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PG&E-8 EXHIBIT

PG&E 2021 WILDFIRE MITIGATION PLAN – REVISED, DATED JUNE 3, 2021

VOLUME 2 OF 3

SEPTEMBER 18, 2024

PACIFIC GAS AND ELECTRIC COMPANY

2021 WILDFIRE MITIGATION PLAN – REVISED

RULEMAKING 18-10-007

JUNE 3, 2021

PACIFIC GAS AND ELECTRIC COMPANY
2021 WILD FIRE MITIGATION PLAN REPORT

TABLE OF CONTENTS

PACIFIC GAS AND ELECTRIC COMPANY
2021 WILD FIRE MITIGATION PLAN REPORT

TABLE OF CONTENTS
(CONTINUED)

PACIFIC GAS AND ELECTRIC COMPANY
2021 WILD FIRE MITIGATION PLAN REPORT

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

PACIFIC GAS AND ELECTRIC COMPANY
2021 WILDFIRE MITIGATION PLAN

TABLE OF TABLES

TABLE OF TABLES
(CONTINUED)

TABLE OF TABLES
(CONTINUED)

TABLE OF TABLES
(CONTINUED)

TABLE OF TABLES
(CONTINUED)

TABLE OF TABLES
(CONTINUED)

TABLE OF FIGURES

TABLE OF FIGURES
(CONTINUED)

TABLE OF FIGURES
(CONTINUED)

TABLE OF FIGURES
(CONTINUED)

TABLE OF FIGURES
(CONTINUED)

TABLE OF FIGURES
(CONTINUED)

TABLE OF FIGURES
(CONTINUED)

7.3.2 Situational Awareness and Forecasting

7.3.2.1 Advanced Weather and Fire Potential Forecasting and Monitoring

Wildfire Safety Division (WSD) Initiative Definition: *Purchase, installation, maintenance, and operation of weather stations. Collection, recording, and analysis of weather data from weather stations and from external sources.*

For this initiative, Pacific Gas and Electric Company (PG&E or the Company) has several sub-initiatives including:

- 7.3.2.1.1: Numerical Weather Prediction
- 7.3.2.1.2: Fuel Moisture Sampling and Modeling
- 7.3.2.1.3: Weather Stations
- 7.3.2.1.4: Wildfire Cameras
- 7.3.2.1.5: Fire Detection & Alerting
- 7.3.2.1.6: Other Meteorology Tools and Upgrades

Overview:

PG&E's Meteorology and Fire Science team is comprised of 15 scientists, most with advanced degrees in scientific fields with diverse backgrounds in operational meteorology, utility meteorology, outage prediction, fire science, data science, cloud computing, atmospheric modeling, application development and data systems development. The team is comprised of alumni from the San Jose State University (SJSU) Fire Weather Research Laboratory (https://www.fireweather.org/), former wildland firefighters, former National Weather Service (NWS) forecasters and Veterans of the Marine Corps and United States Air Force. The team is well positioned to advance operational meteorology and operational decision making at PG&E to reduce wildfire risk.

The meteorology team also partners and collaborates with external experts and companies versed in numerical weather prediction, satellite technology and wildfire spread modeling. The team's responsibilities include monitoring and forecasting weather for utility operations, as well as maintaining, developing, and deploying meteorological and decision support models for utility operations. Each day, PG&E Meteorology ingests and processes multiple terabytes of weather intelligence utilizing PG&E on-premise data centers and cloud computing.

PG&E utilizes public and proprietary state-of-the-art weather forecast model data and operates an in-house, high-resolution meteorological modeling system to forecast weather conditions, outage potential, and fire potential. PG&E also has a robust history of weather data including over 500,000 images from the North American Regional Reanalysis (NARR), as well as a high-resolution (2 x 2 kilometer (km)) 30-year, hourly climatology of weather and fuels data. These historical datasets are utilized to train outage and fire potential models as well as to put forecasts into perspective. PG&E also leverages publicly available forecast information from government agencies

such as the NWS, Geographic Area Coordination Centers - Predictive Services, the National Oceanic and Atmospheric Administration (NOAA) Storm Prediction Center and coordinates directly with meteorologists from these agencies on daily interagency conference calls when there is an increased fire potential. PG&E acquires and processes public and proprietary weather data daily from several sources including, but not limited to:

- European Centre for Medium-Range Weather Forecasts (ECMWF)
- The ECMWF Ensemble Prediction System (EPS)
- Global Forecast System (GFS)
- Global Ensemble Forecast System (GEFS)
- Canadian Meteorological Centre Global Model
- North American Mesoscale Model
- High Resolution Rapid Refresh
- High Resolution Ensemble Forecast model suite
- NanoWeather Uncoupled Surface Layer model
- Clean Power Research, LLC solar irradiance model
- Desert Research Institute California and Nevada Smoke and Air Committee Weather Research and Forecast (WRF) model
- PG&E's 2 x 2 km WRF model; the PG&E Operational Mesoscale Modeling System (POMMS)
- National Center for Environmental Prediction (NCEP) Real-Time (RT) Mesoscale Analysis
- Satellite and Fire Detection data from Geostationary Operational Environmental Satellite (GOES)-16, GOES-17, Moderate Resolution Imaging Spectroradiometer (MODIS)-AQUA, MODIS - TERRA, Suomi National Polar-orbiting Partnership (NPP), and NOAA-20
- NOAA Radar data
- Upper air observations from NOAA soundings and various wind profilers
- Lightning Data from the TOA Systems, Inc. Global Lightning Network
- RT weather station data from over 1000 PG&E, NWS and Remote Automatic Weather Stations (RAWS) weather stations

PG&E first deployed the high resolution in-house mesoscale forecast model, POMMS, in November of 2014 and continues to improve and build upon the model framework to generate short to medium-term weather, outage, and fire potential forecasts across the PG&E service territory. POMMS is a high-resolution weather forecasting model that generates important fire weather parameters including wind speed, temperature, relative humidity (RH), and precipitation. Outputs from POMMS are used as inputs to the National Fire Danger Rating System (NFDRS), the Nelson Dead Fuel Moisture (DFM) model, and a proprietary Live Fuel Moisture (LFM) model to derive key fire danger indicators such as 1hr, 10hr, 100hr, 1000hr DFM, LFM.

In late 2018 to 2019, PG&E successfully completed one of the largest known high-resolution climatological datasets in the utility industry: a 30-yr, hourly, 3 km spatial resolution dataset consisting of weather, dead and LFMs, NFDRS outputs, and fire weather derivative products such as the Fosberg Fire Weather Index (FFWI). The quantity of data generated at the near-surface

was near 80 billion datapoints. With this robust weather and fire parameter dataset, PG&E Meteorology sought to develop outage and fire potential models in 2019 utilizing best-practices deployed in the utility industry, fire science and data science communities.

In late 2019 to 2020, PG&E embarked on an intensive effort to improve the POMMS model by increasing the resolution from 3 km to 2 km as well as increasing the output accuracy. The 2020 goal was to deploy a more accurate and granular high-resolution model to reduce customer impacts due to Public Safety Power Shutoff (PSPS) in 2020. To achieve this goal, numerical weather prediction experts in PG&E partnered with two external experts in numerical weather prediction: DTN, a company that specializes in subscription-based services for the analysis and delivery of real-time weather, agricultural, energy, and commodity market information, and Atmospheric Data Solutions. Over the course of half a year, nearly 20 different model configurations were tested by internal and external experts to determine the optimal weather model configuration that would be deployed. This included extensive back-testing and validation of past PSPS events to fine-tune model parameterization and physics options to achieve the most accurate model possible for deployment. After the optimal model was recommended and agreed upon by internal and external experts, it was deployed in 2020 and utilized during all 2020 PSPS events. In addition, a new 30-year climatology was produced using this new model configuration at 2 km resolution.

In 2020, PG&E also deployed a 2 km EPS based on the optimal model configuration aforementioned. The PG&E Operational Mesoscale Modeling System Ensemble Prediction System (POMMS-EPS) is comprised of a total of eight ensemble members. Six members are perturbed stochastically in order to better understand forecast uncertainty. Two members were set aside for longer-term testing and validation with the goal on informing the next generation of the POMMS model. With these members, PG&E meteorology will be able to test if other model configurations or initializing the POMMS model with ECMWF, for example, provides more accurate results. With these investments in numerical weather prediction, PG&E is positioned to keep pace with industry improvements in weather prediction.

