent and in-field microgrid at Arcata-Eureka Airport, with visibility and control from PG&E control center. The formalization and documentation of a repeatable process will enable a streamlined approach to deploying additional Multi-Use Microgrids as appropriate in HFTDs.</p> |

Program Area: Asset Management and Inspections—New or Emerging Technologies

PG&E is developing new inspection tools and methods to quickly identify issues and proactively manage asset and system maintenance. This in turn reduces the risk of asset failure and potential impacts on our customers. PG&E is leveraging existing technologies, including remote sensing technologies such as LiDAR data and drone imagery capture³, to accurately identify risks, including encroachment clearance and vegetation health. Combined with machine learning software, remote sensing data are being evaluated to identify dead or dying trees that could pose wildfire hazards or contribute to a wires-down situation. Mitigations leveraging new or untested technologies include the following:

7.1.D.3.7 Enhanced Asset Inspections—Drone/AI (Sherlock Suite)

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| (i).A: Project Type | New Technology (Not Widely Commercialized) |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.10 |

³ Future drone technology adoptions are dependent upon FAA regulations for Line of Sight requirements. If exceptions are granted to these requirements, PG&E will have the opportunity to consider new or untested drone technology use cases such as: (i) extended line of sight operations for greater crew efficiency; (ii) autonomous flight paths to expedite drone inspections; (iii) new charging methods that leverage existing asset infrastructure to minimize charging time and increase flight time.; and (iv) new data processing techniques that minimize data hand off processes by capturing and processing data in-air, allowing for greater in-air operation.

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| <p>(i).D: Project Objective and Summary</p> | <p>In 2019, PG&E collected more than 2.5 million high-resolution images (up to 100 megapixel) of our Electric Transmission assets through drones, helicopters, and other means of data capture as part of our enhanced inspection program (WSIP), and has collected an additional 2.5 million images in 2020 as a part of the aerial inspection program. This imagery, when labeled appropriately, can be used to train computer vision models to identify specific components, and in some cases, evaluate the condition of those components. To address this, PG&E is developing an application, Sherlock, to bolster its data visualization capabilities.</p> <p>Sherlock is a web application that allows inspectors to view photographs of assets along with associated data. Sherlock allows for remote access to data captured through drone/helicopter images and enables a review of said data to ensure that only corrected data is viewed by inspectors, reducing the time from flight to inspection. In addition, inspectors can markup issues within the inspection profile of the application, which generates the necessary documentation from the application itself, ensuring auditability and data quality. This documentation provides PG&E with increased data management, reporting, and audit capabilities.</p> <p>The markups from Sherlock feed into computer vision models. Computer vision models are being trained to classify photos, identify asset components, and search for potential issues in an automated fashion. Models within the inspection flow are currently being used to flag select images (e.g. overview, right of way, asset tag) for inspectors. Inspectors can label data and provide feedback on the predictions which improves the models over time while reducing the inspection time and increasing inspection quality. Further, building and improving these models provides opportunities to use computer vision to flag images for review before humans see them, for prioritizing assets/lines for inspection, for identifying asset inventory, and as inputs to models that predict future asset failure.</p> |
| <p>(i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted</p> | <p>D. Asset management and inspections:</p> <ul style="list-style-type: none"> 16. Asset inventory and condition assessments 18. Asset inspection effectiveness 20. Quality Assurance/Quality Control (QA/QC) for asset management |
| <p>(ii).A: Project Phase</p> | <p>Build/Test</p> |
| <p>(ii).B: Project Status</p> | <p>The Sherlock Suite now includes six different profiles for different types of users across the aerial inspection program, in addition to a number of object detection and image classification models. Four AI models are currently in production, classifying images of “standard items” to reduce overall inspection time. Additionally, seven manual processes have been completely automated since the beginning of this project, and the teams are working to further automate manual steps so that inspectors can focus on looking for potential issues on assets.</p> |
| <p>(ii).C: Project Location</p> | <p>Systemwide Applications</p> |

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| <p>(iii).A: Results to Date</p> | <p>Q2 2020 The following items were delivered:</p> <ul style="list-style-type: none"> - Remote image load (cloud to cloud). - Image quality assurance capabilities. - Near real-time tracking of remote inspections within Sherlock. - Created a model to classify images of the top of a structure. - Improved data pipeline, and improved application security. - C-hook detection capabilities. <p>Q3 2020</p> <ul style="list-style-type: none"> - Ability to view completed inspections and potential emergency tags in the post-Inspection quality check profile - Line level reporting and prioritization. - Standardization of items predictions (level 1 automation). - Development of multi component detection capabilities. - Development of bird nest detection. - Development of C-hook wear classification. <p>Q4 2020</p> <ul style="list-style-type: none"> - Ability for post inspection QC with automated tracking within Sherlock - Inspection form built within Sherlock, writing to system of record directly - Bird nests flagged for inspectors using AI - Ability to add new AI models to detect potential failures to the inspector profile - Ability to run AI models at scale against millions of images in a cost-effective manner - Ability for pre-inspection QA to occur within Sherlock - Development of insulator detection, damaged cross-arm detection AI models |
| <p>(iii).B: Lessons Learned</p> | <p>Research shows that introducing AI can affect behavior. For example, introducing automation, if not done carefully, can lead to human error due to fatigue or complacency. We are consistently measuring behavior to ensure safety of the inspection processes. As a result of this learning, we are starting our AI deployments with standard items, such as images of asset tags, overview image, access path, etc. before deploying failure detection models into production.</p> |
| <p>(iii).C: Quantitative Performance Metrics</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - Reduction in time from imagery capture to inspection – started tracking in Q2 2020 - Reduction to imagery inspection times (cumulative) – tracking since 2019 - Upgrade/downgrade rate improvements (inspection quality) – anticipated by Q1 2021 |
| <p>(iii).D: Quantitative Risk Reduction Benefits</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Wildfire risk reduction benefits are anticipated though are not proven at this time.</p> |

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| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | This technology is already in use by remote inspectors. Models within the inspection flow are currently being used to flag select images (e.g. overview, right of way, asset tag) for inspectors, to help focus inspection efforts on potential ignition risks. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | See reporting input (iv).A. |
| (v).A: 'End Product' at 'Full Deployment' and Location | Sherlock is in production and being used by different user groups across the transmission aerial inspection process. We continue to release new features on a regular basis. Future state developments include additional remote inspection processes for transmission, distribution, and substation. Potential capabilities to further enable inspectors, supervisors include: (i) data and imagery quality checks and assurance, (ii) data and imagery quality assurance, and (iii) artificial intelligence enabled search functionalities. Advanced deployments of computer vision models could allow auto-filling inspection forms, automatic flagging of asset issues, and flagging of image quality issues. Additionally, instrumentation to measure inspection quality throughout the process, as well as writing back to source systems (e.g. SAP, GIS), may be considered. |

7.1.D.3.8 Below Ground Inspection of Steel Structures (Steel Transmission Structure Corrosion Assessment and Mitigation Pilot)

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| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | 7.3.4.10 |
| (i).C: 2020 WMP Section | 5.1.D.3.12 |
| (i).D: Project Objective and Summary | PG&E is implementing a pilot that will regularly inspect steel assets below groundline to detect steel corrosion and concrete degradation that may compromise structural integrity, with the goal of reducing risk of steel assets in the transmission steel structures. To inspect below ground, the foundations/footings of steel towers and poles are excavated and evaluated for structural integrity, including measuring steel member material section loss and collecting environmental and soil data (soil resistivity, pH, structure to soil potential/DC voltage, reduction-oxidation reaction). Repairs and mitigations would then be prioritized, based on the field evaluations and soil samples, in combination with other evaluations of tower/structure and overhead assets. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | D. Asset management and inspections: 16. Asset inventory and condition assessments |
| (ii).A: Project Phase | Planning |
| (ii).B: Project Status | We continue to evaluate potential contractors prior to finalizing contracts. |
| (ii).C: Project Location | Approximately 1000 locations throughout the PG&E service territory, including in HFTDs, are planned. |

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| (iii).A: Results to Date | <p>Prior Results</p> <ul style="list-style-type: none"> - Data analysis and project definition. - Structure selection and reaching out to contractors. - Designing the Field Experimentation through a selection of measurements that will provide PG&E the answers sought. <p>Q3 2020/Q4 2020</p> <ul style="list-style-type: none"> - Project scope finalized - Structures for testing identified - Field operations processes and methods for project implementation documented. |
| (iii).B: Lessons Learned | None to date. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - We anticipate the following performance metrics: <ul style="list-style-type: none"> - Assessing ~1000 transmission structure footings. - Documentation of data inputs including soil resistivity, depth of water table, drainage conditions - to contribute to asset health assessment. - Ability to apply analytics from data collected for insights to inform cathodic protection preventative maintenance programs - Ability to apply advanced analytics to the data will improve risk assessment of structures. - Post project closeout, comparison of below ground corrosion with above ground conditions to evaluate for potential correlations. |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>This pilot aims to provide data as to the Asset Health of the below ground foundation of selected steel structures. The knowledge gathered will help the Asset Management and Civil Engineering teams identify required intervention (repair/replace recommendation) and provide a measure of structural design performance over the asset’s service life to reduce the risk of structure failure and reduce the probability of an associated wires-down event that could cause wildfire ignition.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | If the project proves successful, it will provide high quality data inputs that can be used to inform asset maintenance decision-making. PG&E will assess findings and identify next steps based on findings of the project, including an assessment of the accuracy of estimating below ground corrosion based on above ground conditions. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <ul style="list-style-type: none"> - Data can be integrated into asset management data models to help prioritize asset maintenance practices based on risk assessments. - Depending on findings of below ground corrosion conditions, PG&E may consider deploying cathodic protection to better protect from corrosion impacts. The pilot would help dictate where cathodic protection would be most impactful. |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | <ul style="list-style-type: none"> - Broader implementation of below ground inspection of steel structures - Data integrated into asset management data models to help prioritize asset maintenance practices based on risk assessments - Depending on findings of below ground corrosion conditions, PG&E may consider deploying cathodic protection to better protect from corrosion impact. |

7.1.D.3.9 EPIC 3.41 – Drone Enablement

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| (i).A: Project Type | New Technology (Not Widely Commercialized) |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | This project was mentioned at the end of Section 5.1.D.3 New or Emerging Technologies – Project Summaries as a project that PG&E may pursue within EPIC. |
| (i).D: Project Objective and Summary | <p>This project proposes to test the following two hypotheses:</p> <ol style="list-style-type: none"> 1. Transmission Line & Substation Inspections: Automated and Beyond Visual Line of Sight (BVLOS) drone flight operations can offer a more accurate, safe and more efficient alternative to Transmission Line & Substation asset inspection than today’s manual drone operations. 2. Distribution Alert Verification: Automated and BVLOS drone operations can provide a fast, safe and effective solution for field-validating the range of alerts that will be produced through the predictive sensors that are planned to be deployed across the distribution system. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>D. Asset management and inspections:</p> <ol style="list-style-type: none"> 16. Asset Inventory and condition assessments 17. Asset inspection cycle 18. Asset inspection effectiveness 19. Asset maintenance and repair |
| (ii).A: Project Phase | Design/Engineer |
| (ii).B: Project Status | The project was officially launched in August 2020. The internal project team has been staffed, and the team has partnered with an external expert of drone technology and the FAA regulatory requirements and process to provide critical support during the Design/Engineering phase of the project. The team has developed a preliminary project plan and has begun to document the details of each planned use case. These use cases will be translated into a Concept of Operations (CONOPS) document and then translated into technical requirements for the upcoming Request for Proposals (RFP) to identify a drone vendor partner. The team has also begun preliminary coordination with the FAA. |
| (ii).C: Project Location | Project location is TBD. The team is actively working with the consultant on site selection parameters that will both support the project’s objectives and meet FAA requirements for BVLOS operations. |
| (iii).A: Results to Date | <p>Q3 2020</p> <ul style="list-style-type: none"> - Business Plan approved <p>Q4 2020</p> <ul style="list-style-type: none"> - Expert drone consultant onboarded - Project schedule established - Use case questionnaire form completed (transmission, substation & distribution) for CONOPS development - Slide deck for discussion with FAA drafted - Initial RFP invitee list drafted |
| (iii).B: Lessons Learned | None to date. |

