BEFORE THE PUBLIC UTILIITES COMMISSION
OF THE STATE OF CALIFORNIA

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Order Instituting Rulemaking to Implement Electric Utility Wildfire Mitigation Plans Pursuant to Senate Bill 901 (2018).	**R.18-10-007** (Issued October 25, 2018)

PACIFIC GAS AND ELECTRIC COMPANY'S (U 39 E) RESPONSE TO ADMINISTRATIVE LAW JUDGE'S RULING SEEKING ADDITIONAL INFORMATION ON WILDFIRE MITIGATION PLANS

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February 26, 2019

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On February 21, 2019, Administrative Law Judge ("ALJ") Sarah Thomas issued a ruling ("Ruling") requiring that Pacific Gas and Electric Company ("PG&E") provide certain additional information regarding its Wildfire Safety Plan ("Plan"). Below, and in the documents attached to this filing, PG&E provides responses to the Ruling based on information currently available.

1. PG&E's Fire Prevention Plan

The Ruling requests that PG&E:

> Describe and quantify the effectiveness of the mitigation measures included in PG&E's Fire Prevention Plan (as filed for General Order 166). To the greatest extent possible, use the same Indicators and targets proposed in PG&E's WMP, and any other appropriate metrics that PG&E tracks, for the past five years. Additionally, describe how measures in the Fire Prevention Plan informed PG&E on what to include and expand upon for the WMP.

PG&E's Fire Prevention Plan ("FPP") is included as an annex to its Company Emergency Response Plan ("CERP"). The most recent version of the FPP is dated September 30, 2017 and is included as Attachment A to this filing.[1] The FPP includes a number of plan components that start on page 2 of the FPP. The Plan proposed in this proceeding was informed

[1] PG&E's CERP, including the FPP, are filed at the Commission. The most recent filing was on October 31, 2018 in Application No. 94-12-005. The FPP included as Attachment A to this filing is identical to the FPP filed with the Commission in October 2018.

by PG&E's 2017 Risk Assessment and Mitigation Phase ("RAMP") filing, as well as input from subject matter experts that started with the FPP.

PG&E does not currently have a prepared detailed quantification of the effectiveness of each the FPP plan components; preparing this type of quantification would take approximately two weeks to prepare. Nor do the FPP plan components directly correlated to the 2019 targets identified in PG&E's Plan. Thus, PG&E is not able within the three (3) business day time frame to provide a detailed quantification of FPP plan component effectiveness and/or correlate it to 2019 targets and metrics in the Plan. If it would be helpful to ALJ Thomas, Commission Staff, and the parties, PG&E can prepare information regarding the effectiveness of the FPP plan components within approximately two weeks.

Finally, the FPP did provide the basis of work historically performed regarding wildfire mitigation. However, as a result of the increase in catastrophic wildfires, additional measures to mitigate wildfire risk given the effects of climate change on the areas in which PG&E's assets operate were determined to be necessary. To that end, PG&E established the Community Wildfire Safety Program to further enhance the practices described in the FPP, to build upon historical practices with new measures sourced through benchmarking with other utilities.

2. Detail Regarding PG&E's Proposed Programs

The Ruling requests that PG&E:

> Describe in greater detail PG&E's wildfire mitigation efforts that are planned for the next five years, or longer term, in greater detail than that provided within Table 3. Please include any additional strategies and programs not included in this table, as well as any strategies and programs with shorter timeframes that PG&E intends to repeat on an annual or semi-annual basis.

In response to Request #2, this filing provides: (a) details regarding longer term programs; (b) additional strategies not included in Table 3; and (c) the frequency of all programs proposed in the Plan.

a. Details Regarding Longer Term Programs

Table 3 included all of the programs and strategies proposed by PG&E in its Plan, broken down by timeframes including before the upcoming wildfire season (assumed to be June 1, 2019), before the next Plan filing (assumed to be February 2020), within the next five years (2024), and beyond five years (beyond 2024). Some of these programs are one-time events, and some are ongoing work, such as inspections and vegetation management.

The Ruling requests greater detail about each of these programs. Detailed information regarding each proposed program is included in Section 4, in the corresponding Section identified in Table 3. For example, for recloser operations in line 1 of Table 3, Section 4.1.1 describes in detail the work that PG&E is proposing to do to SCADA-enable all line reclosers in Tier 2 and Tier 3 HFTD areas, and the date when this work is projected to be completed (*i.e.*, June 1, 2019).[2] Similar detailed information is provided for each program identified in Table 3 in the corresponding portion of Section 4. Section 4 was intended to provide a detailed discussion of each program identified in Table 3.

PG&E has prepared additional information regarding longer-term programs (i.e., five years or longer) and included that information in Attachment B. However, as indicated in the Plan, as PG&E learns more, it will "continue to improve and evolve these programs and may expand or re-prioritize the work described in the Plan."[3] Thus, the timing and scope of the longer-term plans may change. To the extent there are changes, this will be reflected in PG&E's 2020 wildfire mitigation plan filing.

b. Additional Strategies Not Included in Table 3

The Ruling also requests that PG&E identify any additional strategies or programs that are not in Table 3. PG&E does not currently have any additional strategies or programs to add to

[2] Plan at p. 48.

[3] Plan at p. 10.

Table 3. However, as indicated above, as PG&E learns more, it will "continue to improve and evolve these programs and may expand or re-prioritize the work described in the Plan."[4]

c. Frequency of Plan Programs

Finally, the Ruling requests that programs with shorter time frames (*i.e.,* less than five years) be identified with an indication whether the program will be repeated on an annual or semi-annual basis. Below, PG&E includes all of the programs in Table 3 and indicates whether, and how often, the program repeats. In some cases, programs are constantly ongoing or available. For example, aviation resources are continuously available for ongoing fire suppression efforts as needed. In cases where programs are continuous and available as needed, PG&E indicated that this program is "Continuous/As Needed." In other cases, a program such as the use of new pole materials is continuous and ongoing, and for those programs PG&E indicated they are "Continuous." Finally, in some cases, the program is a one-time event, such as SCADA-enabling all of the reclosers in Tier 2 and Tier 3 High Fire Threat Districts ("HFTDs"). In those situations, PG&E indicated that the program was "Not repeating" because it involves a one-time event.

Program	Repeating/Frequency
Recloser Operations	Not repeating
Personnel Work Procedures in Conditions of Elevated Fire Risk	Continuous
Safety and Infrastructure Protection Teams	Continuous/As Needed
Aviation Resources	Continuous/As Needed
Wildfire Safety Inspection Program ("WSIP"), Distribution	See discussion below
WSIP, Transmission	See discussion below
WSIP, Substation	See discussion below

[4] Plan at p. 10.

Program	Repeating/Frequency
Pole Material	Continuous
Pole Loading and Replacement	Continuous
Conductor	Continuous
System Protection	Continuous
Equipment	Continuous
Vegetation Trimming and Overhanging Tree Limbs	Continuous
HFTD Vegetation Management (VM) Inspection Strategy	Continuous
Inspecting Trees with a Potential Strike Path to Power Lines	Continuous
At-risk Species Management	Continuous
Challenges Associated with Enhanced Vegetation Management	Continuous
Community and Environmental Impacts	Continuous
Meteorological Operations and Advanced Situational Awareness	Continuous
Fire Spread Modelling – Phase 1	Not repeating
Weather Stations	Not repeating
Camera Deployment Strategy	Not repeating
Satellite Fire Detection Systems	Not repeating
Storm Outage Prediction Model	Not repeating
Wildfire Safety Operations Center	Continuous
PSPS Decision Factors	Continuous
Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts	Continuous
Impact Mitigation Through System Sectionalizing	Continuous
Resilience Zones	Continuous/As Needed

Program	Repeating/Frequency
Customer Services and Programs	Continuous/As Needed
PSPS Notification Strategies	Continuous/As Needed
Customer and Community Outreach	Continuous/As Needed
Mitigating PSPS Impacts on First Responders, Healthcare Facilities, Telecommunication, and Water Utilities	Continuous/As Needed
Re-energization Strategy	Continuous/As Needed
Rapid Earth Fault Current Limiter Pilot Project – Demonstration	See discussion below
Enhanced Wires Down Detection Project – Phase 1	Not repeating
Other Alternative Technologies	Continuous
Post-Incident Recovery	Continuous/As Needed
Restoration	Continuous/As Needed
Remediation	Continuous/As Needed
Environmental Remediation – Debris Flow Modeling	Continuous/As Needed

Wildfire Safety Inspection Program: The inspections described in PG&E's Plan will occur in 2019. As to whether these inspections will be annual, semi-annual, or one some other cadence going forward, PG&E proposes to make this determination after the initial WSIP inspections. As noted in the Plan's Executive Summary, PG&E will continue to enhance and build upon these programs as we learn from our experience and our collaboration with customers, communities, and industry experts. PG&E is in the early stages of executing its WSIPs and that, combined with on-going rapid technology advancements, makes it premature to determine the scope, methods, and frequency of future inspections. Regarding technology, for example, as noted in Section 4.2.2 of the Plan, PG&E is investigating the use of helicopter-based autonomous image capture methods for inspections. This technology could prove to be superior to the ground and climbing inspections that PG&E is implementing in the 2019 Plan. Additionally, as noted in Section 4.2 of the Plan, the new and enhanced risk-based approach identifies WSIP work by assessing the risk associated with each asset and by explicitly considering equipment modes of failure. PG&E expects that these efforts will continue to evolve as information is gathered and more is learned. PG&E will use the results of the current inspections to continue to shape a risk-informed re-inspection program and schedule for subsequent inspections. As noted in Section 6.2, the programs described in the Plan will be continuously reviewed,

evaluated, and modified as needed. PG&E's future wildfire safety plans will reflect continuous improvement gained by learning from implementing previous years' Plans.