In 2020, PG&E surpassed 1,000 weather stations installed, which is one of the largest utility-owned and operated weather station networks in the world. Each weather station deployed records and reports meteorological data every 10 minutes and all data is made publicly available. This data can be accessed in real time through the NWS weather and hazards data viewer, Mesowest, the NCEP Meteorological Assimilation Data Ingest System (MADIS), or at www.pge.com/weather. In 2019 and 2020, PG&E meteorologists met with representatives from NWS, California Department of Forestry and Fire Protection (CAL FIRE), United States Forest Service (USFS) and others to coordinate on where deployment of weather stations would be useful to not only PG&E, but to other agencies and the public. In 2021 and beyond, PG&E plans to expand and optimize this network and work with external stakeholders to improve meteorological measurements throughout California.

In 2020, PG&E established a LFM sampling program to complement samples collected by state and federal agencies on the state of live fuels across California. This network consists of 30 locations where plant species such as Chamise and Manzanita are sampled to measure the amount of fuel moisture in these plants throughout the seasonal cycle. These measurements are made publicly available via the National Fuel Moisture Database (NFMDB). These observations are critical to train high resolution LFM models and satellite-derived LFM products.

PG&E also developed and deployed a state-of-the-art satellite fire detection system in 2019 that used remote sensing data from five geostationary and polar-orbiting spacecraft to detect fires. In 2020, this program was expanded to include a newly launched polar-orbiting satellite, NOAA-20, to bolster the program. PG&E has partnered with the Space Science and Engineering Center (SSEC) from the University of Wisconsin, which provides PG&E with a customized, granular feed of fire detections from the next-generation GOES satellites. PG&E also obtains polar-orbiting satellite fire detection data from NASA. PG&E developed a proprietary application and algorithms in-house to consolidate fire detections as they arrive from several satellites and disseminate alerts via internal and external web applications and email. The web application allows PG&E's analysts in the Wildfire Safety Operations Center (WSOC), meteorologists and others to track fire detections in near-real time, evaluate the intensity of fires via the Fire Radiative Power (FRP) outputs, as well as track the general spread of fires. This system is used in concert with the weather station network described above, the expansive high-resolution camera network deployed in PG&E's territory, and several other sources. PG&E is committed to share this data with all interested stake holders. The external application available to the public is found here: https://pgefdp.lovelytics.info/pge_fire_app/.

In addition, PG&E is sharing this data with Technosylva, who has developed wildfire spread risk models and applications. This application is used by other California utilities and CAL FIRE, and PG&E has allowed all stakeholders access to this fire detection data through Technosylva's Wildfire Spread Analyst application. PG&E is also interested in receiving fire detection data available from Fire Guard, which is a produced by the California National Guard but has so far been unable to gain access to this data.

7.3.2.1.1 Numerical Weather Prediction

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

High resolution weather models are used by PG&E and other California utilities to forecast the weather and critical components such as temperature, wind speed and RH. These models were developed and configured to provide the most accurate output possible for the PG&E territory to date. External high-resolution models available to the public, such as the High-Resolution Rapid Refresh model, do not provide enough lead time or are not as granular (i.e., have coarser resolution). This program is a core and foundational component of PG&E's ability to forecast and execute a PSPS event to ultimately reduce the risk of catastrophic wildfire, while giving the public and stakeholders as much lead time as possible. The weather model output is also used by dead and LFM models and also is used in fire spread simulations.

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:

PG&E Meteorology remains committed to advancing and improving our weather prediction capabilities beyond what is publicly available. This generally involves using state-of-the-science weather forecast models, such as the WRF model and determining which model configuration performs best for the PG&E service territory. With more accurate weather model data with a forecast horizon, PG&E will be able to mitigate catastrophic wildfire risk through PSPS while limiting the scope of PSPS events.

PG&E has rigorously tested and deployed high-resolution models and built high-resolution historical datasets. These high-resolution historical datasets and forecasts drive outage potential and Fire Potential Index (FPI) Models, which are the main inputs into the framework PG&E utilizes to make the difficult decision to execute a PSPS event.

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"):

PG&E's weather modeling work is not limited to a particular region. The weather model provides output every 2 x 2 km across the PG&E system territory.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

PG&E first deployed the POMMS in 2014, upgraded the system to POMMS 2.0 in 2018 and upgraded again to the third version of the model called POMMS V3.0 in 2020. The improvements in 2020 led to more targeted PSPS events. More advancements can be expected in the future as the state of weather modeling improves.

The 2020 POMMS V3.0 prediction suite is comprised of the following:

- A deterministic 2 x 2 km weather model (The WRF Model) that provides weather forecasts (e.g., wind, temperature, RH) out 105 hours. This model is run four times per day.
- A 2 x 2 km EPS run twice per day. The POMMS-EPS is comprised of eight ensemble members.
- Experimental 0.67 x 0.67 km forecasts that can be run on-demand during high risk events.
- A historical climatology that contains 30 years (1989 – 2020) of hourly weather data at 2 x 2 km resolution. This climatology was built using the same model configuration as used in forecast model.
- A 30-year climatology of DFM and LFM from multiple plant species at 2 x 2 km resolution.
- The POMMS V3.0 suite is entirely run and processed using the Amazon Web Services (AWS) cloud.

POMMS V3.0 was operationally deployed after significant validation and testing by PG&E and external numerical weather prediction experts DTN and Atmospheric Data Solutions. Nearly 20 different model configurations were run on a variety of test cases covering high wind and precipitation events. Model output from each case were validated against the hundreds of weather stations now available in the PG&E territory, including the hundreds of stations PG&E has deployed since 2018. The ultimate goal was to find the optimal model configuration that produced the most accurate simulations over a range of high-impact events for a range of meteorological parameters.

The model configuration deployed at 2 km resolution was recommend by both external partners and was approved by PG&E Meteorology. The WRF model version 4.1.2 (released July 12, 2019) was selected for POMMS V3.0. Key features added or made default in version 4 of WRF include a hybrid vertical coordinate and a moist potential temperature prognostic variable. A nested grid configuration of 18-, 6-, 2-, and 0.67-km grids are utilized. The vertical grid has 51 levels and a 20 hPa top. Adaptive time stepping is used for computational efficiency and the model was configured to run in the AWS cloud across different AWS regions for redundancy.

The WRF forecasts are initialized using ¼° output from the National Centers for Environmental Prediction (NCEP) - GFS model data as well as 1/12°Sea Surface Temperature analyses. Data assimilation (3DVAR) is applied on the outer grid. Data available for assimilation are taken from MADIS and include conventional surface and upper-air observations, as well as aircraft data and satellite-derived winds. As the NCEP-GFS forecast model is a single point of failure, PG&E and external experts developed the ability to initialize POMMS with ECMWF in case of a Federal/NCEP data outage.

PG&E has also developed an EPS based on POMMS V3.0. Eight forecast ensemble members are run at 2 km resolution to better evaluate forecast uncertainty and to test additional model configurations to potentially inform future

enhancements. Six of the members are stochastically perturbed with the following techniques available in WRF.

- Stochastically perturbed physics tendencies
- Stochastic kinetic-energy backscatter scheme
- Stochastically perturbed parameter scheme

The remaining two ensemble members are being used to test alternate configurations, such as alternate physical parameterizations (e.g., alternate Planetary Boundary Layer scheme) or forcing the model with different initial conditions (e.g., ECMWF forecast data).

In addition to upgrading to POMMS V3.0, PG&E enhanced our use of cloud computing architecture in 2020 to run and process the vast quantities of weather data (multiple terabytes) consumed and produced each day. This provides a flexible and cost-efficient environment and was chosen over utilizing on-premise High-Performance Computing Clusters or super computers. In the AWS cloud, weather and fuels forecasts are processed and stored in PostgreSQL databases and have been dynamically linked to ArcGIS Pro. This allows PG&E meteorologists to visualize the hour-by-hour forecast data with respect to PG&E's assets. Standard meteorological plots are also created and available via AWS web instances for evaluation by PG&E meteorologists.