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| <p>(iii).C: Quantitative Performance Metrics</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Transmission & Substation Inspections:</p> <ul style="list-style-type: none"> - Number of automated flight plan proposals approved - Number of automated flights conducted within Visual Line of Sight (VLOS) - Number of automated flights conducted BVLOS - percent reduction in time of automated inspection compared to equivalent manual inspection - Quality of data captured compared to data captured manually - Number of automated drone operations with flight issues/violations - Number of automated drone operations without flight issues/violations - Maximum uninterrupted drone flight time for drones equipped with in-flight battery recharging subsystem - Maximum non-stop flying range for drones equipped with in-flight battery recharging subsystem <p>Distribution Alert Verification:</p> <ul style="list-style-type: none"> - Number of automated flight plan proposals approved - Number of automated flights conducted within VLOS - Number of automated flights conducted BVLOS - percent reduction in time of automated alert verification compared to equivalent physical employee verification - Number of field validations that find asset issues requiring remediation - Maximum uninterrupted drone flight time for drones equipped with in-flight battery recharging subsystem - Maximum non-stop flying range for drones equipped with in-flight battery recharging subsystem <p>Relevant CPUC-approved metrics:</p> <ul style="list-style-type: none"> - Maintain / Reduce operations and maintenance costs - Criteria air pollution emission reductions - Public safety improvement and hazard exposure reduction - Utility worker safety improvement and hazard exposure reduction |
| <p>(iii).D: Quantitative Risk Reduction Benefits</p> | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Using automated drone dispatch and data capture to investigate alerts generated by sensors in the distribution system has the potential to improve the efficiency and effectiveness of proactive asset health monitoring in HFTDs.</p> |
| <p>(iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices</p> | <p>TBD</p> |
| <p>(iv).B: Methods to Incorporate Project Findings Into Operational Practices</p> | <p>TBD</p> |

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| (v).A: 'End Product' at 'Full Deployment' and Location | <p>1. Transmission & Substation Inspections: Scaled up version of the solution at the end of the EPIC project to extend to the broader set of Transmission lines and substations in HFTDs. Ability to collect imagery data utilizing an autonomous UAV for detailed inspections on all assets within scope.</p> <p>2. Distribution Alert Verification: Scaled up version of the solution at the end of the EPIC project to extend to the broader set of distribution assets in HFTDs. Improved integration between sensor alert system and drone system, with automated sharing of geospatially referenced alerts. Command and control application to monitor and track health and status of the fleet of drones and suggest which drone to deploy for inspection or field validation based on location, range, charge level, weather and other relevant factors. Potentially also a consolidated physical mission control center within a Distribution Control Center for operational management and situational awareness of the fleet of drones. Interfaces between the drone system and additional field sensor alert systems would be created (beyond the specific field sensors being used in this project; for instance, some combination of sensors from the Line Sensor, Enhanced Fault Detection, or Distribution Fault Anticipation projects).</p> |
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Program Area: Vegetation Management and Inspections—New or Emerging Technologies

PG&E is using a variety of technologies to improve our vegetation management practices. For instance, physical ground inspections are being augmented by the capture of LiDAR and related, remote sensing, data that can be thoroughly and consistently analyzed to take measurements, reveal patterns and identify risks. Vegetation Management has benefited from improved intelligence regarding vegetation density and can leverage this data to strategically deploy resources where vegetation is near electrical assets.

Mitigations leveraging new or emerging technologies include the following:

7.1.D.3.10 Mobile LiDAR for Vegetation Management

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| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | 7.3.5.7 |
| (i).C: 2020 WMP Section | 5.1.D.3.13 (In the 2020 WMP, titled as “Mobile LiDAR for Distribution Inspections”) |
| (i).D: Project Objective and Summary | This project seeks to validate that high-resolution data captured with vehicle and backpack-mounted Light Detection and Ranging (LiDAR) and imagery units can help reduce fire risk and improve compliance of PG&E's Vegetation Management (VM) process. The 2020 Pilot focused on one 84-mile circuit to evaluate the benefits and risk spend efficiency of LiDAR to the Planning, Pre-Inspection, Work Verification, and Documentation phases of the end-to-end VM radial clearing process. |

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| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | E. Vegetation management and inspections: 22. Vegetation inspection cycle 23. Vegetation inspection effectiveness 24. Vegetation grow-in mitigation 26. QA/QC for vegetation management |
| (ii).A: Project Phase | 2019 Pilot: Closeout 2020 Pilot: Closeout 2021 Pilot: Planning |
| (ii).B: Project Status | Q4 2020: Closeout of 2020 Pilot Preparations are underway for an enhanced Mobile LIDAR collection effort in 2021. |
| (ii).C: Project Location | 2019 Pilot: ~18K miles driven in Tier 2 & 3 HFTDs. 2020 Pilot: 84 driven miles along a circuit in Placer and Nevada counties. 2021 Pilot: TBD |
| (iii).A: Results to Date | Prior Results - See (iii).B Lessons Learned below. Q3 2020 / Q4 2020 - Collected and analyzed Pre- and Post-Work measurements. - Performed field check of preliminary 2019 radial clearing results, and assigning toward remediation when appropriate. - Determined the percent of circuits measurable from a road with sufficient quality in Tier 2 & 3 HFTDs. |
| (iii).B: Lessons Learned | From the 2019 Pilot PG&E learned that Mobile LiDAR is capable of measuring radial clearances and clearances to sky, and: - Initiated operationalization of results into vegetation management (VM) processes. - Derived cost and data analysis cycle time performance measures for both vehicle and backpack-mounted sensors. In addition, PG&E has learned: - To reduce false positives, point cloud analysis teams need an accurate inventory of primary conductor assets (e.g. the teams need to be able to exclude secondary conductors and telecommunications cables). - Mobile LiDAR can help improve asset locational data accuracy. - Field teams could benefit from integrated access to geospatial data in their mobile applications. - No public receptivity issues found with the car-based mobile LiDAR inspections. -Post-work scan results can support work verification and cycle time planning. From the 2020 Pilot, PG&E learned that the LiDAR data acquisition and processing can occur within 27 days, a period sufficient for VM operational workflow cycle times. |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - Demonstration of the efficacy of Mobile LiDAR measured by comparing false positive and false negative percentages of the radial clearances obtained from analyzing the LiDAR point clouds. - Scan analysis cycle time |

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| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Mobile LiDAR provides a systematic way to identify radial clearance issues and potential grow-ins along road adjacent lines during the moment of data capture. This can create baseline observations for work verification to identify remaining clearance issues that may become grow-ins before the next cycle. Mobile LiDAR cannot identify hazard trees or replace the current inspection operations.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | When the Mobile LiDAR inspections process identifies a radial clearance issue in a region selected for scanning, the local Vegetation Management field operations team is informed and provided the data. Local operations will then consider the finding in context of their operations and then mitigate the identified clearance issue within the requisite timeframe. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | We will evaluate the stepwise integration of the methods described in (iv).A into VM operational workflows for road-side distribution corridors in HFTDs. |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | The potential end product is the integration of Mobile LiDAR data outputs into select phases of the vegetation management radial clearing process in HFTD for road-side distribution corridors. Potential VM processes impacted include work verification and documentation. |

Program Area: Asset Analytics & Grid Monitoring—New or Emerging Technologies

PG&E is assessing new methods to optimize asset maintenance practices. Unanticipated failure of electric assets due to wear and tear can lead to customer service outages and, in the worst case, fire ignition. Proactive management of asset health can reduce this risk and enhance system resiliency. PG&E is researching new or emerging technologies, such as enhanced sensor technologies that enable real-time system monitoring and situational awareness and developing analytic strategies to coordinate data received from multiple sources (e.g., SCADA, SmartMeter™ electric meters, primary line sensors, and emerging sensor technologies). Mitigations leveraging new or emerging technologies include the following:

7.1.D.3.11 EPIC 3.13: Transformer Monitoring via Field Area Network

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.14 |
| (i).D: Project Objective and Summary | As service transformers reach the end of their usable life or overload, they begin to heat up, leading to potential safety and asset risks. Currently, identification of transformer temperature change and potential associated risks poses challenges and requires regular checks from PG&E field teams. The EPIC 3.13: Transformer Monitoring via Field Area Network demonstration project aims to increase the visibility of transformer health through the design and build of an overhead service |

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| | transformer temperature sensor, a Temperature Alarm Device (TAD), supplemented by analytical models that analyze temperature data. The project will test the hypothesis that monitoring the external temperature of the tank of an overhead transformer can help in predicting and preventing imminent failure that could pose a wildfire ignition risk as well as impact safety and resiliency. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>C. Grid design and system hardening:</p> <p>12. Grid design for minimizing ignition risk</p> <p>D. Asset management and inspections:</p> <p>19. Asset Maintenance and Repair</p> <p>G. Data governance:</p> <p>33. Data collection and curation</p> |
| (ii).A: Project Phase | Planning |
| (ii).B: Project Status | The team is evaluating TAD costs provided by vendors, obtaining site licenses to access vendors' servers to obtain TAD data, and preparing to compare data from the two TAD vendors. |
| (ii).C: Project Location | Initial planned locations are in the San Jose area. |
| (iii).A: Results to Date | <p>Q3 2020</p> <ul style="list-style-type: none"> - Business plan approved for project implementation. - RFP executed for external TAD vendor involvement. - Construction contract executed. <p>Q4 2020</p> <ul style="list-style-type: none"> - Business plan approved for project implementation. - External TAD vendors selected for demonstration project |
| (iii).B: Lessons Learned | None to date. |
| (iii).C: Quantitative Performance Metrics | <p>Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Project is in the planning phase therefore performance metrics are not known.</p> |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>If the project hypothesis is proven, the wildfire risk reduction benefit would be the prediction and prevention of imminent failure of an overhead transformer that could pose a wildfire ignition risk as well as impact safety and resiliency.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | If the TAD effectively helps in the detection of imminent failure of overhead transformers, PG&E will be able to proactively replace transformers by dispatching field crews, thereby preventing failure, potential ignition risks, and associated outages. |