Rapid Earth Fault Current Limiter Pilot Project – Demonstration: The nature of a pilot effort is to determine feasibility and effectiveness. Future year implementations of Rapid Earth Fault Current Limiter projects will be dependent upon success of the pilot.

3. Risk Spend Efficiency

The Ruling requests that PG&E:

Provide Risk Spend Efficiency (RSE) values for all mitigations provided in the WMP. Provide any supporting documents or work papers related to the RSE values of the mitigations included in the WMP.

In its 2020 General Rate Case ("GRC"), Application 18-12-009, PG&E discussed a number of the programs and mitigations included in the Plan, and described the RSE for each. An excerpt of the relevant testimony is included as Attachment C. In addition to its testimony, PG&E also provided detailed and extensive GRC workpapers regarding the RSE scores associated with all of the mitigations in the GRC, including wildfire mitigations. The GRC workpapers are available at: http://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=545398.[5] The workpapers are originally in Excel format. PG&E will readily make them available electronically to ALJ Thomas, Commission Staff, or any parties in this proceeding if requested. PG&E did not attach the workpapers here because of their size.

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[5] The GRC workpapers related to RSE scores are in Exhibit PG&E-02, Chapter 3, starting on page WP 3-67.

PG&E has not prepared an additional RSE analysis for mitigations in the Plan which are in addition to those identified in the 2020 GRC. Preparing an RSE analysis takes a considerable amount of time, and PG&E was unable to prepare the RSE analysis during the creation of this plan or in the three-business day response time for this data request.

Respectfully submitted,

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February 26, 2019

Attachment A
PG&E's Fire Prevention Plan

Fire Prevention Plan

September 30, 2017

Preface

This section contains Pacific Gas and Electric Company legal notices and trademarks, and provides information related to the ownership and maintenance of this document.

Document Control

The Electric Emergency Management Department maintains this Electric Annex to the Company Emergency Response Plan. This section records the revisions made to the plan, and approval of the plan by the persons responsible for its preparation, maintenance, and update.

Change Record

The following table is used to record all changes made to the plan. It describes the revisions made, the locations of the revisions, the names of the persons responsible for the revisions, and dates of revisions:

Revision	Sections Affected	Author	Date
1.0	Updated all sections and overall section arrangement. (E.g., added transmission, substation, job package, 911 standby, damage assessment, organization and responsibilities, etc.)	T3SN	7/24/2015
1.1	Updated fire prevention plan and minor edits throughout	T3SN, AMG2	8/28/2015
1.2	Full review and revision of the electric annex	S9SO	9/20/2017

Document Preparer

Name	Signature	Position	Date
Saman Saffarzadeh		Senior Emergency Management Specialist	9/20/2017

Document Reviewers

Names	Date
Jason Regan, Angie Gibson	September 2017

Document Approvers

Name	Signature	Position	Date
Barry Anderson		VP, Electric Distribution	9/20/2017
Greg Lemler		VP, Electric Transmission	9/20/2017

Document Owner

Name	Signature	Position	Date
Jason Regan		Director, Emergency Management & System Operations and Control	9/20/2017

Summary

Pacific Gas and Electric Company (PG&E) has had in place a number of separate operational plans and programs to prevent and mitigate the risk of fire ignitions associated with the operation of PG&E's electric facilities in areas having a "Extreme" and "Very High" fire rating, according to the USFS Wildland Fire Assessment System (WFAS). To complement and support the various operational measures PG&E has in place, PG&E monitors information made available from numerous entities and disseminates predicted weather and fire threat information to employees and contractors within its service territory to keep them informed of critical meteorological conditions. PG&E also has programs to reach out to its customers and first responders throughout its service territory to educate them on electric safety.

This plan collects in a single document the multiple fire prevention and mitigation plans and programs utilized in PG&E's entire service territory. It also includes in Attachment 1 the additional California Public Utilities Commission (CPUC) requirements for "Extreme" and "Very High" Fire Threat Zones in Southern California, which includes Santa Barbara County, and in Attachment 2, the identification of the CIP Tier 3 and Tier 4 fire threat areas to be used as the interim fire threat map, as ordered in Phase 2, D 12-01-032.

Policy Statement

It is the Pacific Gas and Electric Company's policy to:

- Plan for natural and man-made emergencies such as fires, floods, storms, earthquakes, cyber disruptions, and terrorist incidents;
- Respond rapidly and effectively, consistent with the National Incident Management System principles, including the use of the Incident Command System (ICS), to protect the public and to restore essential utility service following such emergencies;
- Help to alleviate emergency-related hardships;
- Assist communities to return to normal activity.

Plan Components

Fire Prevention Pre-Planning

Education

- Each year prior to May 1st, field personnel and their supervisors receive training on Utility Standard S1464 "Fire Danger Precautions in Hazardous Fire Areas." (This standard outlines operational requirements for working and operating in areas that are considered high fire risk during fire season.)
- PG&E conducts annual electric safety training for first responders; including law enforcement agencies, fire departments, public works and transportation agencies.

- PG&E participates in annual joint exercises that include external partners from the first responder community and emergency management community to enhance preparedness and prevention efforts.

Training First Responders

- PG&E meets annually with local, state and federal agencies and jurisdictions to share fire prevention plans, and strategize for the coming year.

Intelligence Gathering – Weather and Fire

- PG&E's meteorology department utilizes state-of-the-art weather forecast model data and information from the National Weather Service (NWS), The United States Forest Service (USFS) Wildland Fire Assessment System (WFAS), and other agencies to evaluate the short to medium term fire weather risks across its service territory.
- The PG&E meteorology department operates PG&E's Operational Mesoscale Modeling System (POMMS), a high-resolution weather forecasting model that forecasts important fire weather parameters including wind speed, temperature, relative humidity, and precipitation down to 3-km resolution. Outputs from the POMMS model then are used in the National Fire Danger Rating System (NFDRS) to derive key fire danger indicators such as the Energy Release Component, Ignition Component, Spread Component, Burning Index, and fuel moistures.
- Each day, fire danger output from the POMMS-NFDRS model as well as Red Flag Warnings or Fire Weather Watches from the NWS determine the "very high" and "extreme" fire danger ratings across the PG&E Service Territory. Operational decisions to reduce the fire ignition risk (see Section 2 – Operational Readiness during High Risk Conditions) go into effect each day "very high" or "extreme" fire danger ratings occur. Daily e-mails to electric operations with fire conditions are sent; fire conditions are also discussed is daily calls.
- Two to seven day forecasts are also provided each day that identifies upcoming periods of heightened fire weather risk. The updates provide information about offshore wind events, extreme hot and dry conditions, and dry lightning potential. This information, combined with weekly forecasts from National Interagency Fire Center (NIFC) - Predictive Services for Northern (ONCC) and Southern California (OSCC), give advanced warning about significant fire danger.

Established Fire Prevention Program

PG&E has in place programs that serve to mitigate the risk of an ignition associated with its electrical operations through its service territory. The various programs are:

Electric Operations – Asset Management

Non-Exempt Equipment Replacement

This program focuses on replacement of non-exempt equipment subject to firebreak maintenance under California Public Resource Code 4292. This work is identified and prioritized by a standardized risk assessment at each site. Prioritization starts with identification of equipment type and site specific fire risk assessment. If equipment is not eligible for replacement, fire risk continues to be mitigated by annual maintenance of firebreaks at the facility base.

CalFire has also granted an exemption for two lightning arresters since 2015. PG&E has developed a surge protection replacement initiative that will target replacement of non-exempt lightning arrestors with these new alternatives.

Infrared (IR) Program and Automatic Splice Inventory

This program is currently prioritized in PG&E designated wildland fire prevention areas with a multi-year strategy to IR and splice inventory the entire electric distribution system. This program utilizes forward looking infrared (FLIR) technology to identify thermal exceptions on all phases of line. Thermal exceptions are evaluated and repair/replacement are prioritized and completed.

Wires-Down Program

Our Distribution Planning department performs a site visit to most wire-down locations caused by either equipment failure or animal contact. The data obtained from these visits aids in our efforts to reduce future wires-down events. Some of the benefits include:

- Establishing failure rates for conductor types and size
- Obtaining splice data which is added to the MapGuide (GIS) system.
- Obtaining details on wire-down events where the conductor remained energized.
- Generating projects to replace deteriorated conductor

Wood Pole - Test and Treat Program

The Pole Test and Treat (PT&T) program performs intrusive testing on all wood distribution and transmission poles. While General Order (GO) 165 mandates this testing on 20-25 year increments depending on the time of installation, PG&E's program is based on a 10 year cycle. This PG&E program exceeds the inspection cycle requirements outlined in the GO and incorporates wood preservation practices beyond the regulatory requirement. These factors allow PG&E to identify and mitigate the decay of wood which reduces failures. The program also allows for proactive reinforcement or replacement of poles that do not meet strength requirements.