Figure PG&E-7.3.2-1 below shows some simplified model output from the POMMS-EPS. The image represents forecasts of the pressure difference or gradient between Redding, California and Sacramento, California from the deterministic POMMS V3.0 output, as well as all eight ensemble members and the ensemble mean.

FIGURE PG&E-7.3.2-1: SIMPLIFIED MODEL OUTPUT FROM POMMS-EPS

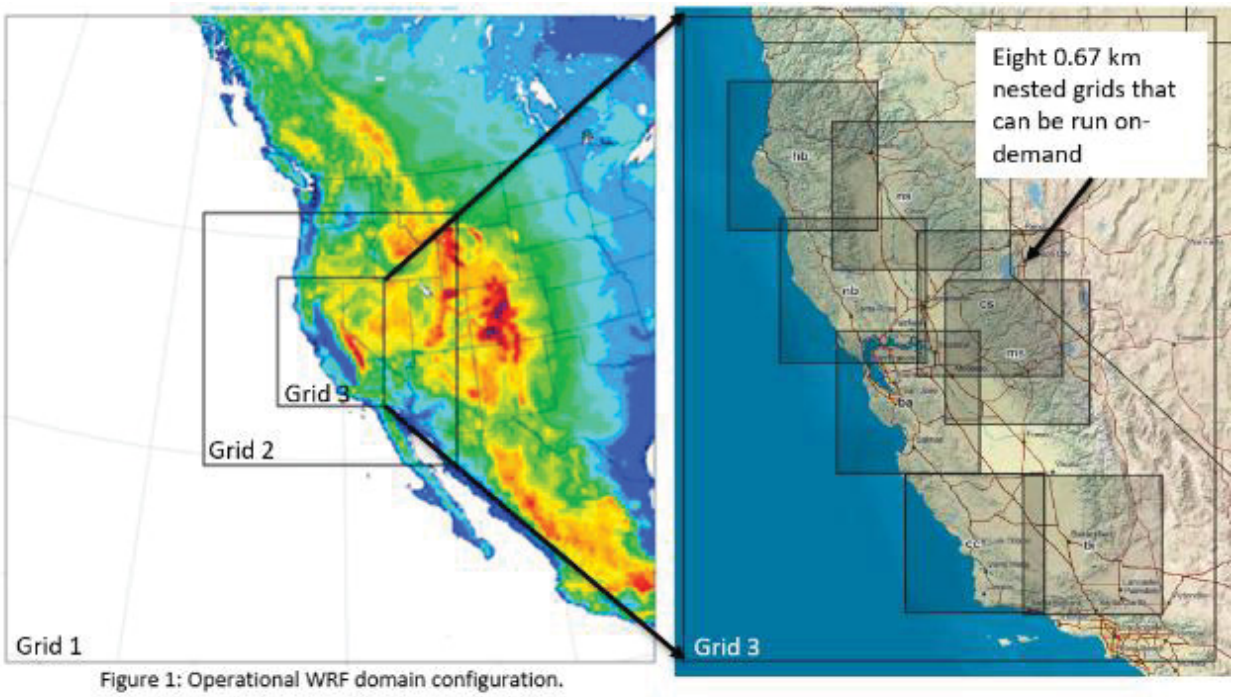
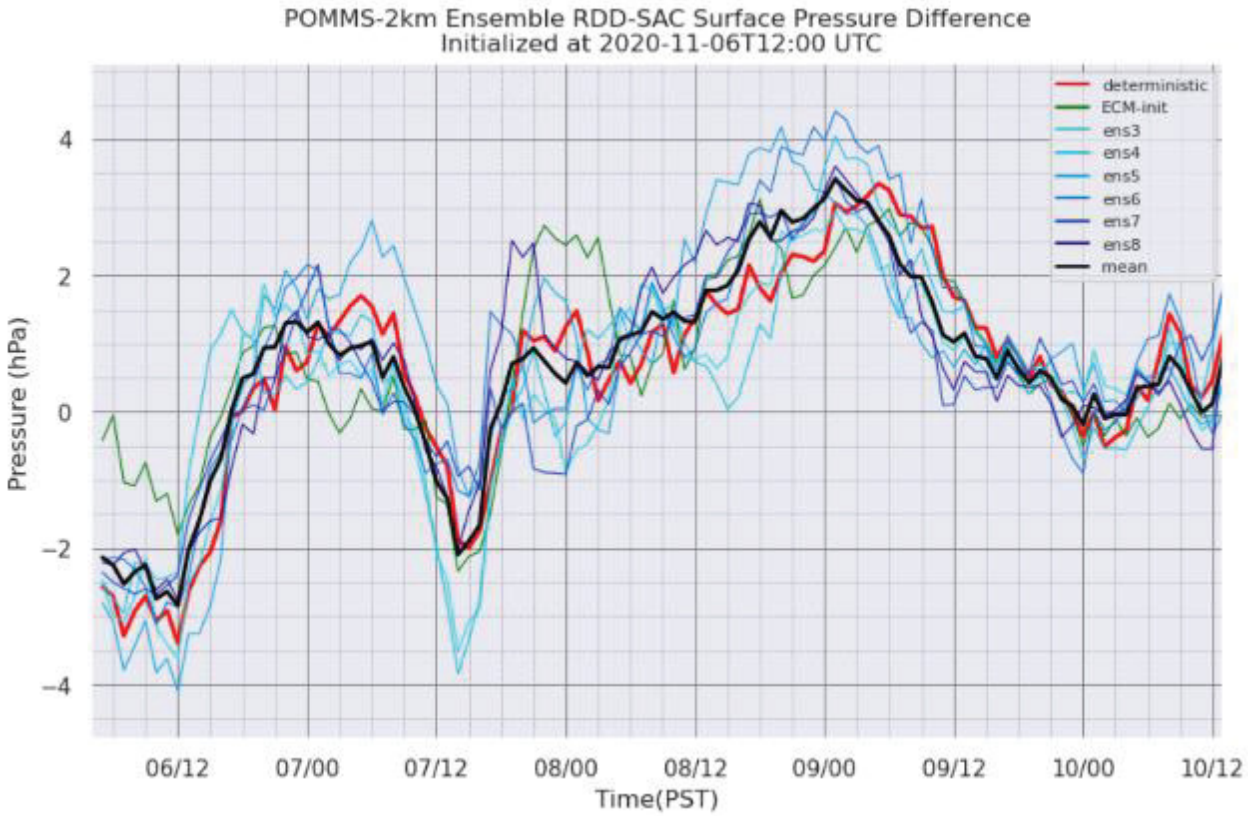


Figure 1: Operational WRF domain configuration.

FIGURE PG&E-7.3.2-2: EXAMPLE POMMS ENSEMBLE PREDICTION SYSTEM OUTPUT



5) Future improvements to initiative:

In 2021, PG&E plans to achieve the following to enhance our numerical weather prediction program:

- Expand the historical weather climatology at 2 x 2 km resolution to back-fill all of 2020. This will allow PG&E meteorologists and data scientists to study the outage and fire events of 2020 using this consistent set of climatology data.
- Explore a methodology to back-fill the climatological data each quarter moving forward.
- Evaluate extending the deterministic forecast to provide another 24 hours of forecast data (from 105 hours currently to 129 hours).
- Evaluate if the POMMS-EPS ensemble mean is more or less accurate than the deterministic POMMS model.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As numerical weather prediction is core and central to the PSPS program, PG&E will continue leveraging high resolution weather model data to inform operational decisions for the foreseeable future. PG&E plans to continue working with external numerical weather model experts to evaluate model physics, configurations, and resolutions that can improve the overall model fidelity.

Meteorological models are expected to improve in the future, and PG&E plans to evaluate and incorporate the latest weather model improvements that can increase forecast accuracy. This includes upgrading to newer version of the WRF Model in the future and producing more granular forecasts if greater accuracy can be achieved. Ensemble weather prediction is also being evaluated and can be expanded to provide a wider range of outcomes and probabilistic forecasts. This program is expected to continue through the next ten years at this time.