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| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | If the TAD technology is proven to be effective, (i) the communication system used by the TADs would need to be operationalized, (ii) the data would need to be integrated with our production databases, and (iii) the data would need to be combined with other data streams in an enterprise data analytics platform to provide a more holistic understanding of asset health. |
| (v).A: 'End Product' at 'Full Deployment' and Location | TADs would be installed on existing overhead transformers, prioritized first in Tier 3 HFTDs followed by Tier 2 HFTDs. Deployment in other locations will be subject to available funding. |

7.1.D.3.12 EPIC 3.20: Maintenance Analytics

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.15 |
| (i).D: Project Objective and Summary | The EPIC 3.20: Data Analytics for Predictive Maintenance project aims to develop analytical models using machine learning based on existing PG&E data sets (including SmartMeter™ electric meter connectivity, geolocational assets, and weather data) to predict electric distribution equipment failures so that corrective action can be taken before failure occurs. The project's current focus is on distribution transformers. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | D. Asset management and inspections: 19. Asset maintenance and repair |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | In Q4 2020 the team completed the first phase of the project which was focused on exploring voltage failures and anomalies while working with the Power Quality group. In coordination with the Asset Health and Performance Center, the second phase of the project is focused on ignition risks and catastrophic failures associated with failing equipment such as overloaded or near-failure transformers, stressed or near-failure cables, or primary side loose neutrals as well as from vegetation contact or other intermittent faults with overhead equipment. |
| (ii).C: Project Location | Algorithm testing and verification is ongoing throughout the PG&E service territory. |
| (iii).A: Results to Date | <p>Q2 2020</p> <ul style="list-style-type: none"> - Added heuristic to identify fuse failures. - The best prediction model had 87 percent precision when making predictions on a set of 300 failures. <p>Q3 2020</p> <ul style="list-style-type: none"> - Field validation of predicted failing transformers (in progress) - Through iterative development, the best model has improved and now has 98 percent precision for predicted failures. <p>Q4 2020</p> <ul style="list-style-type: none"> - Failure model minimum viable product (MVP) is in progress - Submitted change request to expand scope. The expansion of scope will hone project focus on identifying transformer failures with high ignition risk and |

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| | identifying grid event behavior which may indicate vegetation contact or other faults on overhead equipment. Distribution transformers are among the assets whose failures pose the highest ignition risk. |
| (iii).B: Lessons Learned | - Occurrences of poor data quality must be addressed to ensure prediction accuracy. |
| (iii).C: Quantitative Performance Metrics | Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - Accuracy in the prediction of transformer failures - Ability to supplement or automate the manual inspection process for transformer failures (degree to which the project automates or supplements the existing process) |
| (iii).D: Quantitative Risk Reduction Benefits | Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. Distribution transformers are one of the assets that pose the highest wildfire risk. The second phase of EPIC 3.20 will prioritize exploring overloading transformer failure and catastrophic failures to mitigate wildfire risk. The anticipated risk reduction benefits would be decreasing the frequency of wildfires caused by these failures. |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | If the model predicts a failed or failing asset, a troubleman could be alerted based on model findings and dispatched to inspect the asset and perform maintenance or replace the asset as needed. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | The EPIC 3.20 analytics model will be integrated into the Asset Health and Performance Center asset monitoring workflow by using machine learning and automating the troubleshooting process of signal anomalies. When a failure is predicted, the asset will be flagged for review. Depending on findings of the review, PG&E may dispatch crews to inspect perform maintenance on, or replace the asset as needed. |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | The end product will be an analytical model fully integrated into the Asset Health and Performance Center’s distribution grid monitoring and analytics platform. This would include integration of workflows to proactively address and track outcomes from issues identified by the analytic model. The model will enable informed decisions made by the Power Quality and Asset Health & Performance teams through the entire service territory. |

7.1.D.3.13 EPIC 3.32: System Harmonics for Power Quality Investigation

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.16 |

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| (i).D: Project Objective and Summary | The EPIC 3.32: System Harmonics for Power Quality Investigation demonstration project explores the use of next generation metering technology harmonics data to help automate the detection, investigation, and resolution of harmonics issues. Excessive harmonics have been shown to reduce utility equipment life, can cause premature equipment failure due to the potential to overheat, and can interfere with the operation of protection devices. Harmonics data from next generation metering technology can enable power quality engineers to monitor harmonics levels on the circuits and proactively address harmonics issues before they create a negative impact on PG&E and customers' equipment, mitigating the chances of equipment failure to have adverse effects or safety impacts. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid design and system hardening: 12. Grid design for minimizing ignition risk 14. Risk-based grid hardening and cost efficiency |
| (ii).A: Project Phase | Design/Engineering |
| (ii).B: Project Status | Team has issued a Purchase Order (PO) to meter hardware vendor. Expected lead time for the meters is 12-16 weeks. Team plans to identify meter locations and install meters in Q1 2021. |
| (ii).C: Project Location | Three phase commercial/industrial customer locations with a high number of DER/Solar PV and agriculture customers in the Central Valley region. |
| (iii).A: Results to Date | Q3 2020 - Finalized field installation plan including meter installation locations. - Completed RFP and selected meter hardware that met the requirements to provide the necessary harmonics data Q4 2020 - Issued PO to meter hardware vendor. - Kick-off project with Information Technology (IT). |
| (iii).B: Lessons Learned | Meter procurement took longer than expected due to contractual issues between the vendor and PG&E legal teams. We should connect the vendor legal team and PG&E teams together sooner next time. PG&E awarded the contract to the vendor's distributor instead. |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. CPUC-approved EPIC performance metrics are potential areas for measurement of success: - Reductions in outage numbers, frequency, and duration. - Reduction in number of customer voltage complaints related to harmonics issues. - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid. - Reduction in truck roll out to install additional portable monitors. - Reduction in turnaround time for resolving customer voltage complaints related to harmonics issues. - Reduction in downtime for customer equipment, which currently may be weeks or months. |

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| (iii).D: Quantitative Risk Reduction Benefits | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. Anticipated wildfire risk reduction benefits are described as part of answer (iv).A. |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | The plan is to validate locations with high levels of harmonics and determine if there is a harmonics-associated ignition risk to the transformers, cap banks, and fuses in the location. If a suspected ignition risk is found, the plan is to take action using existing operational processes. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | The plan is to use next generation metering technology to monitor and collect harmonics data on our electric distribution system for operationalizing harmonics-associated risk reductions. |
| (v).A: 'End Product' at 'Full Deployment' and Location | The end product is an analytics tool with the ability to monitor for, and enable proactive mitigation of, harmonics-related issues at approximately 3,000 large commercial customers throughout the service territory. |

7.1.D.3.14 Sensor IQ

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| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | 7.3.2.2.4 |
| (i).C: 2020 WMP Section | 5.1.D.3.17 |
| (i).D: Project Objective and Summary | <p>Sensor IQ is a SmartMeter software application that enables SmartMeter electric meters to collect data at a higher frequency and deliver alarms such as high/low voltage outside configurable thresholds without disruption to normal billing data collection. This pilot enables and collects high frequency SmartMeter data; analytics using this data will only be performed through other projects. PG&E has a license to pilot Sensor IQ through October 2021 and will collect voltage, current, and power factor data every five minutes from meters included in this pilot.</p> <p>The purpose of this Sensor IQ project is to collect the needed data to be analyzed through other exploratory use cases to evaluate if the high frequency data supports 1) improved meter phase identification, as this information is needed by the EPIC 3.15: Proactive Wires Down Mitigation Demonstration Project (Rapid Earth Fault Current Limiter), which requires feeder phasing to determine the line-earth capacitive imbalance; and 2) EPIC 3.43: Momentary Outage Information, which seeks to use near real time meter data, including the data provided through Sensor IQ, to develop algorithms that can potentially identify the sources of momentary outages or other anomalies to create predictive maintenance strategies and processes; 3) other predictive grid monitoring and maintenance approaches for potential wildfire risk reduction methods through incipient fault detection as well as improvement of the ability to find faults in wires-down analytics.</p> |

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| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid design and system hardening: 12. Grid design for minimizing ignition risk 14. Risk-based grid hardening and cost efficiency |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | Project is in process of development and testing with the plan of being deployed to 200K meters in Tier 2 & Tier 3 HFTDs by February 2021 and full deployment to ~500K meters in Tier 2 & Tier 3 HFTDs by end Q2 2021. |
| (ii).C: Project Location | ~500K SmartMeter electric meters located in Tier 2 & Tier 3 HFTDs. |
| (iii).A: Results to Date | Q3 2020/Q4 2020 - Data collection profiles, alarm thresholds and configurations have been developed for various meter types. - Sensor IQ has been deployed in the meter test environment to validate developed Data Collection Profiles. |
| (iii).B: Lessons Learned | - High frequency SmartMeter data alone was not enough to detect issues accurately. Analytics support is necessary to make the data provided by this project useful. Therefore, PG&E plans to direct this project's data, when available, into the EPIC 3.20: Maintenance Analytics, and EPIC 3.43: Momentary Outage Information projects to use their analytical components for meters in Tier 2 & 3 HFTDs. See the EPIC 3.20 and 3.43 project descriptions in this report for more information. |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - The ability to reliably collect high frequency data and events on meters which can be used for detecting unexpected conditions or improving analytical models. Example metrics are provided under item (iii).D: Quantitative Risk Reduction Benefits. |
| (iii).D: Quantitative Risk Reduction Benefits | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. Sensor IQ is foundational in collecting the data that could be used with advanced analytics to uncover incipient conditions detectable by our existing population of SmartMeter electric meters. The analytics of the high frequency SmartMeter events and alarms may provide early warning of degrading distribution conditions that are not detectable by other existing sensors. These early detected conditions will permit the prompt and proactive correction of conditions prior to fire season or high fire threat days. |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | If this project is found to benefit early identification of wildfire risks, the analytics developed in companion projects can be automated and integrated into existing preventative monitoring schemes. |

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| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | Automate the ingestion of Sensor IQ data into a data platform and apply analytical methods to assess events for indications of incipient conditions. Integrate data and analytics into existing or newly developed workflows for detection and resolution of incipient grid conditions that could create wildfire risk. Move the project to a production IT environment. The software contract for this pilot would be extended for deployment and converted to a full license. |
| (v).A: 'End Product' at 'Full Deployment' and Location | If effective, this product would be deployed in all circuits in Tier 2 & 3 HFTDs and integrated into standard distribution operation functions. It could also be extended to systemwide deployment to all compatible SmartMeter electric meters with an additional per-meter software license. |