Wood Pole Bridging Program

Bridging crossarms prevents pole fires which can occur at the through-bolt location during light rain or mist. Because this area is dry and has a high resistance to insulator leakage currents flowing to ground, a hot spot exists on the pole. Shunting this high resistance area with a short length of bare wire usually abates the risk.

Electric Operations – Maintenance and Construction

Overhead Patrols and Inspections

PG&E inspects its electric facilities to identify conditions that may pose the risk of an ignition. The program is designed to:

- Perform annual patrols of distribution lines in urban areas, designated high fire threat zones, with biannual patrols of overhead distribution facilities in rural areas.
- Perform targeted patrols on transmission lines located within Tier 3 and Tier 4 designated high fire threat areas.
- Perform detailed inspections of overhead distribution facilities on a 5-year cycle.
- Perform detailed inspections of overhead transmission lines on a 3-year cycle for 500 kV, a 5-year cycle for 230 kV and lower having steel structures, and a 2-year cycle for wood pole structures.
- Document patrol and inspection activity and findings.

Operational Readiness During High Risk Conditions

PG&E Utility Standard S1464 “Fire Danger Precautions in Hazardous Fire Areas,” outlines operational requirements for working and operating in areas that are considered high fire risk during the designated fire season. When an area is rated “Extreme” or “Very High,” it is identified and colored coded on the map. (Refer to Attachment 3.) The following summarizes the plan:

- General readiness requirements for all employees are covered, including awareness of all laws, rules, and regulations of fire agencies having jurisdiction over areas in which they work or travel. Each crew must be equipped with well-maintained firefighting equipment.
- Fire Index ratings, as determined by the POMMS-driven National Fire Danger Rating System (NFDRS) and/or Red Flag Warnings and Fire Weather Watches issued by the National Weather Service, are in effect from 0800 hours to 2 hours after sunset.
- Field personnel traveling or working in an “Extreme” or “Very High” Fire Index area, are prohibited from any burning, welding, blasting, smoking, and driving off cleared roads.
- Electric Operations is restricted from testing any section of line that relays in a Fire Index area rated “Extreme” or “Very High”, until the line has been patrolled and all trouble cleared.

- Notification Process to Personnel of Daily Fire Threat Conditions
- Daily updates of a fire index website that contains an image showing active “Extreme” and “Very High” areas.
- Daily 6 a.m. fire index e-mail.
- Daily review of the fire index by Crew Supervisors and briefing of crews if they are heading into an area having fire indexes of “Extreme” and “Very High” zones.
- Daily dissemination of all Red Flag Warnings on Distribution System Operations (DSO) Storm Outage Prediction Project forecast for Extreme” and “Very High” areas and daily DSO status calls Mondays through Fridays, excluding holidays.
- Weekly fire danger forecast from meteorology team.
- Production of a daily image of the “Extreme” and “Very High” fire index areas, using internal Geographic Information Systems (GIS). This image is available on the PG&E intranet and can be viewed with intranet access.

Notification Process to Personnel of Daily Fire Threat Conditions

- Daily updates of a fire index website that contains an image showing active “Extreme” and “Very High” areas.
- Daily 6 a.m. fire index e-mail.
- Daily review of the fire index by Crew Supervisors and briefing of crews if they are heading into an area having fire indexes of “Extreme” and “Very High” zones.
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- Weekly fire danger forecast from meteorology team.
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Vegetation Management

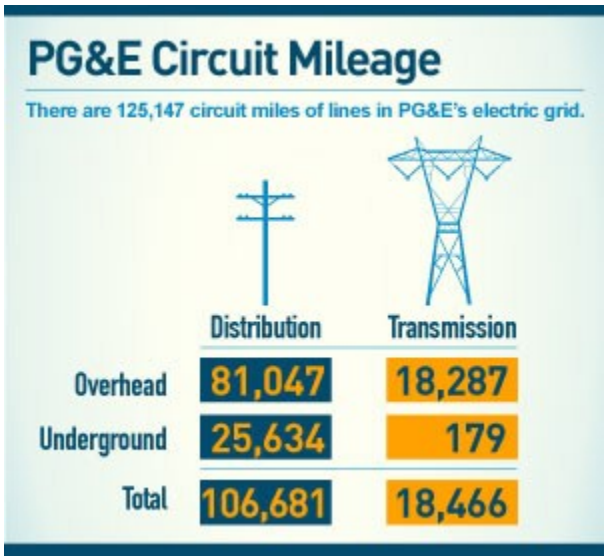
Regulatory

- PG&E manages the vegetation close to its overhead electric facilities, which reduces the risk of possible ignitions associated with vegetation contact. PG&E’s program is designed to:
- Comply with all existing State and Federal regulatory vegetation clearance requirements.

- Perform annual patrols to ensure required vegetation clearances are maintained and hazardous trees abated.
- Maintain tree-to-line clearances as well as radial clearances around its poles pursuant to Public Resources Code Section 4292 and 4293.
- Maintain auditable records of all work done in high fire risk areas.

PG&E's Routine Vegetation Management Inspections

In order to reduce the incidences of vegetation contacting energized conductors, PG&E employs over 400 utility arborists and contractors to conduct annual ground inspections of 100 percent of PG&E's 99,700 miles of overhead distribution and transmission power lines. Through the annual inspections, inspectors look for vegetation growing in the area around the power lines.



PG&E's line clearance qualified professional tree care workers then reduce the risks through pruning or removal of the trees, called "abatement" of the vegetation.

More than 400 utility arborists/foresters and 1,600 line clearance qualified tree care professionals perform routine annual activities on behalf of PG&E's Vegetation Management Department involving:

- 70,000 square mile service territory
- 81,000 miles of overhead distribution
- 18,300 miles of overhead transmission
- 5,000,000 trees with the potential to "grow into" power lines
- 147 million trees within tree-height of the facilities

Contract inspectors and tree workers annually:

- Prune or remove about 1,200,000 trees per year
- Prune or remove about 6,000 trees per day
- Interact with about 10,000 customers per day
- Inspect about 2,000,000 properties per year
- Maintain fire breaks on 120,000 power poles and towers

As a part of these activities, PG&E VM employees and contract work force is trained in fire prevention. Each year, arborists and tree workers learn about sources of ignition, ignition prevention, and fire suppression equipment and its use. Each worker is supplied with fire prevention and suppression tools to use in the field should a fire occur, including extinguishers, Mc Clouds (hoe-like firefighting tools), shovels, and back-pack sprayers.

PG&E's Public Safety and Reliability and Wildfire Risk Reduction Program

In addition to the routine inspection and abatement process, PG&E has also implemented a Public Safety and Reliability (PS&R) Program to further reduce vegetation related outages and ignitions. This program complements the routine inspection activities by providing additional data-driven vegetation management at high risk locations.

From years of performing targeted tree work, PG&E has collected an extensive database of information about tree failures causing outages and ignitions.

Analyzing that data, PG&E VM may predict how, generally when and where each species of tree is more likely to fail and cause an outage. The analyses indicate whether each type of tree species is more likely to shed limbs, break in the stem, or uproot and fall over, and the time of year and soil/climate conditions where each species is more susceptible to failure. PG&E's VM utilizes this experience and knowledge to prescribe tree abatement work along length of wire with a history of tree-caused outages. About 25,000 trees are abated each year with this program.

Utilization of Fire Modeling and Fire OIR Map 2 Products

In addition to PG&E's routine inspections and PS&R, PG&E determined that there was a need for more intensive tree inspections in the highest fire risk areas as determined by wildfire modeling and proposed CPUC Fire Map Tier 3. PG&E VM inspectors will conduct more intensive targeted tree inspections, and tree crews abate trees that meet certain thresholds.

Drought-Affected Vegetation Impacts – Special Redundant Abatement

The cumulative effect of the continued drought is beginning to manifest itself in widespread vegetation mortality—particularly in the low elevation conifer stands of the south and central Sierra.

The unprecedented level of mortality has left whole forested regions dead and has greatly increased the level of work necessary to abate risks associated with dead/dying trees and tree limbs failing.

PG&E's Vegetation Management Drought-Mitigation Initiatives In Addition to Its Annual Routine Work

Focusing on distribution assets, the initiatives to respond to the drought include:

- Redundant tree inspections abatement work where about 73,000 miles of power line are inspected and trees abated. About 155,000 trees will be abated in 2017 using 200 specialized tree inspectors and about 350 specialized tree crews. PG&E is also cleaning up tree debris (fuel) in drought affected counties; especially in High Hazard Zones (HHZ).

- Funding local community groups to conduct fuel reduction and safe ingress/egress work. About $11.6 million has been allocated to local groups since 2014.

In–Development, Pilot and Ad-Hoc Fire Prevention Activities

PG&E is dedicated to exploring the value of additional fire prevention programs associated with its varied operations. The following list of activities and mitigation have varied application within PG&E's service territory. All are being evaluated and incorporated into metrics as part of the company's strategy. These efforts are being evaluated for cost-benefit and fire prevention effectiveness on an on-going basis.