7.3.2.1.2 Fuel Moisture Sampling and Modeling

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The moisture content in living and dead vegetation is a critical component of PG&E's FPI and the NFDRS used by state and federal fire agencies. Other California utilities are engaged in modeling the state of live and dead fuels to better understand when large fires are possible. PG&E Meteorology remains committed to advancing models utilized to simulate fuel moistures in dead and living vegetation, called DFM and LFM.

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.

The DFM and LFM forecasts are inputs into PG&E's FPI Model, which is a core component of PSPS assessments. Working with external experts, these models were enhanced to provide hourly output across PG&E's entire modeling domain at 2 x 2 km resolution to provide more granular output and a longer lead time than is publicly available. This gives PG&E the ability to assess the potential for PSPS events with a longer lead time leading to more advanced noticed of potential PSPS events.

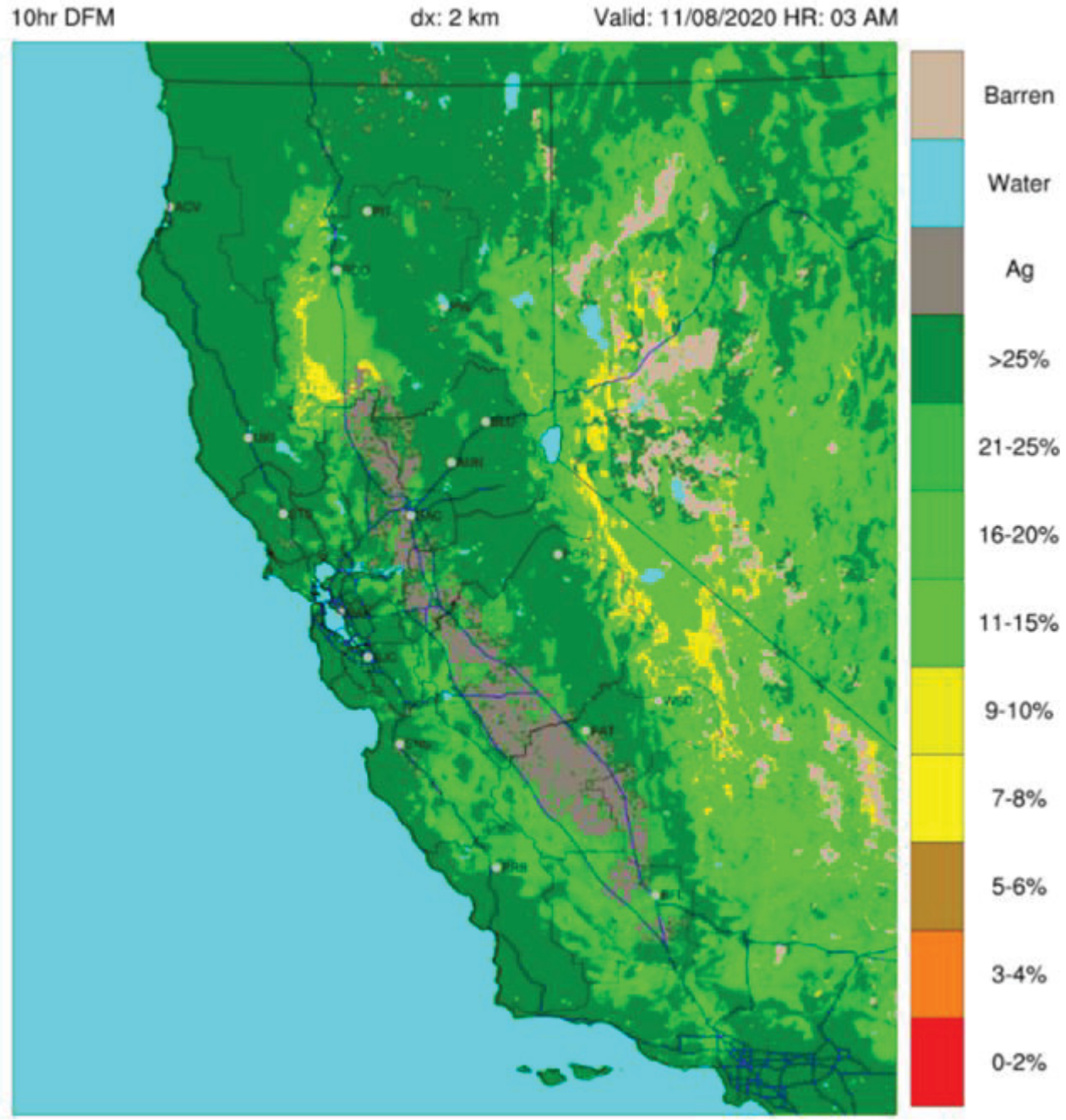
3) Region prioritization ("where" to engage activity) – include reference to a risk informed analysis in allocation of initiative (e.g., veg clearance is done for trees tagged as "high-risk"):

There is no regional prioritization regarding this work. The fuel models provide output across the entire PG&E territory.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

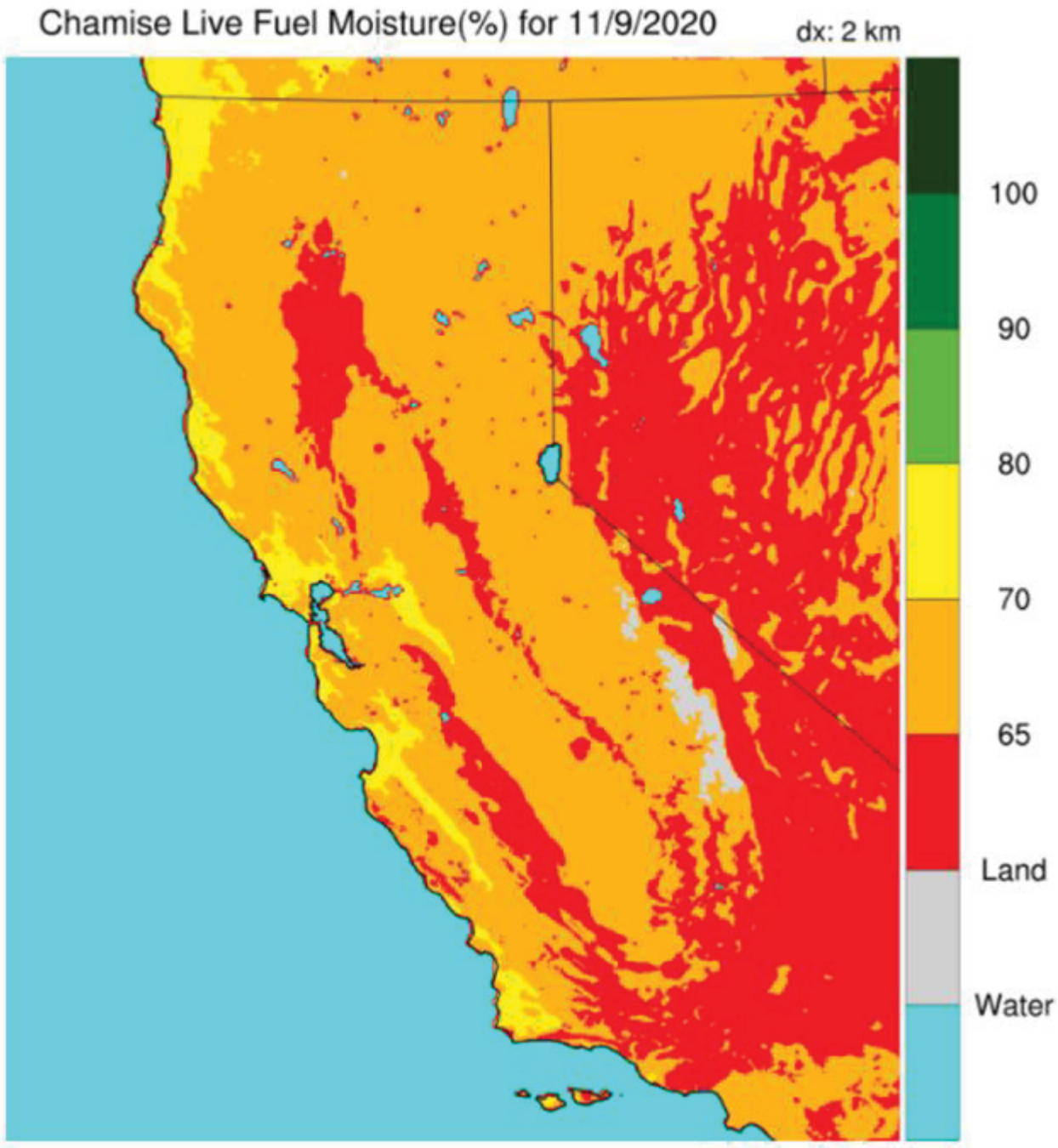
In 2020, PG&E partnered with Atmospheric Data Solutions and Technosylva to develop the next generation of LFM and DFM Models deployed at PG&E. In 2020, PG&E deployed a DFM Model on the PG&E-AWS cloud capable of predicting the moisture content of multiple DFM fuel classes (i.e., DFM 1hr, DFM 10hr, DFM 100hr, DFM 1000hr) at 2 x 2 km resolution. The DFM Model PG&E deployed is a customized version of the Nelson DFM model utilized in the NFDRS 2016 model version. Figure PG&E-7.3.2-3 below is an example hour output from the DFM 10hr fuel class is presented. These models provide hourly DFM forecasts for the four aforementioned DFM classes up to four days in advance.