7.1.D.3.15 EPIC 3.43: Momentary Outage Information

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | 7.3.2.2.4 |
| (i).C: 2020 WMP Section | N/A |
| (i).D: Project Objective and Summary | <p>PG&E has deployed over 5 million SmartMeters that provide alarm traps related to the meter's health and status during abnormal system conditions, such as outages, broad detection of sag and swell events, voltage deviations, intermittent power "blinks", or other anomalies as reported by the SmartMeter technology.</p> <p>This project proposes to leverage SmartMeter data through Sensor IQ as described in Section 7.1.D.15 above on about 500K meters for more granular and real-time data streams that include high frequency voltage, current, power factor, and temperature, and real time notifications voltage variations or temperature alarms that can be used to develop algorithms that can potentially identify the sources of momentary outages/voltage excursions to create predictive maintenance strategies and processes. An objective is to determine if AMI momentary events ("blinks") and trap alarms correlate and can be used to identify specific equipment shortcomings such as transformer failure, cracked insulator, loose neutrals, and/or vegetation contact, thereby leading to preventative maintenance practices that could also help reduce wildfire ignition risk.</p> <p>A second initiative is underway to add field insight from two additional sources of information: a new generation smart meter/grid edge sensor, and a behind-the-meter electrical condition detection sensor. The use of a new generation of meter potentially offers measurement and analysis of various primary and secondary issues including but not necessarily limited to loose neutrals, failing service transformers, failing splices, and vegetation contact, while the behind-the-meter electrical condition detection sensor provides an independent view of similar potential issues, but from the customer side of the meter.</p> |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>D. Asset management and inspections</p> <p>16. Asset inventory and condition assessments</p> |
| (ii).A: Project Phase | Design/Engineer |
| (ii).B: Project Status | The first part of the project is waiting for deployment of Sensor IQ to commence data collection and analytic development (expected completion Q1 2021). |

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| | <p>The second part of the project, related to the new generation meter and behind-the-meter electrical condition detection sensor, is being initiated. Vendors have been selected and contract negotiations are expected to complete in Q1 2021.</p> |
| (ii).C: Project Location | <p>The Sensor IQ-based analysis is applicable to the entire PG&E electric distribution service territory served by SmartMeters but is now focused on meters in Tier 2 & Tier 3 HFTDs.</p> <p>The new generation meter and behind-the-meter electrical condition detection sensor are being piloted in a few Tier 2 & Tier 3 HFTDs.</p> |
| (iii).A: Results to Date | <p>Q4 2020</p> <p>For the first part of the project:</p> <ul style="list-style-type: none"> - Defined data points and data frequency requirements to perform analytics work to potentially identify equipment failures for enhanced preventative maintenance practices that focus on replacement before failure. - Developed IT framework (solutions blueprint) to ingest and provide data for analytics work. <p>For the second part of the project:</p> <ul style="list-style-type: none"> - Vendors and installation locations have been selected. - Two additional potentially useful data sources have been identified: new generation SmartMeter technology, and in-home electrical fire sensing. Analysis of project scope and cost changes to accommodate these data sources has been initiated. |
| (iii).B: Lessons Learned | <p>None to date</p> |
| (iii).C: Quantitative Performance Metrics | <p>Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Performance will be initially measured based on the progress the development team can demonstrate towards validating or invalidating the project's hypothesis. The initial performance metrics are:</p> <ul style="list-style-type: none"> Number of asset failure use cases for which models are developed and tested Number of failure models for which predictive models are developed and tested Area Under the Precision/Recall Curve (AUC) for each Model developed (if appropriate) Top AUC achieved for each asset type (if appropriate) Net operational cost benefit assessment for the best model developed for each use case Number of field verification exercises completed Time required to ingest new data, update model (if appropriate), run model, and have insights ingested into business processes <p>If a successful approach is developed, additional metrics focused on comparing the performance of current processes to the performance of the new analytical approach will be used.</p> |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Wildfire risk reduction benefits are anticipated as described in the second paragraph of answer (i).D.</p> |

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| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | None to date. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <p>For the first part of the project:</p> <p>If the predictive models using Sensor IQ data are found to be successful, the next phase of development would be to move the analytical model to full production. Operational actions potentially include more precisely targeted PSPS events, more precisely targeted vegetation management, optimized truck rolls, or temporarily reconfiguring distribution system topology. Additionally, improved maintenance planning and optimized capital allocations are likely benefits of more precisely understanding equipment condition.</p> <p>For the second part of the project:</p> <p>If the technologies (the new generation meter and the behind-the-meter electrical condition detection sensor) are found to be successful in identifying incipient issues the more effective version will be assessed for larger deployment.</p> |
| (v).A: 'End Product' at 'Full Deployment' and Location | <p>If the first part of the project is more successful in its predictions, full deployment would include Sensor IQ aggregation/analysis on SmartMeters in Tier 2 & Tier 3 HFTDs and/or on select SmartMeters throughout the system, to be determined. If the second part of the project is more successful in its predictions, select or all SmartMeters would need to be upgraded to the new generation, or the behind-the-meter electrical condition detection sensor would need to be installed in select or all customer premises.</p> <p>Regardless of which part of the project is deployed, it would also include:</p> <p>Verified predictive analytics developed through application of data analytics platform toolsets and methods</p> <p>Multiple algorithms for determining equipment failure or underperformance risk in key categories (transformers, cabling, insulators, etc.)</p> <p>Integration of data streams and alerts into operational tools</p> <p>Ongoing tuning of algorithms and analytics using data analytics platform capabilities</p> |

7.1.D.3.16 Wind Loading Assessments

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | 7.3.3.13 |
| (i).C: 2020 WMP Section | 5.1.D.3.18 |
| (i).D: Project Objective and Summary | Excessive wind loads on PG&E's distribution poles may cause asset failure that in turn increases wildfire ignition risk. This project will reduce risk by providing asset intelligence to identify locations that require corrective actions driven by pole safety factors or limitations for wind speeds. The project will leverage existing Light Detection and Ranging (LiDAR) data from VM efforts to geo-correct pole locations. Objectives of this project include a greater understanding of failure modes, establishment of a common repository of data gathered, and effectively updating workflows of key asset systems to align with new data |

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| | strategies. Wind loading segmentation will be performed to identify the wind loading of each asset on a support structure with the objective of integrating findings into risk models. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>A. Risk assessment and mapping</p> <p>2. Ignition risk estimation</p> <p>D. Asset management and inspections</p> <p>16. Asset inventory and condition assessments</p> |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | - Deployed the Wind Loading Assessment application to an initial group of 62 Distribution estimators |
| (ii).C: Project Location | PG&E service territory (PG&E owned distribution poles) |
| (iii).A: Results to Date | <p>Q4 2020</p> <ul style="list-style-type: none"> - Upgraded the foundational modeling software to handle “tree poles” and crossarm framing automation. - Implemented a Citrix version of Wind Loading that allowed PG&E to switch to a less expensive third party Desk Top Review (pole loading review) vendor. - Consolidated all Distribution wind loading data onto a PG&E platform. - Completed the initial deployment stage of the project, with 62 (of 800) Distribution estimators using the new application. |
| (iii).B: Lessons Learned | <ul style="list-style-type: none"> - Data integration into external cloud environment has the potential to provide significant benefit by enabling greater data access and data sharing capabilities with external partners. - Data sharing through the external environment requires new methods for cybersecurity when sharing data externally. - LiDAR holds potential in enabling PG&E to geo-correct pole configurations and arrangements in an automated fashion, which will be further explored through this project. |
| (iii).C: Quantitative Performance Metrics | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <ul style="list-style-type: none"> - Ability to perform pole geo-correction based on LiDAR data. - Integration of data into external cloud environment for greater data accessibility. - Accuracy of data for pole loading calculations. |
| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>The anticipated wildfire risk reduction benefit is reduction of asset failures and associated wildfire risk due to excessive wind loads on PG&E’s distribution poles and lines.</p> |

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| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | <ul style="list-style-type: none"> - Integrate data provided through wind loading assessment for failure mode insights to inform manual inspection cycles (integration would occur through a separate project). - Pole geo-corrections will assist field crews in identifying correct pole locations in the field. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <ul style="list-style-type: none"> - Data provided through this project can provide insights for proactive asset management practices (e.g. integrate results into distribution risk model). |
| (v).A: 'End Product' at 'Full Deployment' and Location | <ul style="list-style-type: none"> - Wind loading segmentation analysis will be performed to identify the wind loading of each asset, e.g., a conductor, on a support structure and integrate findings into appropriate systems. This will provide asset intelligence to identify locations that require corrective actions driven by pole safety factors or limitations for wind speeds, or to assess the safety factor of distribution poles as part of the preparation to exit a PSPS event. In addition, geo-corrections to pole locations can be determined based on LiDAR data. |

Program Area: Foundational—New or Emerging Technologies

Foundational new or emerging technologies, including grid communication tools and control networks, can enable greater exchange of information required to provide real or near-real time operational visibility across the grid for enhanced decision-making including for PSPS events. These foundational items can also increase the flexibility of the grid, providing fundamental capabilities to advance system resiliency.

7.1.D.3.17 EPIC 3.03: Advanced Distribution Energy Resource Management System

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| (i).A: Project Type | Emerging (Pre-commercial) Technology |
| (i).B: Additional References in the 2021 WMP | |
| (i).C: 2020 WMP Section | 5.1.D.3.20 |
| (i).D: Project Objective and Summary | <p>The EPIC 3.03: Advanced Distributed Energy Resource Management System (DERMS) demonstration project seeks to design, procure, and deploy a prototype enterprise DERMS providing foundational operational capabilities which will support situational intelligence and broader wildfire mitigation efforts including remote grids, microgrids, and other Distribution Investment Deferral Framework (DIDF) opportunities (i.e. Non Wires Alternatives).</p> <p>This project includes the development of a cost-effective solution for providing advanced situational awareness and control capabilities for operators to manage Distributed Energy Resources (DER), dispatch DER registration data requests and monitor smart inverter-based DERs. As part of the effort to lower the cost of telemetry for interconnected DER assets, PG&E is engaging with vendors that would eventually produce PG&E-certified site gateways. Additionally, the project is engaging with potential DER aggregator partners to evaluate feasibility of integrating with the PG&E DER headend server as an alternative to the site gateway approach.</p> <p>Anticipated benefits of this project once deployed at scale include: (1) increased situational awareness of DER grid impacts which could allow for greater operational flexibility to safely reconfigure the grid during PSPS; (2) decreased time to de-energize remote grid locations by utilizing the remote disconnect</p> |

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| | feature of DERMS for remote grids during PSPS events; and (3) potential reduction in the number of customers impacted from PSPS events through microgrid technologies. We note that this project's technology is foundational; actual reduction is dependent on broader microgrid implementations. |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | C. Grid Design and System Hardening: 12. Grid design for minimizing ignition risk 13. Grid design for resiliency and minimizing PSPS |
| (ii).A: Project Phase | Build/Test |
| (ii).B: Project Status | - Factory acceptance testing for the gateway device to be installed at the first pilot site at Blue Lake Rancheria has been completed. Installation of headend server at PG&E has been completed. - Installation of the gateway device at the pilot site is scheduled for early 2021. The field deployment has experienced delays because the pilot site is involved in COVID-19 response with the recent surge in cases. - Third-party site gateway vendors have begun interoperability testing with the headend server. |
| (ii).C: Project Location | Blue Lake Rancheria (BLR), Blue Lake, CA (Humboldt County). The BLR is a 100 acre tribal reservation and State-designated Disadvantaged Community (DAC). |
| (iii).A: Results to Date | - Completed design and installation of an IEEE 2030.5 DER Headend Server (CSIP certification pending) - Initial gateway buildout at the Blue Lake Rancheria site to test telemetry and control (in progress). - To build a market for remote site gateway devices for DER developers, PG&E selected two vendors for development of additional third-party remote site gateways meeting PG&E standards and requirements. This also set up a pathway for future vendors to develop their own remote site gateways. |
| (iii).B: Lessons Learned | - Technology ecosystem for DER integration utilizing the IEEE 2030.5 protocol is still rapidly evolving and is not yet "plug and play." Further interoperability testing and industry collaboration is required. - Technology architectures for integrating critical operational systems with 3 rd party owned devices needs multiple levels of cybersecurity. |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - Proven ability of telemetry and control of DERs through a communications link with at least two DER sites and/or DER aggregators. - Cost effectiveness meet or exceed CPUC telemetry requirements at each site or aggregator. - Increased visibility of DERs on the grid and their utilization for microgrids, remote grids, and PG&E Control Centers. - Integration with other grid advancement programs and systems to enable scaled up deployment after EPIC project completion. |