- Ignition reporting metrics and driver evaluations
- Voluntary firebreak maintenance for non-exempt equipment in PG&E designated areas
- PT&T prioritization of pole reinforcement and replacement in high fire threat areas
- Annealed copper replacement
- Targeted conductor replacement
- Annual detailed wildfire inspections in PG&E designated areas
- Increased SCADA and Fault Detection
- SCADA enabled Line Recloser auto-blocking in select high fire threat areas
- Equipment Testing and overhaul in high fire threat areas
- Sensitive ground fault tripping
- Increased Squirrel/Raptor Protection
- Protection-line down guy / insulator retrofits
- Targeted Pole Loading evaluations
- Insulator Washing
- Small Fire Suppression Training - Indian Backpacks/McCleod

- Exploration of emerging fire detection technologies and services

Detection Activities

PG&E's has implemented several fire detection efforts to aid early detection and facilitate rapid response to all fires.

- Contracted daily contacted, fixed wing aerial "smoke," patrols during fire season
- Daily "Service Line Agreement" for fire detection during daily Gas Operations flights
- Sponsoring remotely operated cameras to identify and call-in fires.
- Satellite fire detections

Fire detection from space has rapidly improved over the last decade. PG&E Meteorology is leveraging fire detection data from polar (MODIS) and geosynchronous satellites (GOES) at present. The next generation weather satellite (GOES R/16), once operational (~ November 2017), will scan the entire continental US every 5 minutes and will be able to detect fires as small as roughly 2/3s the size of a football field.

Pro-Active Responses to Fire Incidents

PG&E's fire prevention activities include firefighting and fire-recovery response. In the event a fire threatens public safety or PG&E facilities, PG&E will support firefighting efforts as appropriate, through the procurement and allocation of man power, particularly those from unaffected areas and outside sources and activation of PG&Es Incident Command System. PG&E has developed and has ready two 39', one 30' and four 24' Incident Command Centers that are self-contained, operationally ready, mobile coordination and communications centers, which can be deployed within hours.

With approval of the fire Incident Commander at the Incident Command Post, there are many cases where PG&E crews respond to the fire area and perform pole pre-treatment and fuel reduction activities ***ahead of the fire*** on and near the power line right-of–way.

- Pole pre-treatment is conducted with an approved wildland fire chemical applied to wooden power poles, thus helping to prevent ignition of the power pole from direct flame impingement or radiant heat.
- Vegetation clearing/fuel reduction – Vegetation Management crews may work ahead of the fire to reduce the fuel in and around the power poles and utility right-of-way using a variety of vegetation clearing/fuel reduction methods.
  - Limbs are removed to reduce ladder fuels, thus preventing a fire from getting into the tree crowns and reducing the volume of fuel/vegetation in the right-of-way.
  - Vegetation is treated with masticators to create defensible space around the power poles if the fire were to burn in the proximity, the right-of-way would act as a fuel break and bring the fire out of the crown and down to the ground , so that the fire suppression crews will have a better chance to control the spread of the fire.

- Field readiness – Field personnel may work directly with the fire suppression Incident Command to coordinate efforts to identify potential hazards and mitigations to provide a safe area for the public and the personnel working onsite. If the power lines need to be de-energized, the crews are onsite to perform the task for the fire control personnel. This will alleviate a hazard and the possibility of contact with a live/hot conductor should it come down from a burned power pole or be brought down by a hazardous tree or other conditions.
- Operational controls – Onsite personnel may coordinate with fire suppression Incident Command personnel should a change in tactics be necessary to protect critical generation, transmission and distribution system assets.

Post Incident Recovery

Critique Process

- PG&E normally conducts a thorough post-event critique within 21 days after a fire-related incident resulting in Operations Emergency Center (OEC) activation.
- PG&E also participates in joint public agency/PG&E debrief sessions following a fire event that required an escalated response, to gather information on response activities that went well, identify areas for improvement, and share best practices and lessons learned.
- Each department involved in an escalated-response event should review their emergency operations plans to determine whether modifications need to be made in light of the experience gained during the emergency.
- PG&E normally requests after action reports from responding agencies to review, and utilizes them in future improvement planning efforts.

Remediation Activities

- Abating fire affected trees that pose a threat to the utility lines is normally done after the fire has gone through the area.
- To control erosion, mastication is used with minimal soil disturbance and dense organic material left behind. In coordination with fire suppression agencies, PG&E may construct water bars in the power line right-of-way access roads for erosion reduction in the burned area. This is done after the restoration efforts are completed.
- In some cases conductors and insulators may need to be cleaned based on the possibility that fire retardant was dropped on the line and that the particulate matter from the smoke plume could have caused a buildup on the line due to incomplete combustion of the fire, particulate matter, and radiant heat.

Example of Masticated Area

Fire Prevention Plan Performance and Metrics

This Fire Prevention Plans performance is monitored and evaluated through annual program planning and schedule attainment monitoring. Annual CPUC reportable ignitions and a wildfire program dashboard are updated and distributed monthly.

Reportable Ignition Metric

Ignition reporting has been incorporated into PG&E operations since June, 2014. This data has been utilized in reporting to establish baselines to inform metrics that focus on continuous improvement. Ignition drivers are evaluated to identify and develop potential mitigations designed to reduce annual ignitions.

Wildfire Dashboard

Fire Prevention Plans performance is monitored monthly with a dashboard that highlights its programs and status relative to the annual schedules. Status is reported as Red, Amber or Green. Programs outside of “Green” status require corrective actions that identify operational challenges and actions required for schedule recovery.

Fire Prevention Plan References

1. CPUC General Order 166, Standard 1.E: *Fire Prevention Plan*.
2. CPUC Decision 09-08-029: *Decision in Phase 1—Measure to Reduce Fire Hazards in California Before the 2009 Fall Fire Season*, August 20, 2009. (Phase 1 of Rulemaking 08-11-005.)
3. CPUC Decision 12-01-032: *Decision Adopting Regulations to Reduce Fire Hazards Associated with Overhead Power lines and Communication Facilities*, January 12, 2012. (Phase 2 of Rulemaking 08-11-005.)
4. Electric Distribution and Transmission Utility Standard S-1464 "Fire Danger Precautions in Hazardous Fire Areas"
5. CPUC Decision 14-05-020: *Decision Granting In Part and Denying In Part The Petition to Modify Decision 12-01-032*, May 2014. (Refer to Attachment 4.)

Fire Prevention Plan Attachments

Attachment 1 – Special Fire Threat Zones: Santa Barbara County

Summary

The CPUC has directed utilities to take additional steps to mitigate fire risk in certain high fire threat areas in Southern California counties, including Santa Barbara County.[8]

As a result PG&E's plan includes the following additional fire prevention and mitigation measures for its facilities in the applicable areas of Santa Barbara County.[9]

Vegetation Management

For line sections in a State Responsibility Area (SRA) or line sections located in "Extreme" and "Very High" Fire Threat Zones in a Local Responsibility Area (LRA), the following vegetation clearance requirements apply.

Clearances to be maintained year-round:

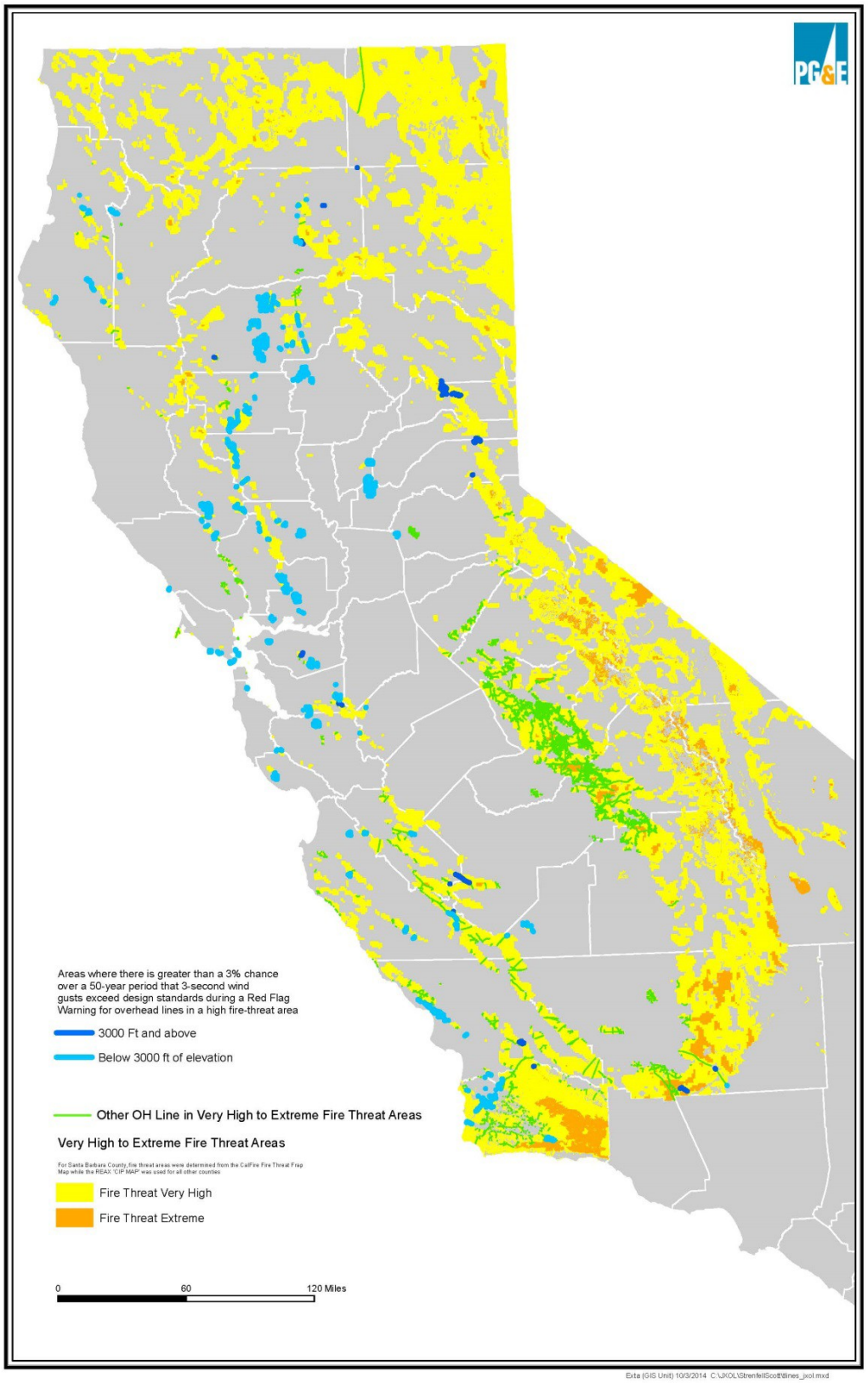
- 2.4 kV-72 kV = 6.5' at time of trimming, 4' at all times
- 72 kV-110 kV = 10' at time of trimming, 6' at all times
- 110kV-300 kV = 20' at time of trimming, 10' at all times
- Above 300 kV = 20' at time of trimming, 15' at all times

Overhead Patrols

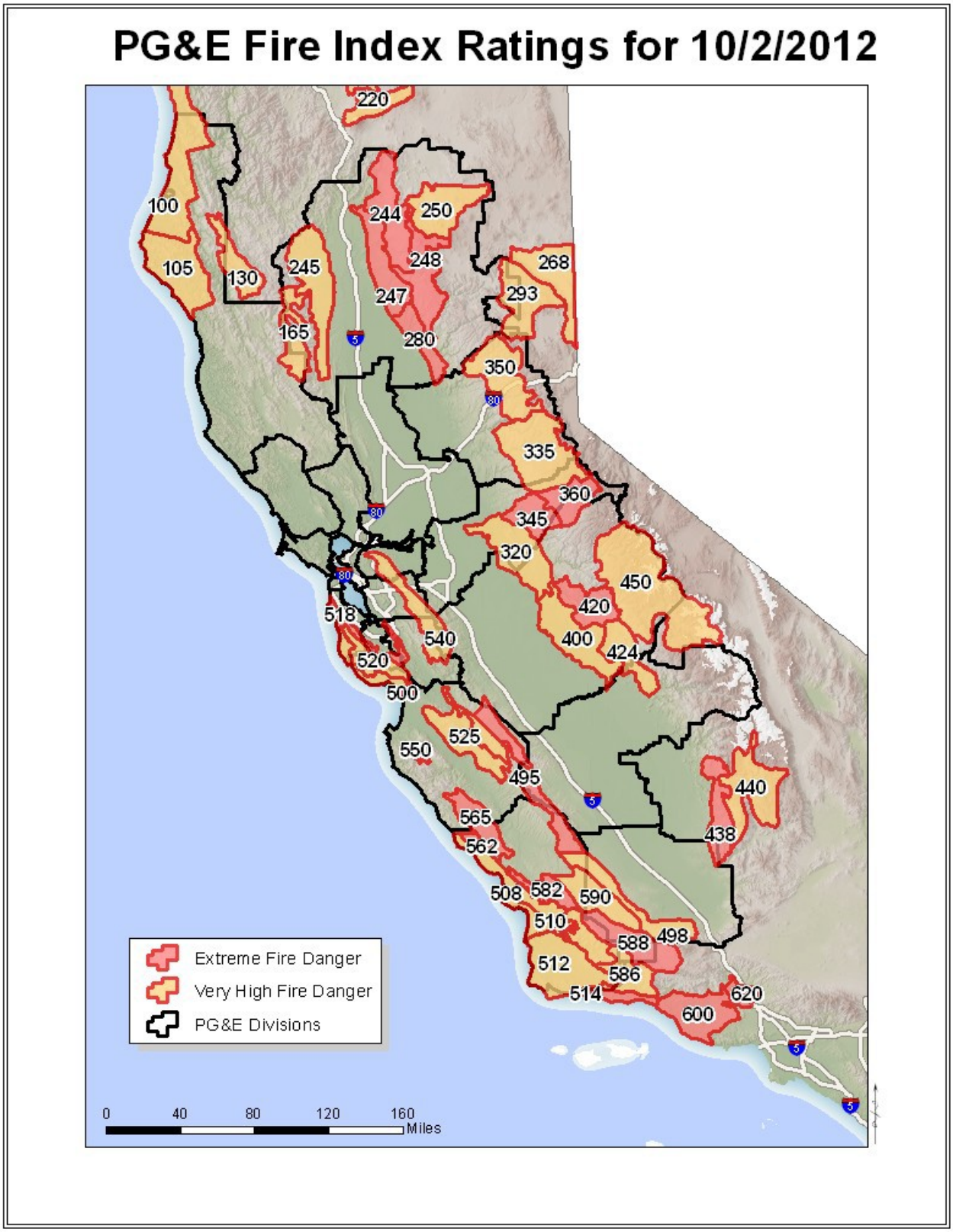
For overhead distribution facilities located in rural areas in the "Extreme" and "Very High" Fire Threat Zones of Santa Barbara County, patrols of applicable facilities should be conducted annually instead of every two years.

[8] See CPUC D.09-08-029 and D.12-01-032 and corresponding requirements in General Order (GO) 95 (including new Case 14 in Table 1 and Appendix E) and GO 165.
[9] The areas to receive special treatment by PG&E in Santa Barbara County are the "Extreme" and "Very High" Fire Threat Zones as designated on the Fire and Resource Assessment Program (FRAP) Map.