FIGURE PG&E-7.3.2-3: HOUR OUTPUT FOR 10-HOUR DFM MODEL



PG&E also deployed 2 x 2 km LFM models for Chamise as well as Manzanita plant species. These are machine-learning models developed by ADS using NFMDB observations. Figure PG&E-7.3.2-4 below is an example hour output from the LFM Chamise model is presented.

FIGURE PG&E-7.3.2-4: HOUR OUTPUT FROM LFM MODEL

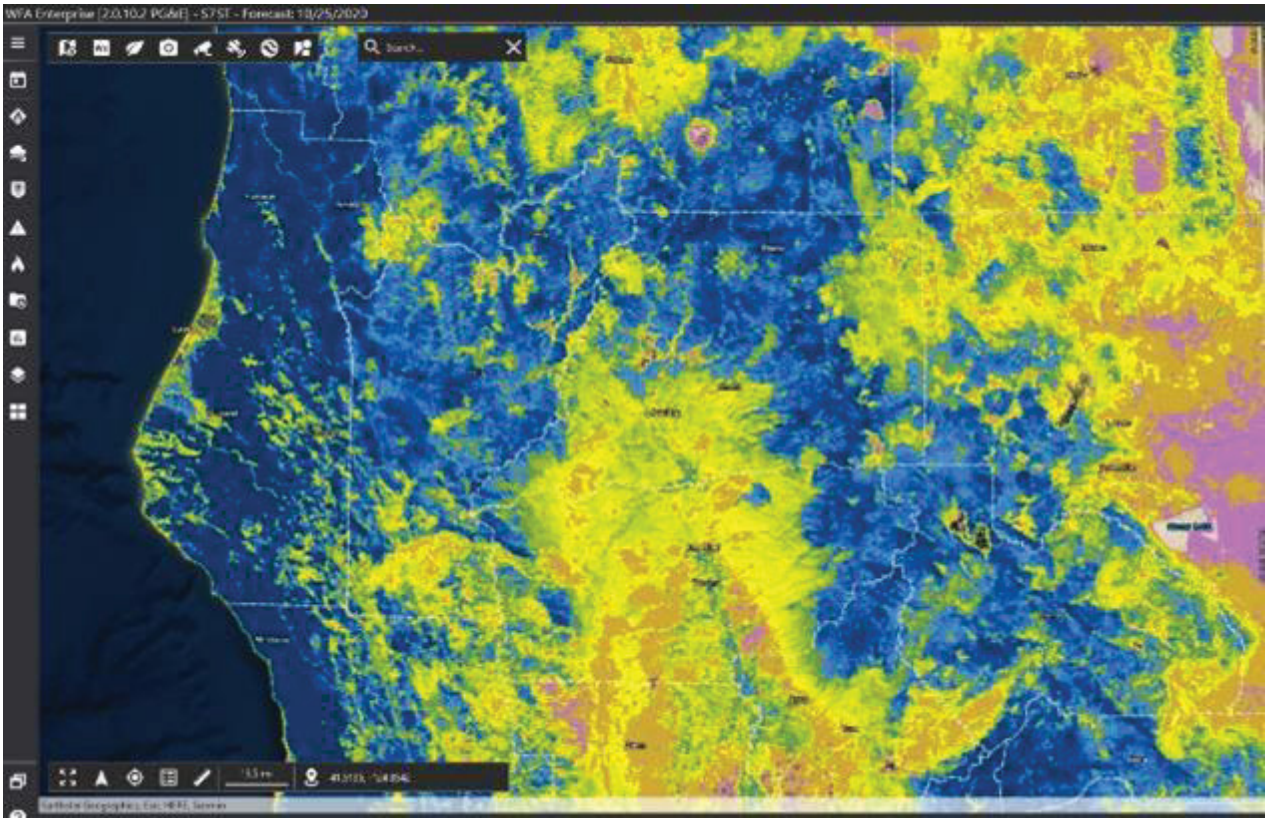


In addition to creating new forecast models, PG&E created a 30-year climatology of DFM and LFM output at 2 x 2 km resolution as well. These robust historical datasets allow PG&E meteorologists and data scientists to evaluate the dead and LFM conditions present during historical fires.

PG&E also sought to create new LFM models using remotely sensed satellite data. To this end, PG&E partnered with Technosylva to deploy LFM woody and LFM herbaceous fuel models that take advantage of recent Moderate Resolution Imaging Spectroradiometer (MODIS) satellite measurements and indices such as

the Normalized Difference Vegetation Index (NDVI). Figure PG&E-7.3.2-5 below is an example NDVI output is presented. These models were built using machine learning techniques and were trained against NFMDB observations.

FIGURE PG&E-7.3.2-5: EXAMPLE OF NORMALIZED DIFFERENCE VEGETATION INDEX OUTPUT



LFM models developed and deployed are trained on field observations. PG&E is taking steps to bolster these observations and to provide them to the public, to help validate existing models and enable more accurate models to be developed in the future, as they can take advantage of many more observations. To this end, PG&E partnered with SJSU in 2019 and 2020 to sample LFM at multiple locations in the High Fire Threat District (HFTD) within the Bay Area. Data collected from SJSU is available here: https://www.fireweather.org/fuel-moisture and also published to the NFMDB.

In 2020, PG&E also established an internal LFM sampling program to complement samples collected by state and federal across Northern and Central California. As of January 1, 2020, this network consists of 30 locations where plant species, such as Chamise and Manzanita, are sampled to measure the amount of fuel moisture in these plants throughout the seasonal cycle. Site locations are selected and scouted by PG&E meteorologists as well as Safety and Infrastructure Protection Teams (SIPT) personnel. The samples are collected in the field and shipped to PG&E's chemistry laboratory for processing. The results of all measurements are uploaded and made publicly available via the NFMDB. These observations are critical to train and validate high-resolution LFM models and satellite-derived LFM

products and will be helpful for PG&E and others to train the next generation of LFM models.

5) Future improvements to initiative:

In 2021, PG&E plans to achieve the following to enhance our Fuel Moisture Sampling and Modeling efforts:

- Expand the historical DFM and LFM climatology at 2 x 2 km resolution to back-fill all of 2020. This will allow PG&E meteorologists and data scientists to study the fire events of 2020 using this consistent set of climatology data.
- Evaluate extending the deterministic DFM and LFM forecast to provide another 24 hours of forecast data for more advanced warning of potential PSPS conditions.
- Continue the LFM sampling program in 2021 by continuing to measure LFM at 30 locations across PG&E's territory to bolster situational awareness and build historical datasets for model calibration.
- Evaluate sampling DFM as observations of DFM 100hr and DFM 1000hr fuels are currently sparse.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As fuel moisture sampling and prediction is core and central to the PSPS program, PG&E will continue leveraging high resolution fuel moisture models to inform operational decisions such as PSPS for the foreseeable future. PG&E plans to continue working with external experts to evaluate and operationalize new methodologies and models that may contribute to the overall model fidelity and accuracy. This program is expected to continue through the next ten years at this time.