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| (iii).D: Quantitative Risk Reduction Benefits | <p>Per “Action PGE-18” in Section 5.1.7 of the “Wildfire Safety Division Evaluation of Pacific Gas and Electric Company’s First Quarterly Report” dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021.</p> <p>Again, we note that this project’s technology once deployed at scale will provide foundational capabilities for visibility and control rather than direct wildfire risk reduction benefits.</p> <p>Anticipated wildfire risk reduction benefits are described as part of answer (i).D.</p> |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | <p>This project will demonstrate capabilities to:</p> <ul style="list-style-type: none"> - Enhance situational awareness and DER control capabilities for distribution operators to support grid needs as part of wildfire mitigation related initiatives. - Enable PG&E to dispatch registration data requests to verify compliance of Smart Inverters with Rule 21 curve settings and monitor Smart Inverter-based DERs to maintain safe and reliable grid operations during PSPS and normal grid conditions. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | <p>The DERMS would be integrated into the distribution system operators’ systems and processes as described in (iv).A. The project team is also coordinating with the ADMS team (see Section 7.1.D.3.18 below) for future integration to optimize DER utilization and system-wide grid services.</p> |
| (v).A: ‘End Product’ at ‘Full Deployment’ and Location | <p>The end product is a fully integrated enterprise DER Headend that can scale to accommodate the growth of managed DERs over time. The headend server will be located at PG&E and the remote site gateways will be located at customer DER sites.</p> |

7.1.D.3.18 Advanced Distribution Management System (ADMS)

| | |
|--|---|
| (i).A: Project Type | New Technology (Commercially Available Offering) |
| (i).B: Additional References in the 2021 WMP | 8.1 |
| (i).C: 2020 WMP Section | 5.1.D.3.21 |
| (i).D: Project Objective and Summary | <p>PG&E is undertaking the first component of a multi-year effort to implement an Advanced Distribution Management System (ADMS) which will, when fully deployed, integrate into a single platform several of the current mission critical distribution control center applications (Distribution Supervisory, Control and Data Acquisition (DSCADA) software, Demand Management System (DMS), and Outage Management System (OMS)) that are currently spread across multiple platforms. The ADMS will become part of the core distribution operations technology tools that enable the visibility, control, forecasting, and analysis of a more dynamic grid.</p> <p>ADMS impacts grid resiliency through: (i) facilitation of DER integration; (ii) switching operation enablement during PSPS events by providing more timely and accurate data to operators; (iii) identification of devices within fire areas to allow operators to disable reclosing relays when weather and conditions pose significant risk to the system.</p> |
| (i).E: Utility Wildfire Mitigation Maturity Model (UWMMM) Categories & Capabilities Potentially Impacted | <p>F. Grid operations and protocols</p> <p>27. Protective equipment and device settings</p> <p>28. Incorporating ignition risk factors in grid control</p> |
| (ii).A: Project Phase | Multiple (phase varies with functionality considered) |
| (ii).B: Project Status | Software is under development. |

| | |
|---|---|
| (ii).C: Project Location | Applicable to the entire PG&E electric distribution service territory |
| (iii).A: Results to Date | Q3 2020/Q4 2020 - Performing software build for wildfire mitigation functionality |
| (iii).B: Lessons Learned | - None to date |
| (iii).C: Quantitative Performance Metrics | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. - ADMS ability to identify automatic reclosing devices (e.g. Line Reclosers, Trip Savers, Fuse Savers) within fire areas and present the potentially impacted areas to operators for verification (to inform reclosing relay disablement) - Improvement of the situational awareness of operators through compilation of switching operation data sources into a single platform. |
| (iii).D: Quantitative Risk Reduction Benefits | Per "Action PGE-18" in Section 5.1.7 of the "Wildfire Safety Division Evaluation of Pacific Gas and Electric Company's First Quarterly Report" dated January 8, 2021, PG&E will be updating this field in the supplemental filing to be filed no later than February 26, 2021. Wildfire risk reduction benefits are anticipated as described in the second paragraph of answer (i).D. |
| (iv).A: Ignition or Fault Risk Reduction Project Findings That Inform Current Operational Practices | - PG&E is taking a phased approach to ADMS implementation to ensure that foundational capabilities are first established. - Operator training simulator is planned for SCADA system and reclosing relay capabilities will help train operators on ADMS functionality to ensure timely adoption of ADMS platform. |
| (iv).B: Methods to Incorporate Project Findings Into Operational Practices | ADMS is a platform used for distribution operations. Operators will require training on the system and former systems will need to be sunset in a methodical manner that minimizes disruption to ongoing operations. Change management practices focused on people, process, and technology will be employed to ensure value streams from ADMS implementation are captured. |
| (v).A: 'End Product' at 'Full Deployment' and Location | Multi-year ADMS deployment will integrate several mission critical distribution control center applications that are currently spread across multiple platforms. This technology will enable the visibility, control, forecasting and analysis required from a more dynamic grid. When fully deployed, the ADMS platform will bring the capabilities of today's Distribution Supervisory, Control and Data Acquisition (D-SCADA) software, DMS, and Outage Management System (OMS) into a single platform. Integrating these systems into a single, more efficient platform will reduce the potential for operator error, improve cybersecurity risk controls, and enable PG&E to run a new suite of advanced applications that enhance current capabilities associated with safety and resiliency, while responding to future needs associated with the growth of DERs and complexities from wildfire risk. |

7.2 Wildfire Mitigation Plan (WMP) Implementation

Describe the processes and procedures the electrical corporation will use to do all the following:

7.2.A Monitor and Audit WMP Implementation

A. Monitor and audit the implementation of the plan. Include what is being audited, who conducts the audits, what type of data is being collected, and how the data undergoes quality assurance and quality control.

PG&E monitors and regularly reviews the implementation of the 2021 WMP as it is being implemented. The effort to monitor and audit 2021 WMP implementation is supported by the WMP implementation teams, the Community Wildfire Safety Program (CWSP) Program Management Office (PMO), Electric Operations' Quality Team and PG&E's Internal Audit (IA) organization. PG&E has developed programmatic quality and monitoring processes and protocols for many of the individual programs within the WMP.

PG&E's CWSP PMO is responsible for monitoring the overall progress of the WMP workstreams and the quality of the WMP work at the program level. The PMO produces progress tracking and status updates via a weekly dashboard. The PMO also produces both a monthly status update and a comprehensive quarterly WMP report. The PMO provides on-going oversight and direction to the WMP program leaders. In addition, the status and tracking reports provide PG&E leadership, and ultimately the board of directors, visibility into the different elements of the WMP and gives them the information they need to monitor and, when needed, make adjustments to the program. PG&E has provided these reports and dashboards to WSD in its response to Condition PGE-11 for the 2020 WMP.

At the individual WMP program level, PG&E has developed quality monitoring and audit plans tailored to each program. For example, the WMP quality monitoring and audit programs developed for the System Hardening and Enhanced Vegetation Management programs including 100 percent work verification. For both of these key WMP programs no miles are recorded as complete in either program until they have been fully verified to be complete. The operating LOB generally validates that the work conducted is accurate and complete while the program data verification is validated by PG&E's QA or IA teams. The LOB that validates that the work is accurate and complete has the expertise to identify any technical issues. The IA teams have expertise in designing data validation and quality monitoring programs. Taken together, the quality monitoring and auditing program that PG&E implements validates both the physical completion of work and the quality of the program data.

In addition to the processes outlined above, PG&E also provides implementation information to parties in CPUC proceedings and has a number of external parties that are monitoring our wildfire mitigation activities. PG&E regularly provides updates and information requested to the following:

- Federal Monitor: PG&E's Federal Monitor has been given

responsibility to review PG&E's wildfire mitigation efforts and compliance activities.

- Independent Safety Evaluators: In compliance with the Wildfire OII, starting in 2021 and conducted annually for three years, Independent Safety Evaluators working at the direction of the Safety Enforcement Division (SED) will audit and review financial data related to PG&E's Wildfire Safety Plans. Safety Evaluators are separate and distinct from Independent Evaluators provided for in Public Utilities Code § 8386.3(c). The Safety Evaluator audit reports shall be provided to the Director of SED and served on the service list for I.19-06-015.
- WSD: In 2020, WSD's compliance branch has engaged with PG&E on a bi-weekly audit of our system hardening projects, PSPS sectionalizing device installation, and EVM projects. Every two weeks, PG&E sends a list of these projects to the WSD for audit.
- Independent Evaluator: Starting in 2021, an Independent Evaluator will review PG&E's compliance with its WMP, as provided in Public Utilities Code § 8386.3(c).
- AB 1054 Quarterly Advice Letters: WMP implementation progress updates are one of the components contained in this quarterly filing requirement that is provided to the CPUC and parties.

7.2.B WMP Deficiencies

B. Identify any deficiencies in the plan or the plan's implementation and correct those deficiencies.

PG&E continuously tracks WMP implementation during the year through tracking reports and quality reviews to assess both the progress and quality of the WMP work completed and to identify any program deficiencies. As discussed in the Section 7.2.A, PG&E's CWSP PMO is primarily responsible for monitoring the individual WMP programs in order to identify any potential deficiencies in the plan or the plan's implementation. The CWSP PMO provides PG&E's senior leaders regular WMP reports to evaluate and identify potential deficiencies. Any deficiencies identified at any level are reported to the PMO and the PMO is ultimately responsible for correcting those deficiencies and ensuring completion of the WMP.

As part of the "Conditional Approval" of PG&E's 2020 WMP, issued by the CPUC on June 11, 2020, there were a number of identified "deficiencies" that PG&E has been working to resolve through several follow-up filings including the Remedial Corrective Plan submitted on July 27, 2020 and Quarterly Reports submitted on September 9, 2020 and December 9, 2020. PG&E recently received feedback on those submissions including additional "actions" that are being incorporated into the 2021 WMP or provided as part of a supplemental filing by February 26, 2021. The details of those WSD-identified "deficiencies" and follow-up "actions" are included in a Section 4.6 and are not being repeated here.