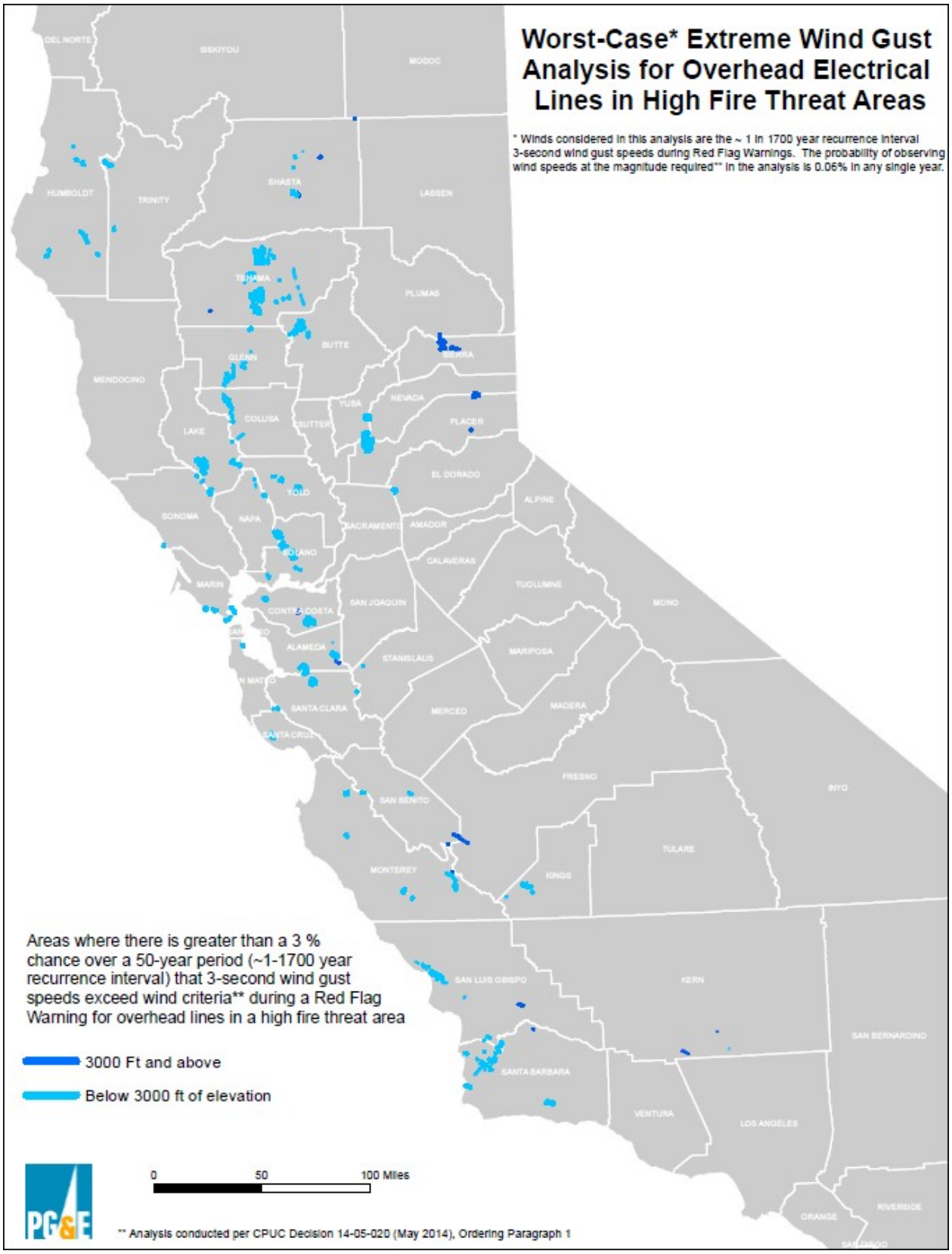
Attachment 2 – Interim Fire Threat Map



Attachment 3 - Fire Index Map of PG&E Territory



Attachment 4 – Worst Case Extreme Wind Gust Analysis



Attachment B
Details Regarding Longer Term Programs

Attachment B
Details Regarding Longer Term Programs

System Hardening:

Timeframe:

- Longer-term effort (>5 years) to system harden ~7,100 circuit miles
- 2019 Target: 150 miles
- 2020 Target: 600 miles
- 2021 Target: 600 miles
- 2022 Target: 600 miles
- 2023 Target: ~860 Miles

Description:

The System Hardening Program is an ongoing, long-term (more than five years) capital investment program to rebuild portions of PG&E's overhead electric distribution system. In 2018, PG&E initiated construction pilots to evaluate various overhead conductor and equipment configurations, including potential undergrounding, as well as to develop best practices. In 2019, PG&E will begin the System Hardening Program with a target of completing 150 circuit miles by the end of the year. In 2020-2022, PG&E forecasts completing work on 600 circuit miles per year, and complete approximately 860 miles from 2023-2028 in order to complete work on 7,100 circuit miles in Tier 2 and Tier 3 HFTD areas within 10 years.

This program consists of ignition-risk-modeled and field identified work that will result in a full rebuild of the overhead distribution system to increase its overall strength, replace aging assets, and reduce risk from external factors, such as vegetation contacting lines. Design aspects include the replacement of bare overhead primary and secondary (480V and below) conductor with covered conductor, targeted pole replacement, replacement of non-exempt equipment, and potential targeted undergrounding. Each of the above design aspects are discussed in Chapter 4 Section 3 of the Plan, starting on page 60. This work will occur based on PG&E's risk modelling of the distribution circuits.

The precise scope of hardening work will be site-specific and dependent on local conditions. Not every measure is effective or necessary at every location. As PG&E implements the system hardening program, we will continue to evaluate the design considering local conditions optimizing the appropriate solution for that location. For example, where appropriate, PG&E may perform some undergrounding of select overhead lines. In addition, bird/animal guards will also be installed where necessary to help prevent electrical contacts and outages. PG&E will continue to update the risk model with asset failure information, utility best practices, and new technology, which will result in a more refined asset investment plan.

In addition, PG&E is also evaluating different protection schemes and equipment that may further reduce the likelihood of a fire ignition when a system failure occurs. The program includes:

- Fusesavers™: Fusesavers™ enable localized isolation of all phases of a line when a problem is detected on only one or two phases. For example, if a single wire down on a three-phase line is detected, Fusesavers™ can automatically and locally de-energize all three phases. Installing these devices can also create additional points where lines can be segmented to support other wildfire risk reduction programs such as PSPS.
- High Impedance Fault Detection: PG&E is piloting and proposes to deploy newer protection capabilities of reclosers and circuit breakers that increase the ability to detect high impedance faults.
- Increased Protection Sensitivity: PG&E is evaluating the use of more sensitive protection settings and use of fast curves set on reclosers and circuit breakers. The proposed settings and use of fast curves would reduce the amount of energy experienced when a system failure occurs. This may lower the potential for a fire ignition to occur. The proposed protection schemes, however, could reduce the ability to coordinate with protective devices downstream and will lead to an increase in the size and duration of outages.

Enhanced Vegetation Management:

Timeframe:

- Longer-term effort (>5 years) to perform Enhanced Vegetation Management on ~25,000 circuit miles
- 2019 Target: ~2450 miles
- 2020 Target: ~2900 miles
- 2021 Target: ~2900 miles
- 2022 Target: ~2900 miles
- 2023 Target: ~2900 miles

Description:

1. Vegetation Trimming and Overhanging Tree Limbs: In Tier 2 and Tier 3 High Fire-Threat District ("HFTD") areas PG&E will remove all branches that directly overhang the radial clearance zone around electric distribution lines required by CPUC regulations and California statutes. GO 95, Rule 35 and PRC Section 4293 generally require a four-foot radial clearance between vegetation and electric distribution wires in HTFD areas. By removing overhanging tree limbs, there will be fewer tree limbs that could fall or grow into the mandated clearance zones. PG&E forecasts performing both these activities at the approximate rate of 2,900 circuit miles per year, a pace based an estimated 8-year effort to complete the work within Tier 2 and Tier 3 HFTD areas. Progress will vary by year, and the target for 2019 is to complete approximately 2,450 miles.
   On the electric transmission system, all circuits are planned to be inspected and worked in 2019 to remove overhangs. This scope of overhang removal work will be incorporated into the annual inspection and tree work cycle for all transmission circuits. Due to the historically broader clearances maintained between transmission lines and vegetation and a practice of preventing direct overhangs of transmission lines, the number of trees anticipated to require work to align the electric transmission system with this scope will be significantly less than for the distribution system.

In addition to the initial overhang clearing work, discussed above, PG&E will

need to perform annual, follow-up vegetation maintenance work on the sections of line cleared of overhangs, to keep all branches above powerline height from growing back into an overhanging position. As the number of miles initially cleared of overhangs increases, the annual maintenance and upkeep effort will also grow.

2. At-risk Species Management: PG&E has identified ten tree species as responsible for approximately 75 percent of the vegetation-related ignitions in Tier 2 and Tier 3 HFTD areas. While performing the overhang clearing work described above, PG&E will remove or trim trees from these ten species that are tall enough to strike distribution lines, have a clear path to strike, and exhibit other potential risk factors (e.g., leaning towards power lines). As this work will be performed concurrent to the overhang clearing work, PG&E forecasts performing this activity at the approximate rate of 2,900 circuit miles per year, a pace based an estimated 8-year effort to complete the work within Tier 2 and Tier 3 HFTD areas. Progress will vary by year, and the target for 2019 is to complete approximately 2,450 miles.

Weather Stations:

Timeframe[6]:

- Longer-term effort (within 5 years) to install weather stations throughout the HFTD areas of PG&E's service territory
- 2019 Target: 400 weather stations
- 2020 Target: 400 weather stations
- 2021 Target: 300 weather stations

Description:

PG&E plans to install new weather stations at a density of one station roughly every 20 circuit miles in HFTD areas within PG&E's service area to provide detailed information about temperature, wind speeds and humidity levels. Data from these new stations will provide improved awareness of current fire danger conditions.

PG&E currently operates more than 200 weather stations within its service area to obtain local weather data in real-time and these data are publicly available through the NWS. This data is utilized to assess current fire danger conditions to facilitate operational decision making and support safe operation of facilities. PG&E plans to deploy an additional 400 weather stations by September 1, 2019, doubling the installation pace from 2018. In the 2020 GRC PG&E forecasted installing approximately

[6] In the 2020 GRC, PG&E forecasted installing approximately 1,300 weather stations in total within five years at the following pace: 200 per year in 2018 and 2019 and 300 per year in 2020-2022. The proposed timeframe listed above accelerates the pace of weather station installations.

1,300 weather stations in total within five years. Ultimately, PG&E may deploy more than or less than 1,300 stations as it continues to study and learn from these efforts, but 1,300 stations installed by 2022 is the best estimate at this time. It would take years to perform research and modeling to determine the optimum density of weather stations that would provide PG&E with clear knowledge of local conditions in its service territory. In the meantime, PG&E exercised judgment, considering knowledge of its service territory and other utility practices such as those of SDG&E, to decide the density of weather stations to install at this time, which will provide PG&E with sufficiently granular knowledge of local conditions to appropriately guide its wildfire risk reduction measures. The data collected from these stations are made publicly available in near-real time to benefit the public, federal, state, and local agencies.

Camera Deployment Strategy:

Timeframe[7]*:*

- Longer-term effort (within 5 years) to install high-definition cameras throughout the HFTD areas of PG&E's service territory
- 2019 Target: ~ 70 cameras
- 2020 Target: ~ 180 cameras
- 2021 Target: ~ 180 cameras
- 2022 Target: ~ 170 cameras

Description:

PG&E plans to install a network of high-definition cameras by 2022 that, when complete, will allow PG&E and fire agencies to monitor over 90 percent of PG&E's HFTD areas. PG&E currently estimates this will require the installation of approximately 600 high-definition cameras in Tier 2 and Tier 3 HFTD. PG&E piloted the installation of 9 cameras in 2018 and plans to install approximately 70 cameras in 2019, 180 cameras per year in 2020 and 2021, and 170 cameras in 2022.