7.3.2.1.3 Weather Stations

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

This section includes a description of weather stations and addresses Actions PGE-43 (Class B) and PGE-44 (Class B)

1) Risk to be mitigated/problem to be addressed:

There is high wildfire risk across many remote areas within PG&E's 70,000 square mile service territory. California contains thousands of microclimates in which wind patterns differ based on location and topography (e.g., on top of a ridge, in a canyon, or on a valley floor). As weather events unfold, such as in Diablo wind events, the complex dynamics of wind and terrain alignment as well as boundary layer height may result in downslope windstorms where wind speeds accelerate down mountain ranges and topographic features. Although there are hundreds of RAWS and NWS Weather Stations in remote areas of California, there are many locations where micro-scale effects can occur. These effects should be monitored.

By installing an expansive network of weather stations that cover some of these remote areas, we are able to enhance our real time situational awareness of conditions in these locations during critical fire weather events and also begin building a historical climatology in places where we never had verified observations before.

This historical data is also used to enhance predictive capabilities by using historical observations to test new weather model forecast configurations for enhanced accuracy. Installing such an expansive network across even the most remote portions of the territory's high fire threat areas increases real time situational awareness (in locations where it previously lacked) and mitigates wildfire risk by allowing us to better monitor conditions and respond in RT. It also allows us to use these observations to enhance predictive modeling to better forecast high risk wildfire conditions in the future and better prepare and respond to these events with as much time and confidence as possible.

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:

Data from weather stations installed in PG&E's service area are used to help forecast and monitor for high fire-risk weather conditions. This data helps inform implementation of additional precautionary measures such as PSPS.

Starting in 2018, PG&E began building our utility weather station network to provide more real time weather intelligence across the PG&E service area. As of January 1, 2021, PG&E operates, maintains and calibrates more than 1,000 weather stations in the PG&E service area. This robust weather station network is used to obtain RT, local weather information to facilitate operational decision-making and support safe operation of facilities. Weather station data is also used to validate model forecasts and to test new high-resolution model

configurations. The weather stations record wind speed, temperature, and humidity, which are the three most important fire weather parameters.

In 2018 and into 2019, PG&E developed an internal web application that presents real time weather station data from multiple networks (PG&E, NWS, RAWS) and color codes the observation based on the FFWI being observed. The FFWI is an index that uses wind speed, temperature, and RH to capture the fire weather conditions being observed.

Meteorologists can interact with the data and view data from individual stations or click on a Fire Index Area (FIA) to see a summary of conditions from each weather station in the FIA over the past 24 hours. PG&E also developed the PG&E Wind Alert System (PWAS) that displays and disseminates alerts when real time data collected from PG&E, RAWS, and NWS weather station approach or exceed defined wind thresholds. The internal web application allows users to define the areas(s) where alerts are received.

In Figures PG&E-7.3.2-6, PG&E-7.3.2-7, and PG&E-7.3.2-8 below, PG&E provides: (1) a photograph of a weather station; (2) real time weather station data from multiple networks; and (3) a snapshot of PG&E's Wind Alert System that displays and also disseminates alerts when wind speeds exceed thresholds.

FIGURE PG&E-7.3.2-6: PG&E WEATHER STATION AND ASSOCIATED INSTALLATION DETAIL

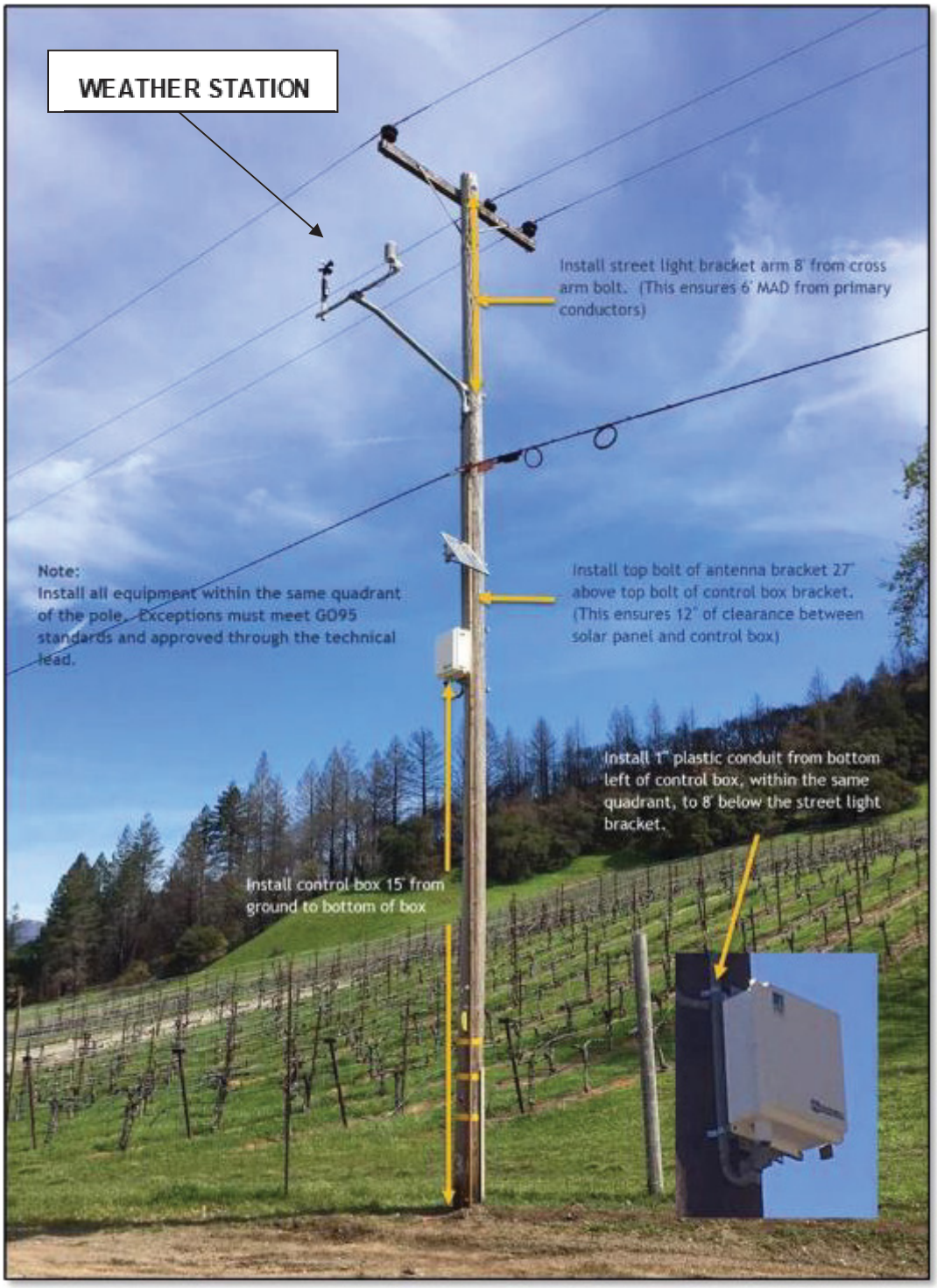


FIGURE PG&E-7.3.2-7: INTERNAL WEB APPLICATION DEVELOPED BY PG&E THAT SHOW REAL TIME WEATHER STATION DATA FROM MULTIPLE NETWORKS (PG&E, NWS, RAWS)