Looking back to the implementation of PG&E's 2020 WMP, we successfully implemented and substantially completed the 38 commitments made in that plan, with the exception of one pending change order under review. In many cases, we were able to exceed our 2020 WMP targets. In particular, while PSPS events remain a significant disruption for those customers who are impacted PG&E delivered a substantially better PSPS experience in 2020 for both community partners and customers. Key examples of some of the most impactful WMP activities PG&E delivered in 2020 include:

- System Hardening – hardened 372 miles in HFTD areas (including Butte County undergrounding miles) exceeding the 2020 WMP target;
- Enhanced Vegetation Management – completed 69 percent of the 2020 target of 1,800 miles in the first half of 2020 on the way to completing 1,878 miles for the year;
- Smaller PSPS events – we targeted making 2020 PSPS events impact one-third less customers than they would have in 2019 and the multiple actions we took were successful in making the 2020 PSPS events 55 percent smaller, which avoided a PSPS event for over 800,000 customers;
- Shorter PSPS events – PG&E restored power more than 40 percent faster

in 2020 after the severe weather passed, as compared to 2019. On average post-PSPS inspections were completed and power was restored for customers 10 hours after the weather cleared in 2020, as compared to 17 hours in 2019; and,

- Smarter PSPS events – despite the challenges created by the COVID-19 pandemic, PG&E better partnered with communities and customers to prepare for and navigate PSPS events. Due to various efforts including adding staff to partner closely with Counties and Tribes and improving communication and data-sharing tools the overwhelming feedback from Counties and Tribes was that their experience with 2020 PSPS events was improved from 2019 events. Similarly, our tools and resources provided to customers for 2020 PSPS were substantially improved.

Beyond these largest wildfire-related programs, PG&E's 2020 WMP efforts delivered on nearly all of our commitments. The full list of 2020 commitments and performance against them is provided in **Table PG&E-7.2-1** below. Of the 38 total commitments outlined in the 2020 WMP, 34 were completed or exceeded. The remaining four are:

- Two new technology implementation efforts ran into software / firmware challenges and Change Orders were filed with the CPUC for both. The Change Order revising the implementation timeline for the Sensor IQ project (referenced in Section **7.3.2.2.4** of this plan) was approved in early January 2021. The Change Order filed in December for the Partial Voltage Detection project (referenced in Section **7.3.2.2.2** of this plan) was approved by WSD on January 28, 2021.
- The Remote Grid new technology deployment effort (referenced in Section **7.3.3.17.5**) was substantially completed in 2020. The primary objectives of learning through the deployment of actual projects was completed. Five Remote Grid sites are currently in the advanced stages of deployment, and forecast to be operationalized in 2021, although construction of these projects has been delayed, primarily by challenging permitting constraints associated with sensitive species.
- The PSPS restoration initiative was also substantially completed. Aerial assets acquired as planned and overall customer average restoration time after the severe weather passed was improved by more than 40 percent. One goal within this initiative was to restore power to 98 percent of customers within 12 daylight hours after the severe weather passed, which was nearly achieved with 95.5 percent performance. The primary driver of falling short of the 98 percent performance was that heavy smoke (due to pre-existing wildfires from the August lightning fire complexes) during the first PSPS event of 2020 on September 7th limited visibility such that only 28 of 60 helicopters were able to fly. This forced shifting of planned aerial inspections to need to be executed by slower, ground-based inspections which ultimately drove 91 percent performance for that event.

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|---|---|---|
| B.1 Upgraded POMMS Model to 2km | Increase POMMS model resolution to 2 km, increase model lead time to ~96 hours, deploy 0.67 km forecasts on demand, and deploy a high-resolution model ensemble package with 8 model members at 2 km resolution | Selected vendor running 2KM model operationally 4x per day. On-demand simulations and vendor-hosted training have been completed. The 8-member model ensemble is also being produced and delivered to PG&E daily |
| B.2 NOAA-20 Satellite Data | Add NOAA–20 data including Visible Infrared Imaging Radiometer Suite (VIIRS) into the suite of fire detection tools | PG&E has incorporated NOAA-20 data into the existing fire detection workflow |
| B.3 Wind Event Forecasting Tool (Diablo) | Develop and deploy a (2 to 4 week) Diablo wind event forecasting system based on statistical, machine learning and/or artificial intelligence techniques | An internal long-range diablo wind forecast was created internally by Meteorology. This was done after analysis of teleconnections against Diablo winds revealed that the Madden-Julian Oscillation could be used to indicate the potential for an increased or decreased risk of diablo winds. This forecast is now produced twice a week. |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|--|--|---|
| B.4 Wildfire Spread Model – Operational Impacts | PG&E will evaluate incorporating the fire spread model consequence into decision support frameworks including PSPS | Phase 2: Implementation of territory-wide fire risk, probabilistic fire spread modeling. Improved urban encroachment into WUI areas and improved fire spotting algorithm completed 5/28/2020. Phase 3: CalFire validated technology in 2019 with pilot project and likely to move forward with state-wide fire spread solution: improvements with Techno sylvia scoped for 2020 (SOW executed); IT SAR contract approved. PG&E has evaluated incorporating fire spread outputs directly into PSPS decision making in 2020 |
| B.5 Live Fuel Moisture (LFM) Sampling | Conduct LFM sampling utilizing Safety and Infrastructure Protection Team (SIPT) resources. Targeting samples from 10 locations by 06/01, and 15 additional sites by 9/01 for a 2020 total of 25 | As of the end of September 25 sites (two sites were lost due to fires) are actively being sampled by SIPT crews. Sampling will be done on the 1st and 15th of the month going forward. This commitment has exceeded the WMP target of 25 sites. |
| B.6 Re-calibrate the OPW and FPI models | Reproduce 30-year weather and fuel moisture climatology at the same 2 km resolution and model configuration as the enhanced operational POMMS model. Re-calibrate the OPW and FPI models using the new 2 km historical dataset | The 30-year climatology production of weather, DFM and LFM was entirely completed by 10/1. |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|---|---|--|
| <u>B.7 SmartMeters - Partial Voltage Detection</u> | Deploy 365,000 Three-Phase Smart Meters™ and extend the partial voltage detection enhancement to 3-phase Smart Meters™ and 4-Wire Distribution systems | Product issues identified in November began to cause delays. Issue was escalated to Itron Executive leadership as root cause was determined and remediated. Change Order was submitted on 12/11/20 informing CPUC change in deployment timing due to product issue identified during deployment. Vendor is in the process of developing a schedule for delivering a firmware fix. PG&E will test the new firmware upon delivery and deploy firmware to field meters upon successful certification. Deliverable (2) which involved updating DMS interface and business logic was completed on schedule and ready for deployment. PG&E expects to have Partial Voltage Implementation in place on Three Phase meters in time for the 2021 Wildfire Season (6/1/21) |
| B.8 Smart Meters™ – Sensor IQ Pilot Deployment | Deploy Sensor IQ pilot to 500K Smart Meters™ covering ~25,597 distribution line miles in HFTD and customize reads and alarms to identify service transformer failures | Vendor product issue & technology constraints in current datacenter necessitated change in deployment timing. A Change Order submitted to CPUC on 9/11 has been approved, therefore this commitment is now on track to start deployment of Sensor IQ profiles to field meters in January 2021 and reach the 200K milestone by end February 2021 as per revised WMP commit. PG&E will resume profile deployment to remaining 300K meters in April 2021 after PG&E completes the Data |

Center Migration project and meet revised commit of 500K by 6/1/2021.

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|--|--|---|
| B.9 High-Definition Cameras Deployment | Deploy an additional 200 cameras by December 31, 2020 | 216 cameras were installed to meet the year end goal, 16 units ahead of the original YTD target of 200 |
| B.10 Weather Stations | Install 400 weather stations in 2020 | 404 stations were installed to meet the year end goal, 3 units ahead of the original YTD target of 400 |
| C.1 SCADA Transmission Switching (switches) | Install 23 SCADA transmission switches to provide switching flexibility and sectionalizing for PSPS events | 54 Scada Switches install YTD exceeding the target of 23 |
| C.2 Distribution Segmentation (automated devices) | Enhance distribution segmentation by adding 592 automated sectionalizing devices by 09/01/20 | 603 devices commissioned YTD exceeding the target of 592 |
| C.3 Remote grids | Deploy 4-8 initial sites to validate use cases, design standards, deployment | Commitment substantially complete. The primary objectives of learning through the deployment of actual projects have been |

| | | |
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| | processes and commercial arrangements and deliver recommendations for scale-up | completed. Five Remote Grid sites are currently in the advanced stages of deployment, and forecast to be operationalized in 2021, primarily delayed by challenging permitting constraints associated with sensitive species. |
|--|--|--|

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|--|--|--|
| C.4 Transmission Line Evaluation for PSPS Scoping | Evaluate all 552 transmission lines in HFTD areas to determine which lines can potentially be removed from future PSPS Event scope | Evaluation of all 552 Transmission lines was completed in Q1 |
| C.5 System Hardening (SCADA enabled circuit breakers) | Enable SCADA capability on the remaining circuit breakers within HFTD (excluding 4kV). | All of the remaining distribution circuit breakers in HFTD area have been enabled with SCADA as planned. |
| C.6 System Protection (surge arresters) | Replace 8,850 non-exempt surge arresters with exempt surge arresters in Tier 2 and Tier 3 HFTD areas in 2020 | 9,154 non-exempt surge arresters were replaced (Installed and QA verified) in Tier 2 and Tier 3 HFTD areas YTD. This exceeds the 2020 commitment target of 8,850 |

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| C.7 System Protection deploy DCD (reclosers) | Based on High Impedance Fault Detection pilot results, deploy newer protection capabilities Downed Conductor Detection (DCD) to 100 reclosers in Tier 2 & 3 HFTD | PG&E has 126 recloser within Tier 2 & 3 fire areas with DCD enabled to alarm for a wire down condition by the end of June. Exceeding target of 100 |
| C.8 Rapid Earth Fault Current Limiter (REFCL) Pilot | REFCL demonstrations are planned to begin in 2020 on operational assets to test its capabilities. | All pieces of the REFCL system have been installed (construction completed for both all substation and distribution line equipment) which meets the scope of the 2020 REFCL commitment. |

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TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments^(a) | WMP Commitment | Summary of 2020 Performance |
|---|---|---|
| C.9 System Hardening Criteria Refinement (Dist.) | Refining Criteria for Hardened Distribution Facilities During Potential PSPS Events Includes, simulate OH performance using Finite Elements Analysis (FEA) | Calibration of the criteria with PSPS tools is complete. The criteria have been applied during the 10/25 PSPS event, to simulate the application of the criteria for the future descoping of a segment of the Oakland K 1102 circuit. |
| C.10 System Hardening | System Hardening; 241 miles in 2020 (includes 20 Butte County Line Miles see C.11) | 369 miles was completed YTD, exceeding the line miles YE target. |