The high-definition, pan-tilt-zoom cameras will improve PG&E's overall situational awareness and be a valuable tool for assisting PG&E's Wildfire Safety Operations Center, first responders, and fire agencies. The cameras currently planned for installation have near infrared capability and a web interface with time lapse functionality to assist with confirmation of fire reports, and monitoring fire progression and environmental conditions. First responders can control the cameras and use the live feeds to quickly confirm, locate, and respond to fires, and to provide that the right resources go to the right area.

[7] In the 2020 GRC, PG&E forecasted installing approximately 600 weather stations in total within five years at the following pace: 9 camera pilot in 2018, 60 cameras to be installed 2019 and 180 cameras per year in 2020-2022. The timeframe listed above accelerates the pace of camera installations.

Resilience Zones:

Timeframe:

- Longer-term effort (>5 years) to build Resilience Zones in HFTD areas
- 2019 Target: 1 Resilience Zone
- 2020 and beyond targets: results of the 2019 pilot will dictate and inform how the program should evolve in the future to better serve the needs of our customers; PG&E plans to continue to research and add additional resilience zones as needed

Description:

PG&E uses the term "Resilience Zones" to describe projects that will allow PG&E to safely provide electricity to central community resources when PSPS is activated during Extreme-Plus conditions. Customers near Resilience Zones will benefit from the ability to access services such as grocery stores and gas stations while the wider grid is de-energized for safety. Host sites for Resilience Zones are selected in full coordination with the System Hardening Program for safe operation. Resilience Zones are still in a pilot phase, which will inform and dictate how the program should evolve in the future to better serve the needs of our customers.

Resilience Zones are enabled by pre-configured segments of the distribution system that can be quickly isolated from the broader grid when a PSPS is initiated. Using pre-installed interconnection hubs (PIH), PG&E will be able to quickly and safely connect temporary mobile generation to energize the isolated Resilience Zone. Generally, PIHs will consist of a transformer and associated interconnection equipment, ground grid, and grid isolation and protection devices (reclosers and switches). Resilience Zone PIHs may evolve into Resilience Zone Microgrids over time, as preferred resource combinations begin to meet technical requirements, and as PG&E's capability to operate these systems matures. See Section 4.7.3 of PG&E's Plan for more information on microgrids.

PG&E's pilot Resilience Zone will operate as needed during 2019's wildfire season in Angwin, a town situated within the Tier 3 HFTD area in Napa County (Fire Index Area 175). PG&E is working with Pacific Union College to align the operation of the Resilience Zone with the college's privately-owned cogeneration plant to collaboratively increase resilience for the town of Angwin. Should Extreme-Plus conditions occur, the presence of the Resilience Zone will allow PG&E to safely energize facilities such as the fire station, gas station, Brookside Apartments, and portions of the Angwin Plaza not already served by the local college's on-campus generation.

PG&E plans on expanding the Resilience Zone workstream for other towns that may be impacted by PSPS. The geographic scope of a potential Resilience Zone will depend on a range of factors including the current grid configuration and safety to energize during Extreme-Plus conditions. Resilience Zones will only be built in areas that meet the following criteria:

- Targeted sectionalizing in the area is not feasible due to grid configuration or other reasons; and

- The area has a sufficiently large hardscape and/or has been sufficiently de-risked of ignition danger through system hardening measures that a temporary mobile generator can safely run during Extreme-Plus conditions

Alternative Technologies:

Timeframe:

- Longer-term effort (>5 years) to build investigate and utilize alternative technologies
- 2019 Target: continued research and use of pilot projects
- 2020 and beyond targets: results of the 2019 research and pilots will dictate and inform alternative technology evolution in the future to better serve the needs of our customers;

Description:

1. Rapid Earth Fault Current Limiter Pilot Project Demonstration: The Rapid Earth Fault Current Limiter Technology has been shown by the Victoria State Government (Australia) to directly reduce the risk of wildfires for single line to ground faults. PG&E has a demonstration project planned in 2019 to test the capabilities of this technology within PG&E's system. The Rapid Earth Fault Current Limiter technology consists of an inductor installed between the substation transformer neutral and ground and tuned to the line to ground capacitance of the circuits fed off of a distribution substation bank. In effect, this technology moves the neutral to the faulted phase during a fault reducing the potential to ground on that line to effectively zero (less than 250V) which significantly reduces the energy available for the fault.

2. Other Alternative Technologies: In addition to the pilot programs, PG&E is researching other possible alternative technologies to determine whether they would be feasible and effective in system hardening. PG&E is evaluating emerging sensor technologies that enable real-time system monitoring and situational awareness and is advancing the use of primary line sensor fault measurements in combination with CYME Power Engineering software fault calculations to display possible primary fault locations for targeting field patrol and accelerating fault locating. PG&E is also developing analytic and dashboard strategies to produce prioritized and actionable information from the correlation of data from multiple sources (e.g., SCADA, SmartMeter™, primary line sensors, and emerging sensor technologies).

PG&E is in the early stages of executing its Wildfire Safety Inspection Programs (WSIPs) which, combined with on-going rapid technology advancements, makes it premature to determine the scope, methods, and frequency of future inspections. Regarding technology, for example, as noted in Section 4.2.2 of the Plan, PG&E is investigating the use of helicopter-based autonomous image capture methods for inspections. This technology could prove to be superior to the ground and climbing inspections that PG&E is implementing in the 2019 Plan. Additionally, as noted in Section 4.2 of the Plan, the new and enhanced risk-based approach identifies WSIP work by assessing the risk associated with each asset and by explicitly considering equipment modes of failure. PG&E expects that these efforts will continue to evolve as information is gathered and more is learned. PG&E will use the results of the current

inspections to continue to shape a risk-informed re-inspection program and schedule for subsequent inspections. As noted in Section 6.2, the programs described in the Plan will be continuously reviewed, evaluated, and modified as needed. PG&E's future wildfire safety plans will reflect continuous improvement gained by learning from implementing previous years' Plans.

Strategies and programs with shorter timeframes that PG&E intends to repeat on an annual or semi-annual basis include the following, and are described in detail in Chapter 4 of the Plan:

1. Recloser Operations (annual)
2. Personnel Work Procedures in Conditions of Elevated Fire Risk (annual)
3. Safety and Infrastructure Protection Teams (annual)
4. Aviation Resources (annual)
5. HFTD Vegetation Management (VM) Inspection Strategy: (at least two times each year and as often as four times per year in some locations [in Wildland Urban interface areas])
6. Inspecting Trees with a Potential Strike Path to Power Lines (annual)
7. Wildfire Operations Center (annual)
8. Public Safety Power Shutoff (annual)

Attachment C
Excerpt from PG&E's 2020 GRC
Exhibit PG&E-4, Chapter 2A,
Pages 2A-40 Through 2A-45

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 2A

WILDFIRE RISK POLICY AND OVERVIEW

working with its existing construction labor contractors to obtain the additional labor necessary to perform the forecast work in the System Hardening program. The amount of work forecast in the program means that there should be steady work for construction crews over an extended time period, which makes it easier for PG&E to obtain skilled contract labor (e.g., linemen) from outside of California.

Another challenging aspect of the System Hardening work is the amount of permitting needed due to the fact that various aspects of the as-installed system are changing (e.g., the location, dimensions, and number of poles, the length of anchor wire needed to secure poles). To address this challenge, PG&E has created a dedicated group within its permitting department that is focusing solely on permits related to System Hardening work. This group is already obtaining permits for System Hardening projects at a faster rate than is the norm for PG&E.

G. Risk Spend Efficiency

Table 2A-9 below details the RSEs of the mitigations discussed above as modelled in the Wildfire Risk Model. These RSEs represent the risk model calculated risk reduction for each mitigation per dollar spent on that mitigation. More detail on how RSEs are calculated can be found in the 2017 RAMP Report and in Exhibit (PG&E-2), Chapter 3: Risk Management and Mitigation. In addition, as discussed above, several of these mitigations are classified as foundational, in that they represent initial work that facilitates or enables other mitigations. Since these foundational mitigations do not directly reduce ignition frequency or fire consequences, they have not been assigned an RSE.