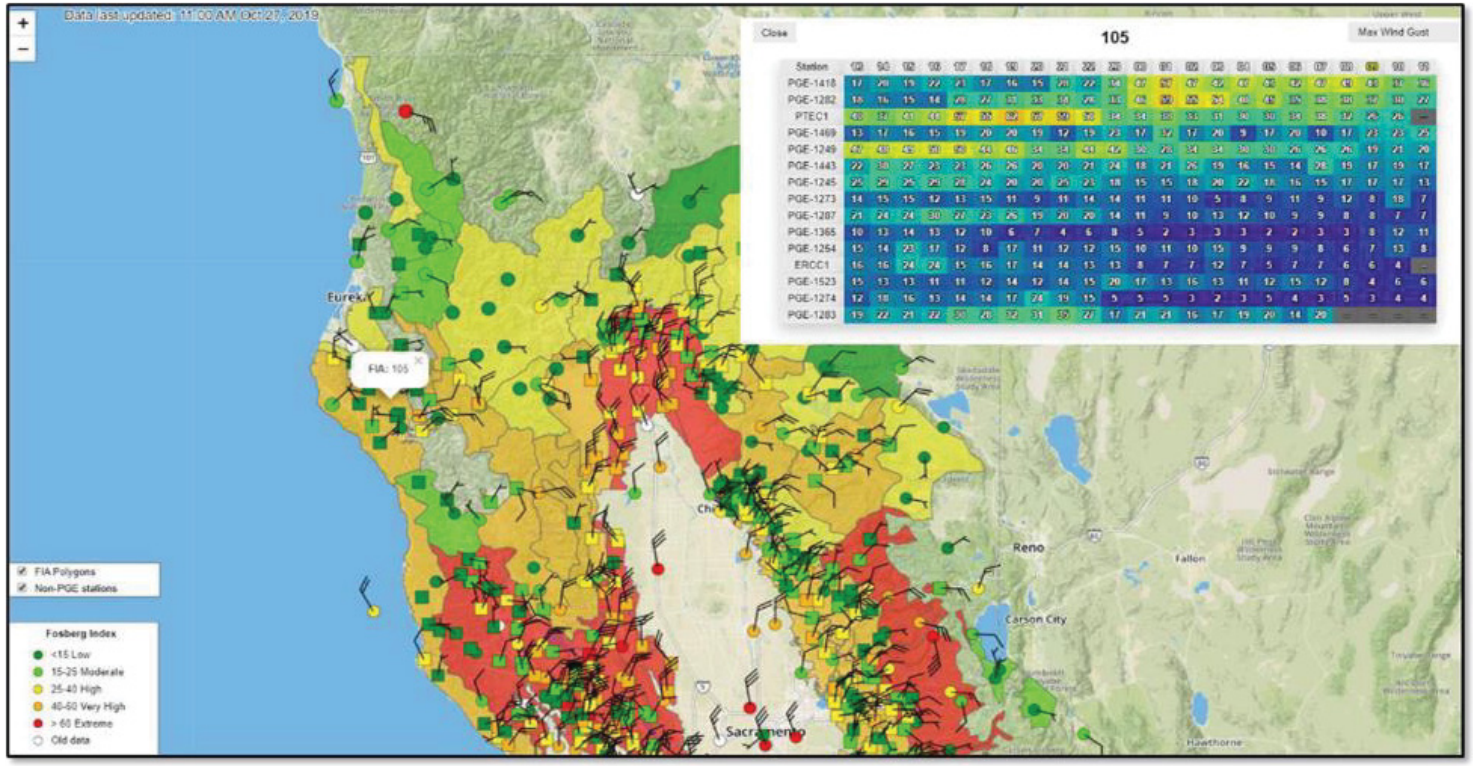
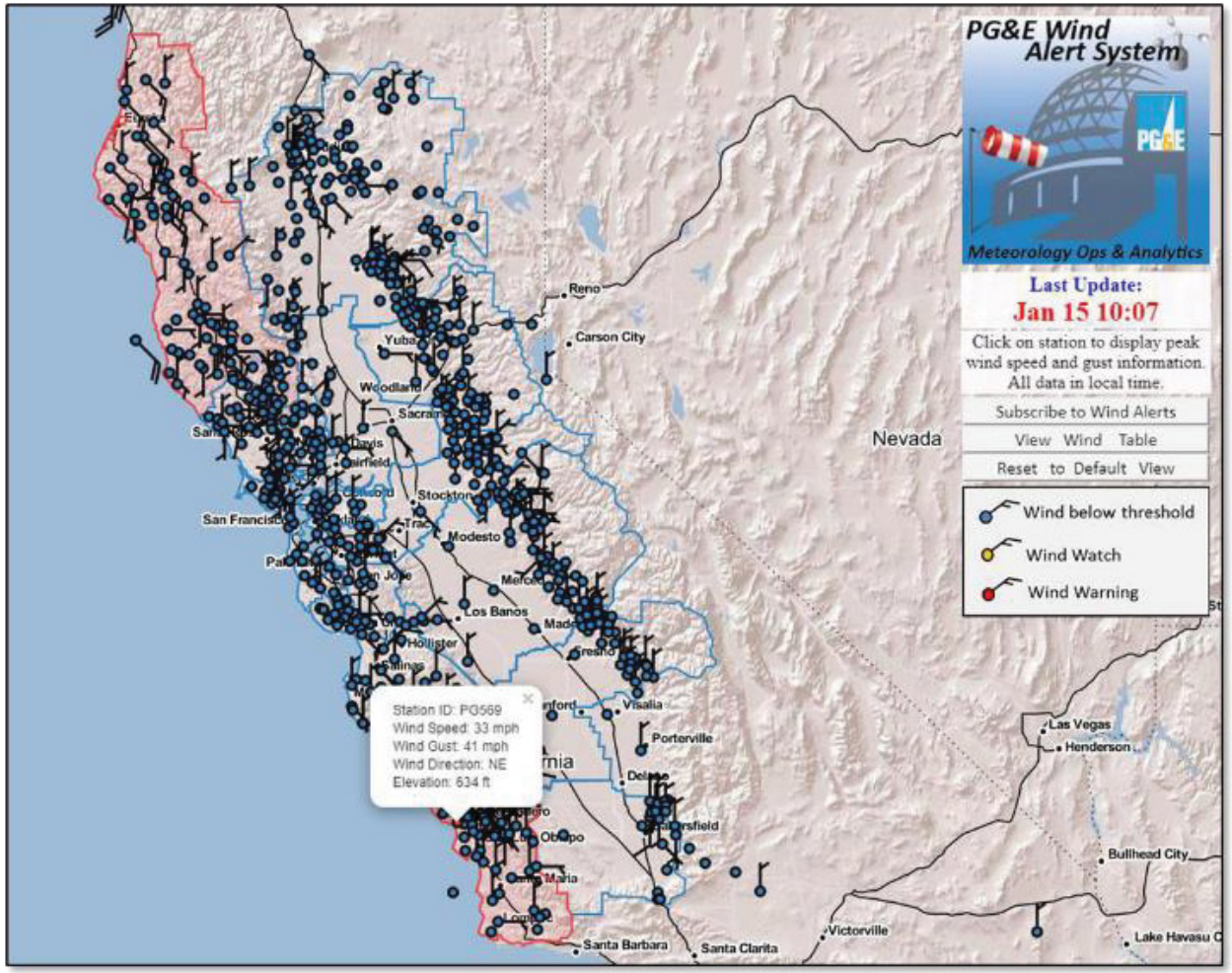


FIGURE PG&E-7.3.2-8: THE PWAS THAT DISPLAYS AND ALSO DISSEMINATES ALERTS WHEN WIND SPEEDS EXCEED THRESHOLDS – USERS CAN CUSTOMIZE ALERTS TO ONLY RECEIVE ALERTS FOR THE AREA(S) NEEDED



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"):

PG&E has dedicated a meteorologist, who formerly worked at the NWS, to lead the station siting effort of each weather station. At a high level, this involves selecting optimal locations where weather stations can be installed on PG&E poles and towers. Next, pole and tower loading calculations are performed to ensure the pole/tower can adequately handle the additional forces a weather station installation will produce. Site visits are then conducted, and pictures are taken to ensure adequate wind fetch. Finally, the weather station is installed once final signoff is provided by the PG&E meteorologist weather station lead.

PG&E has worked and will continue to collaborate extensively with external agencies such as the NWS, CAL FIRE, Bureau of Land Management and the USFS to gain input on where additional weather stations would be valuable. Our goal is to build a weather station network that will not only help PG&E mitigate wildfire risk but assist other federal and state agencies to gain superior situational awareness in localized areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

From 2018 to 2020, PG&E has aggressively installed weather stations and as of 12/31/2020 installed and in operating more than 1,000 weather stations. These weather stations report data publicly every 10 minutes on fire weather conditions: wind, temperature, and RH. The live and historical data from these stations are available for anyone to download via Mesowest or the NWS Weather and Hazards Viewer.