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| (line miles) | | |
| C.11 Butte County Rebuild (UG de-energized miles) | Butte County Rebuild; 20 miles in 2020 (noted as tracking separately from other 221 miles) | Completed 21.3 WMP miles, exceeding the 20-mile target |
| C.12 Expulsion Fuse Replacement (non-exempt equipment) | Enhance distribution segmentation strategies by adding 592 automated sectionalizing devices by 09/01/20 | YTD Non-Exempt Fuses (643) excluding units still in QA. Exceeding the target of 592 |
| D.1 Ultrasonic Inspections Pilot | Commence a pilot of Ultrasonic technology in both transmission and distribution | PG&E ATS Team completed the pilot, produced summary conclusions, and received a 3rd party vendor validation repo |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments^(a) | WMP Commitment | Summary of 2020 Performance |
|--|---|---|
| D.2 Distribution HFTD Inspections (poles) | For 2020, perform detailed overhead inspections on 100 percent of HFTD Tier 3, and 33 percent of HFTD Tier 2 assets (Dist.), reference Compliance | YTD attainment is at 100 percent with 339,728 inspections completed December YTD. |

| | | |
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| | Plan and Utility Bulletin: TD-8999B-001 | |
| D.3 Transmission HFTD Inspections (structures) | For 2020, perform detailed overhead inspections on 100 percent of HFTD Tier 3, and 33 percent of HFTD Tier 2 assets (Trans.) reference Compliance Plan and Utility Bulletin: TD-8999B-001 | All HFTD inspections. 100 percent of Tier 3 and 33 percent of Tier 2 completed in 2020, with the final inspections delayed by Access Limitations resolved in December. |
| D.4 Substation HFTD Inspections (substations) | Inspections once annually for all HFTD Tier 3 stations, on a three-year cycle for stations in HFTD Tier 2 | The YTD completions at 100 percent of the full target of 99 substation inspections |
| E.1 EVM (line miles) | In 2020, complete and validate an additional 1,800 EVM circuit miles on distribution lines in HFTD areas | Approximately 1,878-line miles were validated, exceeding the 1,800-line mile YTD target. |
| F.1 SIPT Crews and Engines Resourcing | Increase staffing to budgeted level of 98 STIP crew members and place 40 Engines, and maintain SIPT Viewer daily usage rate of 90 percent | PG&E has exceeded the commitments targets with 42 engine trucks operational, 102 STIP crew members staffed and a STIP Viewer daily usage at the end of May of 91 percent to further support SIPT in 2020 |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|--|---|--|
| F.2 Protocols for PSPS Re-Energization¹ | Update TD-1464B-002 to include lessons learned from 2019 PSPS events and latest meteorology inputs, update the existing DCC Operator training materials to incorporate revisions to TD-1464B-002, and confirm that PG&E personnel to complete annual TD-1464S training. | (Complete): DCC operator training materials (PSPS-0002WBT) were finalized and released on 6/19 with a targeted completion date of 8.31. 131/131 required DCC operators completed PSPS-0002WBT. Phase 3 (Complete): 99.999 percent (10514 of 10515) employees have completed TD-1464S training (SAFE-1503WBT). |
| F.3 Removal of TripSaver Auto-Reclosing Functionality | Permanently remove the automatic reclosing functionality of the remaining TripSavers serving the Tier 2 and Tier 3 HFTD areas | 2019 YE remaining TripSaver total = 275 (29) Less replaced with other devices (Fuse, FuseSaver, Switch, Recloser) (2) Less removed device as result of Camp fire 244 = 2020 TripSavers total completed as of June 1, 2020 |
| I.1 Emergency Preparation & Restoration¹ | Finalize TD-1464B-002, perform field and classroom exercises, and conduct classroom / web-based training to prepare utility personnel to restore services after emergencies | Central/Bay Region is complete (7/15-7/17), North Region is complete (8/3-8/7). Phase 3 (off track): Web Based Training PSPS-0001WBT finalized and deployed to field on 6/15. Web Based Training PSPS-0002WBT was finalized and deployed to DCC operators on 6/19. DCC operator training, PSPS-0002WBT, is complete. PSPS-0001WBT training is 100 percent complete as of 10/3 |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|--|--|--|
| I.2 PSPS - Service Restoration | PG&E has adopted a new goal of conducting safety patrols and restoring service to 98 percent of PSPS-affected customers within 12 daylight hours of the "weather all-clear" declaration. | Commitment substantially complete for the year. Aerial assets acquired as planned. Goal of 98 percent restoration within 12 daylight hours nearly achieved with 95.5 percent performance and limited further PSPS events anticipated in 2020. Driver of performance was (1) heavy smoke during the first PSPS event of 2020 (9/7) such that only 28 of 60 helicopters were able to fly, driving ~91 percent performance for that event; and (2) the 10/25 PSPS event taxed restoration teams due to its geographic breadth, driving 96 percent performance. |
| I.3 PSPS Customer Impact Mitigation | Mitigate PSPS customer impacts by using 1) advanced meteorology tools to forecast wildfire risk conditions, 2) apply improved analysis on system facing high fire risk, and 3) improving switching / sectionalizing, to affect smaller portions of the grid. | Condition 1 of 3 was met with the completion of commitments B.1 "Upgraded POMMS Model" and B.2 "NOAA-20 Satellite Data" meteorology forecasting tools. Condition 2 of this commitment is completed based on the improved analysis being utilized in the approved 2020 guidance for T&D PSPS. Condition 3 of this commitment, 2020 switching/ sectionalizing has been completed as of 9/1/2020- Distribution Sectionalizing, 602 devices commissioned YTD. The program completed the target commitment YTD ahead of time. Transmission switching has also surpassed its goal of 23 as we are at 36 YTD. |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|---|--|---|
| I.4 Community Based Organizations (CBOs) Coordination | PG&E will enhance coordination with Community Based Organizations (CBOs) and multi-cultural media partners that have existing relationships and serve disadvantaged and/or hard to reach communities to provide in-language / translated education | PG&E has conducted outreach to 264 CBOs and 38 multicultural media organizations that serve various groups within the AFN community to share information about PSPS preparedness. Overall a total of 250 CBOs and 36 multicultural media organizations have agreed to share PG&E awareness & preparedness messages with their consumers/network before and/or during PSPS events as applicable. |
| I.5 CERP (Update and Publish) | Updated/published Company Emergency Response Plan (CERP), 6/30 logged to GDL and 9/30 for Annexes logged to EDRS, both in accordance with EMER-2001S. | Final version of the 2020 CERP was held with Sr. Director of EP&R, on 10/08 and final approved and publish CERP was completed on 10/29. |
| I.6 Microgrids for PSPS Mitigation (operationalized units) | Mitigate the customer impacts of PSPS through permanent and temporary front-of-the-meter microgrid solutions | <ol style="list-style-type: none"> 1) 392 Mw of temporary generation have been reserved that could be deployed to PIH or substations that are safe to energize. 2) 4 temporary microgrids are operational (Angwin*, Calistoga, Shingletown, Placerville). 3) 62 substation sites have been made Operationally Ready or ready to receive temporary generation and energize safely within 48 hours of need to deploy prior to a PSPS event by the revised 9/21/2020 internal due date. |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

TABLE PG&E-7.2-1: 2020 WMP COMMITMENTS AND PERFORMANCE (CONTINUED)

| 2020 Commitments ^(a) | WMP Commitment | Summary of 2020 Performance |
|---|---|---|
| I.7 PSPS - 24/7 Information Updates | Mitigating Impacts on De-energized Customers during PSPS through 24/7 Information Updates. PG&E's website and call center allow customers 24/7 access | De-energized Customers during PSPS received 24/7 Information Updates. 100 percent completion as all 6 phases of the (Emergency Web) was complete by end of December |
| I.8 CRC Mitigate PSPS Customer Impacts | Mitigating Impacts on De-energized Customers during PSPS through Community Resource Centers (CRC) | In total, we have 362 event-ready outdoor and indoor sites as of December 21, 2020. |

(a) Color code legend: Blue Fill = Commitment is completed; Green Fill= Commitment is on target; Amber Fill = ~one month or less behind plan/"At Risk" or "Substantially Complete, if after due date"; Red = >one month behind plan / "High Risk" or "Commitment Missed, if after due date."

7.2.C Monitor and Audit Inspection Effectiveness

C. Monitor and audit the effectiveness of inspections, including inspections performed by contractors, carried out under the plan and other applicable statutes and commission rules.

To monitor and audit the effectiveness of inspections carried out under the 2021 WMP and other applicable statutes and CPUC rules, PG&E uses a combination of processes, tools and other control points intended to quickly identify anomalies in inspection and/or patrol results. Once identified, our programs are designed to address the gap, determine the root cause and pursue improvement opportunities.

In 2020, PG&E began staffing an inspection Process Quality function responsible for establishing and monitoring process control measures and notifying responsible parties to take corrective measures when predefined inspection quality standards are not achieved. The Process Quality group exists within System Inspections, operating alongside IA and Electric QA. To drive intra-departmental consistency, the Process Quality department is formally documenting governing processes to guide ongoing quality assurance, quality control, and quality verification as it relates to the inspection and patrol tasks.

PG&E continues to migrate inspection and patrol recordkeeping to digital tools and technology. As results and data are recorded electronically at the time of the inspection, opportunities for analyzing inspection quality are expanded and accelerated. Using digital records, the Process Quality teams can begin to identify potential outliers and identify areas where additional audits or re-inspection may be required. For example, flagging inspection personnel whose local productivity far outpaces their peers, or whose field issue find rates fall statistically below peers. Using such targeted metrics, PG&E can better identify the need for process improvements, additional training or supervision, and other corrective actions. Such inspection process control metrics remain under development and are expected to expand in 2021.

In addition, field work and inspections are audited by the Federal Monitor and WSD, as described in more detail in Section **7.2.A** above.

Additional information regarding monitoring and auditing of inspections is provided in Section **7.3.4.14**.

7.2.D Report in a format that matches across WMPs, Quarterly Reports, Quarterly Advice Letters, and annual compliance assessment

D. Ensure that across audits, initiatives, monitoring, and identifying deficiencies, the utility will report in a format that matches across WMPs, Quarterly Reports, Quarterly Advice Letters⁴, and annual compliance assessment.

Like other California utilities, PG&E is required to provide information regarding our wildfire risk mitigation activities in a variety of reports and forms. Each of those documents, including this one, generally have a prescribed format, information and set of objectives and metrics defined by the regulator and/or requestor. Several of those reporting forums are identified in the prompt to this question. PG&E agrees that it is in everyone's best interest to standardize and streamline these documents and reports to minimize duplication and confusion while maximizing the investment of time from all parties in developing, reviewing and responding to the valuable content of these discussions. PG&E is working to align our reporting and communication about WMP activities across these various reporting forums and will continue to do so. PG&E's CWSP PMO is the primary department that facilitates and responds to all wildfire mitigation related questions and reports and provides a level of consistency and continuity between document through its leadership. PG&E looks forward to partnering with the WSD and other parties on continuing to streamline the templates, formats, requirements and timeframes of all of wildfire mitigation related filings for the benefit of all parties.

⁴ General Rule for filing Advice Letters are available in General Order 96-B:
<https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M023/K381/23381302.PDF>.

7.3 Detailed Wildfire Mitigation Programs

In this section, describe how the utility's specific programs and initiatives plan to execute the strategy set out in Section 7.1. The specific programs and initiatives are divided into 10 categories, with each providing a space for a narrative description of the utility's initiatives and a summary table for numeric input in the subsequent tables in this section. The initiatives are organized by the following categories provided in this section:

1. *Risk assessment and mapping*
2. *Situational awareness and forecasting*
3. *Grid design and system hardening*
4. *Asset management and inspections*
5. *Vegetation management and inspections*
6. *Grid operations and protocols*
7. *Data governance*
8. *Resource allocation methodology*
9. *Emergency planning and preparedness*
10. *Stakeholder cooperation and community engagement*

7.3.a Financial Data on Mitigation Activities, By Category

In the following Section (7.3.2) is a list of potential wildfire and Public Safety Power Shutoff (PSPS) mitigation activities which fit under the 10 categories listed above. While it is not necessary to have initiatives within all activities, all mitigation initiatives will fit into one or more of the activities listed below. Financial information—including actual / projected spend, spend per line- miles treated, and risk-spend-efficiency for activity by HFTD tier (all regions, non- High Fire Threat District (HFTD), HFTD Tier 2, HFTD Tier 3) for all HFTD tiers which the activity has been or plans to be applied—is reported in the attached file quarterly. Report any updates to the financial data in the spreadsheet attached in Table 12.