TABLE 2A-9
WILDFIRE RISK MITIGATIONS RISK SPEND EFFICIENCIES

Line No.	Mitigation #	Mitigation Name	RSE (2017-2022) Tail Average (Units per Million Dollars)	RSE (2020-2022) Tail Average (Units per Million Dollars)
1	M5	Non-Exempt Surge Arrester Replacement Program	0.006	0.004
2	M10	Resilience Zones	Foundational	Foundational
3	M11	Light Duty Steel Poles for Transmission Lines	$1.79 * 10^{-6}$	$1.23 * 10^{-6}$
4	M12	Wildfire System Hardening	0.005	0.003
5	M13	Public Safety Power Shut Off	0.120	0.120
6	M14	Reclose Blocking	0.038	0.038
7	M15	Automation and Protection	Foundational	Foundational
8	M16	Enhanced Vegetation Management	0.018	0.016
9	M17	Vegetation Increased Line Clearances	0.024	N/A*
10	M18	Wildfire Safety Operations Center	Foundational	Foundational
11	M19	Expanded Weather Station Deployment	Foundational	Foundational
12	M20	SOPP Model Automation	Foundational	Foundational
13	M21	Advanced Fire Modelling	Foundational	Foundational
14	M22	Wildfire Cameras	Foundational	Foundational
15	M23	Satellite Fire Detection System	Foundational	Foundational
16	M24	Enhanced Wire Down Detection	Foundational	Foundational
17	M25	Wildfire and Infrastructure Protection Teams	N/A**	N/A**
18	M26	Aviation Resources	Foundational	Foundational
19	M27	Employee Engagement, Training, and Tools	Foundational	Foundational
20	M28	CWSP PMO	Foundational	Foundational
21		Overall Plan RSE (For Mitigations with RSEs)	$2.43 * 10^{-8}$	$1.91 * 10^{-8}$

Notes:

* RSE was not calculated for the Vegetation Increased Line Clearances mitigation program for the 2020-2022 time period because the initial clearing work will be completed before 2020. Maintenance of the new clearances will be included in PG&E's routine VM work.

** RSE was not calculated for the Wildfire and Infrastructure Protection Teams mitigation. PG&E is working with state and local fire agencies to determine how these resources will fit into overall fire response activities. An RSE may be calculated once the role of these resources is clarified.

1. Model Limitations

Before discussing the RSEs for each mitigation discussed above, it should be noted that, while PG&E's risk model is a significant step towards quantification, there are currently limitations to the model that may skew certain RSEs higher or lower relative to others. These limitations were

noted in the 2017 RAMP Report, but are discussed here again to give context to the RSE discussion that follows it. These limitations are being considered as PG&E builds its next generation risk models.

One limitation involves the model's limited time horizon. The model currently calculates the risk reduction benefit of mitigations only up through the years covered by this GRC. This may result in relatively low RSEs for mitigations that have high upfront costs captured in the 2020 GRC cycle, but have decades of lower cost benefit after the 2020 GRC cycle. For example, the asset replacements that are part of the Wildfire System Hardening mitigation have a high initial installation cost, but reduce risk for potentially decades after they are installed for a much-reduced maintenance cost.

Another limitation stems from the fact that risks are currently modelled individually even though a given risk mitigation may reduce multiple risks. Modelling risks separately, with the full cost of the mitigations loaded for each risk, rather than allocating costs across each of the risks, may result in the understating of the risk reduction impact of those mitigations. For example, the EVM Program will reduce risk for both the Wildfire and Distribution Overhead Conductor Primary risks. However, the benefit of reducing each of those risks is modelled separately while still using the full cost of the mitigation for each risk. As a result, the RSE in both models is understated because the risk reduction benefits are split between the two risks, and the full costs are allocated to each program.

2. RSE Discussion

The mitigations were evaluated together as parts of a holistic plan rather than as discrete individual workstreams. The mitigation plan as a whole is discussed in the next section. However, to further clarify the ranking of the mitigations by RSE, PG&E summarizes the factors underlying the RSEs for each mitigation individually below, from the highest RSE mitigations to the lowest.

- **M13 – Public Safety Power Shut Off and M14 – Reclose Blocking:** These mitigations limit risk through system operations and rank first and second respectively. These mitigations were modelled with a relatively high base effectiveness because, when activated, they will impact a large set of ignition drivers when fire risk is highest. For example, when

PSPS is in effect, lines will be de-energized, which is modelled to remove all causes of ignition risk associated with those lines. The cost for the PSPS mitigation is based on the cost of outreach to inform customers of the PSPS mitigation. PG&E is also cognizant of the loss of service that accompanies this mitigation and the value of this service to PG&E's customers as well as the corresponding safety concerns during a PSPS event. To account for this loss of service and its impacts, a dollar Value of Service (VOS) cost was added into the total expenditure used to model this mitigation. The calculated VOS cost of planned outages related to PSPS and Reclose Blocking was understandably large, reducing the RSEs for these mitigations despite their high effectiveness.

- **M17 – Vegetation Increased Line Clearances:** This mitigation has the third highest RSE of the modelled mitigations, driven primarily by the low forecast cost of the work. Many existing lines in Tier 2 and 3 HFTD areas overlap with designated State Responsibility Areas (SRA) where PG&E already maintains 4-foot vegetation clearances from distribution lines. Therefore, applying 4-foot clearance to all lines within Tier 2 and Tier 3 HFTD requires relatively low incremental cost. The clearing work itself is also relatively low cost. Though this mitigation is not modelled to have a high base effectiveness due to the historically low percentages of ignitions caused by vegetation growing into (as opposed to falling into) lines in HFTDs, the low per mile cost of this mitigation results in a relatively large RSE.
- **M16 – Enhanced Vegetation Management:** This mitigation has an RSE that ranks fourth of the modelled mitigations. The high forecast cost of this work balances its relatively high effectiveness. Vegetation contact with overhead equipment represents the largest historical driver of ignition risk. By removing overhanging limbs, removing or pruning trees from high risk species, and clearing fuel around distribution lines, this mitigation has a large impact on reducing ignition risk due to vegetation contact. However, this mitigation's RSE is driven down primarily because of the large upfront costs of EVM. It should be noted that, as discussed in the model limitations section above, the model is

not accounting for the benefits of this work beyond the 2020 GRC cycle. Once established, the newly cleared areas can be maintained relatively inexpensively after 2022, primarily through routine VM practice. If this benefit were accounted for, this lower cost, longer term risk reduction after 2022 may increase the RSE of this mitigation.

- **System Hardening Mitigations:** M12 – Wildfire System Hardening, M5 – Non-Exempt Surge Arrester Replacement, and M11 – Light Duty Steel Poles for T-Lines: These mitigations have the lowest ranking RSEs of the modelled mitigations. This work represents PG&E's core work to prevent potential ignitions and has a relatively high mitigation effectiveness. However, the upfront forecast costs of the specialized equipment, tools, and labor necessary for large-scale asset replacement is high, which significantly drives down the RSE for these mitigations. These mitigations, like the EVM mitigation discussed above, may have artificially low RSEs as a result of limitations of the risk model because their RSEs only include calculated risk reduction through 2022 despite the fact that the asset replacement work included in these mitigations will reduce risk for the life of the equipment installed, which could be many decades in the case of line equipment, conductor, and poles. Because the modeling ends in 2022, the future reductions in operations and maintenance expense and long-term risk reduction is not factored into the RSE calculation. In addition, the System Hardening RSEs may also be understated since the programs may reduce risk from other Electric Overhead risks.

3. Discussion of Proposed Plan

Though the RSEs vary individually between each of the mitigations, they must be considered based on how they fit together into an overall wildfire strategy instead of as discrete mitigations. As a result of the extraordinary and rapidly evolving wildfire risk conditions that California is currently experiencing, PG&E's wildfire mitigation plan includes mitigations involving several aspects of electric utility operations and wildfire risk management to create an effective program. For example, although based on RSE alone, the PSPS mitigation ranks very high when compared to the other wildfire mitigations, it would not be prudent to focus entirely on this mitigation

program at the expense of other mitigations that potentially prevent the wildfire event from occurring, such as EVM or Wildfire System Hardening, which have lower RSEs as a result of much larger expenditures. PG&E's proposed CWSP, which comprehensively addresses all of the mitigation categories, allows PG&E to dynamically reduce wildfire risk drivers and consequences using several targeted programs.

4. Updates Since the SED Report

On March 30, 2018, the SED published a report on its review of PG&E's 2017 RAMP Report,[53] in addition, the SED provided guidance at its April 17, 2018 workshop.[54] In the workshop, the SED noted areas where PG&E could improve its Wildfire risk model, including:

1) Separate the Transmission and Distribution wildfire risks and mitigations in the model;
2) Further refine the model to be more specific to local and regional environmental conditions;
3) Incorporate efforts to implement new tools and mitigation techniques; and
4) Capture the long-term benefits of its mitigation programs in the model.

As stated in its reply to the SED, PG&E agrees with the SED's recommendations and intends to evolve its risk modeling capabilities through the creation of the CWSP risk analytics function which will consider incorporating these recommendations into future iterations of the risk model in the longer term.[55] Since some of these recommendations are complex to implement, they have not been performed for this GRC, but PG&E has taken some initial steps to incorporate some of them.

For example, regarding Recommendation 1, PG&E has been able to analyze ignitions, model risk drivers and mitigation program effectiveness,

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53 SED Report: Risk and Safety Aspects of Risk Assessment and Mitigation Phase Report of Pacific Gas & Electric Company Investigation (I) 17-11-003, March 30, 2018, pp. 83-90.

54 SED Report: Introduction and Background Section Staff Report, PG&E I.17-11-003, p. 10.

55 See WP 2A-137, Exhibit (PG&E-4), Reply Comments of PG&E (U 39 M) on SED's RAMP Report, May 24, 2018, Section II-B, p. 5.