Financial spend information:

PG&E has included the requested financial spend information for each initiative in Table 12 in "Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx". With regard to financial information, 2020 actual costs and 2021-2022 forecasts are provided. These forecasts are subject to changes as a result of operational and regulatory events. For example, as PG&E continues to gain experience implementing initiatives, the forecasts of cost may need to be updated. Forecasts are also subject to regulatory outcomes, including CPUC approval of the scope or timing of a specific initiative. With regard to plans and information for the number of units that will be installed for

certain initiatives, these are also subject to change. Actual unit installation and operation can be impacted by delays due to permitting, weather or access, labor availability, and availability of equipment. PG&E expects that the actual unit numbers will change from forecasts, especially for future years such as 2022.

In addition, PG&E is providing the following explanation regarding the financial spend information provided:

- Financial figures have been mapped to each initiative and/or category based upon the activity being described;
- Due to the updates in the 2021 Wildfire Mitigation Plan (WMP) templates, Non-High Fire Threat District (HFTD) and HFTD financials have now been included in the financial figures;
- Where applicable, Provider Cost Center costs have been utilized to accurately reflect the activity being described in the WMP initiative.
- Where detailed tier data was not available to delineate HFTD vs Non HFTD, the number of line miles across the system was leveraged to inform the split of financials and units into HFTD versus Non HFTD
- The costs reflect PG&E's best estimate of the costs for the proposed programs as of February 5, 2021. Actual costs may vary substantially depending on actual conditions and requirements.
- For the "2020 Actual" and "2020 Projected" cells in Table 12, the financial assumptions and reference point to extract the spend information is based the 2021 WMP scope. Please note that due to changes in scope for the initiatives from 2020 to 2021 (for example, we have added/removed sub-initiatives or as indicated above, we are now required to include Non-HFTD financials), we had to base the financials assumptions on the 2021 scope to ensure consistency.

Line Miles Treated and Transmission Voltage Definition:

The 2021 WMP Tables include data on the number of "line miles treated" for each initiative. This data has been provided, including being estimated, wherever possible, however there are a few limitations that should be understood for these figures.

First, a number of programs are not primarily defined by line miles but are defined by a number of assets (like the number of structures inspected each year, etc.). In these cases, PG&E made high level assumptions to estimate the approximate number of line miles that could be considered "treated" by such asset-based activities. As a result of these assumptions and estimates, the actual number of miles "treated" by these activities may not end up matching with the forecasts provided.

Second, activities at PG&E substations in HFTDs have been generally assigned as treating zero-line miles, since these activities primarily only impact assets within the substation itself and may or may not have material benefit to the circuit / line miles beyond the substation. The same is true for several programs where assets at just one particular point on the grid are being

addressed.

Finally, throughout this WMP, PG&E references Transmission assets and programs. PG&E defines transmission voltage (for this and other regulatory filings) as being 60kV or above, PG&E notes this because in some of the initiative definitions the WMP Guidelines provided referenced transmission as being “at or above 65kV.” PG&E is unable to reconfigure all of its data to align with a cut-off of 65kV instead of the historically used 60kV and therefore, when PG&E references transmission that is reflective of assets operating at or above 60kV.

Year Initiated

Table 12 (Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx) includes a column labeled “Year Initiated” for each of the initiatives. A number of the “initiatives” identified in the WMP templates include activities and programs that have been underway for a very long time, including routine vegetation management, asset inspections and forecasting a fire potential index. It would be difficult or impossible to pinpoint precisely when PG&E began some of these activities which stretch back decades. Therefore, PG&E has populated this column with either “<2018” for initiatives that were started before the current period of dedicated wildfire mitigation activities began in 2018 and has provided specific years for initiatives that were undertaken since the formation of PG&E’s Community Wildfire Safety Program in 2018.

Regulations

Table 12 (“Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx”) includes a column labeled “Current compliance status – In / exceeding with regulations.” For purposes of this column and the adjacent column regarding rules, PG&E has interpreted the term “regulations” to mean CPUC General Orders and federal or state laws. Therefore we have not included as “regulations” directives and decisions from the CPUC and potentially others that provide guidance or compliance expectations for some of the WMP initiatives.

7.3.b Detailed Information on Mitigation Initiatives By Category and Activity

Report detailed information for each initiative activity in which spending was above \$0 over the course of the current WMP cycle (2020-2022). For each activity, organize details under the following headings:

- 1. Risk to be mitigated/problem to be addressed*
- 2. Initiative selection (“why” engage in activity) – include reference to a risk informed analysis on empirical (or projected) impact of initiative in comparison to alternatives*
- 3. Region prioritization (“where” to engage activity) – include reference to a risk informed analysis in allocation of initiative (e.g., veg clearance is done for trees tagged as “high-risk”)*

4. *Progress on initiative (amount spent, regions covered) and plans for next year*
5. *Future improvements to initiative*

Mitigation initiatives:

In Section 7.3.b, PG&E presents a description of our programs for 124 initiatives across the 10 categories listed above. The financial spend information for 2020-2022 and Risk Spend Efficiencies (RSE) calculations for each initiative can be found in Table 12 in [Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx](#). Detailed workpapers for the RSE calculations can be found in Attachment 2021WMP_Section7.3_Atch01. PG&E provides the following clarifications on the some of the questions included in the guidelines for the Section 7.3.2 wildfire mitigation initiatives.

- *Question 2: Initiative selection (“why” engage in activity) – include reference to a risk informed analysis on empirical (or projected) impact of initiative in comparison to alternatives*

For each of the initiatives, we have provided an explanation as to why we engaged in this activity. However, in terms of “the risk informed analysis of empirical (or projected) impact of initiative in comparison to alternatives,” PG&E includes references to risk informed analysis in the response as applicable. Since our 2020 WMP filing, PG&E has made progress to increase the number of RSE calculations performed from 4 to 72. While PG&E needs to do more in evaluating how RSE scores can be leveraged into our strategic planning process for work prioritization and comparison of alternatives, in the near-term, PG&E is focused on refining on RSE modelling and increasing the number of RSE calculations across the initiatives. We have not performed a quantitative alternatives analysis on every initiative, some of which are very foundational and fundamental, like benchmarking with other utilities. At a minimum PG&E has considered not performing this initiative as a primary alternative, but in most all cases has at least subjectively evaluated that the benefits of performing the initiative outweigh the costs.

- *Question 4: Progress on initiative (amount spent, regions covered) and plans for next year and Question 5: Future improvements to initiative*

To address the “amount spent, regions covered” in Question 4, PG&E is capturing this information in Table 12 in [Attachment 1 – All Tables Required by 2021 WMP Guidelines.xlsx](#), which includes the financials and regions covered for each initiative, split out by Non-HFTD, Zone 1, Tier 2, and Tier 3. There are instances in which financial spend information is included in the response to Question 4 for a specific initiative to provide additional insights or context, but largely the financial data has been reserved for the corresponding portion of Table 12.

The second part of Question 4 (“plans for next year”) and Question 5 are asking for similar information. Therefore, for a number of initiatives, PG&E has combined our answers to address both Question 4 and 5. Furthermore, for some initiatives, PG&E does not yet have specific future plans or improvements defined. Certain initiatives are piloting new programs and therefore lessons learned have not been realized yet to inform future strategic plans. In other cases, as improvement opportunities come up, PG&E may implement these improvements rather than planning these improvements as future improvements. These are some of the cases where PG&E describes our future plans as reliant on further evaluation or assessment to determine the path forward. These labels are intended to accurately portray the next steps for these initiatives and reflect the current level of maturity for some of these programs.

Risk Quantification:

With regard to risk information, the initiatives in this section have been categorized into Mitigations, Controls, and Foundational Activity. These categories are defined as follows and the tables in Section 7.3.2 are populated accordingly:

Mitigations: Specific additional or enhancement programs, beyond compliance, with specific start and end dates and a project budget, or an additional proposed activity not previously identified. PG&E has calculated RSEs for these initiatives except where relevant data is not available. This could be because the initiative is a Pilot or otherwise does not capture data found usable for RSE calculation. For mitigations with RSEs, PG&E has provided data for columns ‘Primary driver targeted’, ‘Secondary driver targeted’, ‘Estimated RSE in non-HFTD region’, ‘Estimated RSE in HFTD Zone 1’, ‘Estimated RSE in HFTD Tier 2’ and ‘Estimated RSE in HFTD Tier 3’ at the initiative level to the best of its ability.

Controls: Safety and compliance programs already in place. These activities are performed at a standard level every year to ensure that our electric system assets remain in a suitable condition. In the case of controls, it is difficult to determine the wildfire risk level absent of performing the control, for several reasons:

- *PG&E has been performing this work for so long that it is challenging to estimate the counter-factual (consequences of number of equipment failures, outages and ignitions) that might occur if PG&E were not performing these routine control activities*
- *Some level of this work is required by regulation and good utility practice, it is difficult to zero-base budget, benchmark against peer utilities, or otherwise determine the appropriate minimum level of effort and investment for these activities*
- *PG&E has been tracking program inputs (work hours and resources) and outputs (trees trimmed, inspections performed, circuit miles replaced) as broad programmatic activities, rather than in more granular terms.*

PG&E has calculated RSEs for these initiatives except where relevant data is not available. For controls with RSEs, PG&E has provided data for columns 'Primary driver targeted', 'Secondary driver targeted', 'Estimated RSE in non-HFTD region', 'Estimated RSE in HFTD Zone 1', 'Estimated RSE in HFTD Tier 2' and 'Estimated RSE in HFTD Tier 3' at the initiative level to the best of its ability.

Foundational Activity: Enablers to mitigations or controls. They are work needed to implement mitigations or information that would be used to better inform the execution of a control (i.e., investments in Information Technology infrastructure or data gathering). Foundational activities generally do not result in stand-alone risk reduction. As a result, foundational initiatives do not have associated risk drivers or RSE values.

PG&E has not calculated RSEs for the majority of these initiatives; however, it has presented RSEs for some foundational initiatives in order to elicit feedback about its approach.

For the majority of Foundational Initiatives, PG&E has not provided data for columns "Primary driver targeted", "Secondary driver targeted", "Estimated RSE in non-HFTD region", "Estimated RSE in HFTD Zone 1", "Estimated RSE in HFTD Tier 2" and "Estimated RSE in HFTD Tier 3" and has indicated N/A-Foundational. For the foundational initiatives where RSEs are calculated, these columns have been populated.

Finally, accurately and meaningfully measuring risk is challenging, and while PG&E has made every effort to provide the data requested, we encourage the Commission, the WSD, and stakeholders to continue to facilitate a collaborative discussion on how to most reasonably quantify these programs.