5) Future improvements to initiative

In order to enhance our Weather Station Project, PG&E plans to install or optimize the location of 300 additional weather stations throughout our service territory. We will also begin development of a weather-station specific wind gust model based on machine-learning or statistical techniques. Lastly, we will continue to work with local, state and federal stakeholders to optimize PG&E's weather station network for external uses.

Beyond 2021, we will assess the need to install additional weather stations as well as optimize the location of existing stations. Each weather station will require maintenance and calibration as stations are physical devices in the field.

ACTION PGE-25 (Class B)

1) Integrate discussion *on long term planning within the respective section of each individual initiative.*

Response:

The long-term plan of the weather station project will be to operate, maintain and optimize the weather station network. This network is a crucial component of the PSPS and situational awareness program and will continue for the next ten years and beyond.

The stations will need to be maintained as they are physical devices in the field exposed to environmental hazards. This includes replacing data loggers, anemometers, solar panels, batteries, and other equipment as required. Each year, the stations will be physically visited and calibrated to ensure data accuracy. In addition, PG&E will reserve the option to install a nominal number of additional weather stations and/or relocate stations to new locations if needed. PG&E is committed to making all the data collected from these important weather stations publicly available moving into the future.

ACTION PGE-43 (Class B)

1) Provide the locations via Geographic Information System (GIS) of the 111 stations awaiting installation, and

2) Explain how PG&E chose these 111 locations.

Response:

1) PG&E's process for tracking weather stations awaiting installation involves manually updating a spreadsheet to continuously add and remove weather stations from the listing. As such, PG&E could not recreate the listing of 111 weather stations that were awaiting installation at the time the First Quarterly Report was submitted. However, the current data indicates that PG&E has 127 stations awaiting installation in federal forest lands (see Attachment 2021WMP_ClassB_Action-PGE-43_Atch01.csv for a list of these weather stations pending installation with details of their latitudes and longitudes, as well as Attachment 2021WMP_ClassB_Action-PGE-43_Atch01.kmz for details of their locations via GIS). The number of weather stations pending installation fluctuates primarily due to new sites being identified, permitting issues, or other construction-related issues.

2) Station siting is performed by the Meteorology Department using Google Earth. On rare occasions the decision is made based on an in-person site visit. Initially, PG&E chose to site these weather stations on PG&E's distribution assets. We then moved to leverage transmission asset infrastructure. At the end of 2020, PG&E transitioned to installing additional weather stations on third-party lands where there are no utility assets. To do this, we mount a stand-alone pole to house each station. Weather stations are sited in mostly Tier 2 and Tier 3 HFTDs. Locations must be bucket truck accessible for installation, ongoing maintenance, and calibration of the station units. The locations are chosen based on accessibility and location from a meteorological standpoint in order to obtain critical fire weather observations at sites with the greatest exposure to offshore Diablo wind events that prompt catastrophic wildfire risk and possible PSPS events. A 3 kilometer (km) by 3 km high-resolution 30-year climatology study is used to develop a detailed

historical view of the highest-risk fire weather areas across the service territory. This 3km hi-resolution climatological analysis is currently being re-run with the latest hi-resolution model upgrade to 2km (essentially more than doubling the 3km granularity). This analysis is used as a guide to align weather station placement with highest meteorological risk on and off the PG&E grid. By the end of 2021, there will be a PG&E weather station roughly every 20 circuit miles in Tier 2 and Tier 3 HFTDs, with approximately 1,300 weather stations total. Meteorologists continue to reach out to agency partners like the NWS and CAL FIRE in the siting process and incorporate siting suggestions from key wildfire safety partners.

ACTION PGE-44 (Class B)

1) Explain why it finds installation of weather stations far from PG&E electrical assets to be necessary, and

2) Explain how installation of such weather stations will augment its situational awareness.

Response:

The goal of the PG&E weather station program is multi-faceted. There is a benefit to weather stations both from a real time situational awareness perspective and a predictive perspective. Both perspectives benefit not only PG&E but also agency partners like the NWS, CAL FIRE, national and state forests, and other agencies. Critical fire weather conditions persist across the state, far away from PG&E assets. These areas still need observation from a situational awareness perspective. For example, PG&E may not have assets across portions of the far northern edges of our service territory, but having weather stations there alerts meteorologists that conditions are materializing upstream of forecast risk areas. This essentially signals that weather is starting and tracking with forecast models for that place/time and will translate accordingly downstream to areas planned for PSPS. This is also true for agencies like the NWS that are monitoring conditions as they materialize and using those observations to adjust critical fire weather forecasts. These observations also help in remote fire response; both as a tool for decision making (e.g., assessing wind conditions and knowing where to place crews or, in the case of CALFIRE, where to place brigades safely).

These observations are also incorporated into our fire spread and consequence modeling. Some of these observations take place in areas that have not previously been observed. This provides critical data for fire spread modeling that is not only useful in real time but can also be used for long-term gains in model training and bias correction. Meteorologists are also beginning to develop a tool using observations and machine learning techniques to create statistical model outputs, which will enhance wind forecasts for critical fire weather events. With this data publicly available, it is likely that agencies like the NWS will use the data in the same manner. This would help create an additional better and more accurate forecast to keep our high fire risk communities safe. The wildfire safety mission is bigger than PG&E; therefore, it is crucial to install weather stations both along PG&E assets as well as in remote areas where no assets exist.

7.3.2.1.4 Wildfire Cameras

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Wildfire cameras are used by CAL FIRE, the California Governor's Office of Emergency Services, USFS, PG&E, and other local agencies to identify, confirm and track wildfires and general conditions (based on fire behavior and associated weather risks) in real time. Cameras allow firefighting agencies to wildfire confirm reports quickly, assess size and spread of the fire, and evaluate where to deploy fire suppression resources in affected areas. PG&E can also utilize these cameras to assess a fire's impact on our assets.

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.

The high-definition, Pan/Tilt/Zoom (PTZ) wildfire cameras improve PG&E's real time visual situational awareness. Cameras are a valuable tool for PG&E's WSOC, first responders and external fire agencies like CAL FIRE and the USFS. These external fire agencies can control the PTZ cameras to assist with their respective wildfire response efforts. An example of a camera output is provided in Figure PG&E-7.3.2-9 below.

The cameras have near infrared capabilities, allowing them to operate in low-to-no sunlight conditions. They offer a time-lapse function to confirm wildfire reports and monitor wildfire progression and environmental conditions. They are often featured on local television broadcasts. Live feeds and time-lapse data from the camera's network are available to the public at pge.com/weather and via www.alertwildfire.org.

PG&E has leveraged an existing and mature platform used by three major California utilities, CAL FIRE, USFS and other local agencies (where cameras are accessible by anyone using the AlertWildfire platform).

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")

In 2018, PG&E installed nine high-definition cameras in HFTD areas through a pilot program to test the technology. In 2020, PG&E met the installation target of 200 cameras (installation target of 333 lifetime cameras). By December 31, 2020, PG&E installed 216 cameras, bringing the lifetime total of operationally ready cameras to 349. PG&E will install an additional 135 cameras by December 31, 2021. The additional wildfire cameras will be installed with viewsheds facing toward Tier 2 & Tier 3 HFTD areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

The number of wildfire camera installations has grown beyond the capability to manually monitor. As a result, PG&E leverages other information, such as satellite fire detections and Integrated Reporting of Wildland-Fire Information (IRWIN), to help determine which wildfire camera(s) should be viewed. In coordination with University of California Regents, the Alert Wildfire consortium and other partners, PG&E will support research aimed at advancing automated capabilities further. Specifically, this research is aimed at identifying and incorporating Artificial Intelligence (AI) early fire detection software, and visualization techniques to display 360° imagery. This would allow cameras to automatically rotate and zoom to view emerging incidents quicker.

5) Future improvements to initiative

Beyond 2022, PG&E plans to reassess our wildfire camera network coverage, as several other external agencies, such as Sonoma Water, CAL FIRE and USFS, install wildfire cameras in our service territory. Similar to the weather station program, PG&E welcomes input from external parties on wildfire camera deployment to maximize their impact on enhancing public safety and improve emergency response efforts.

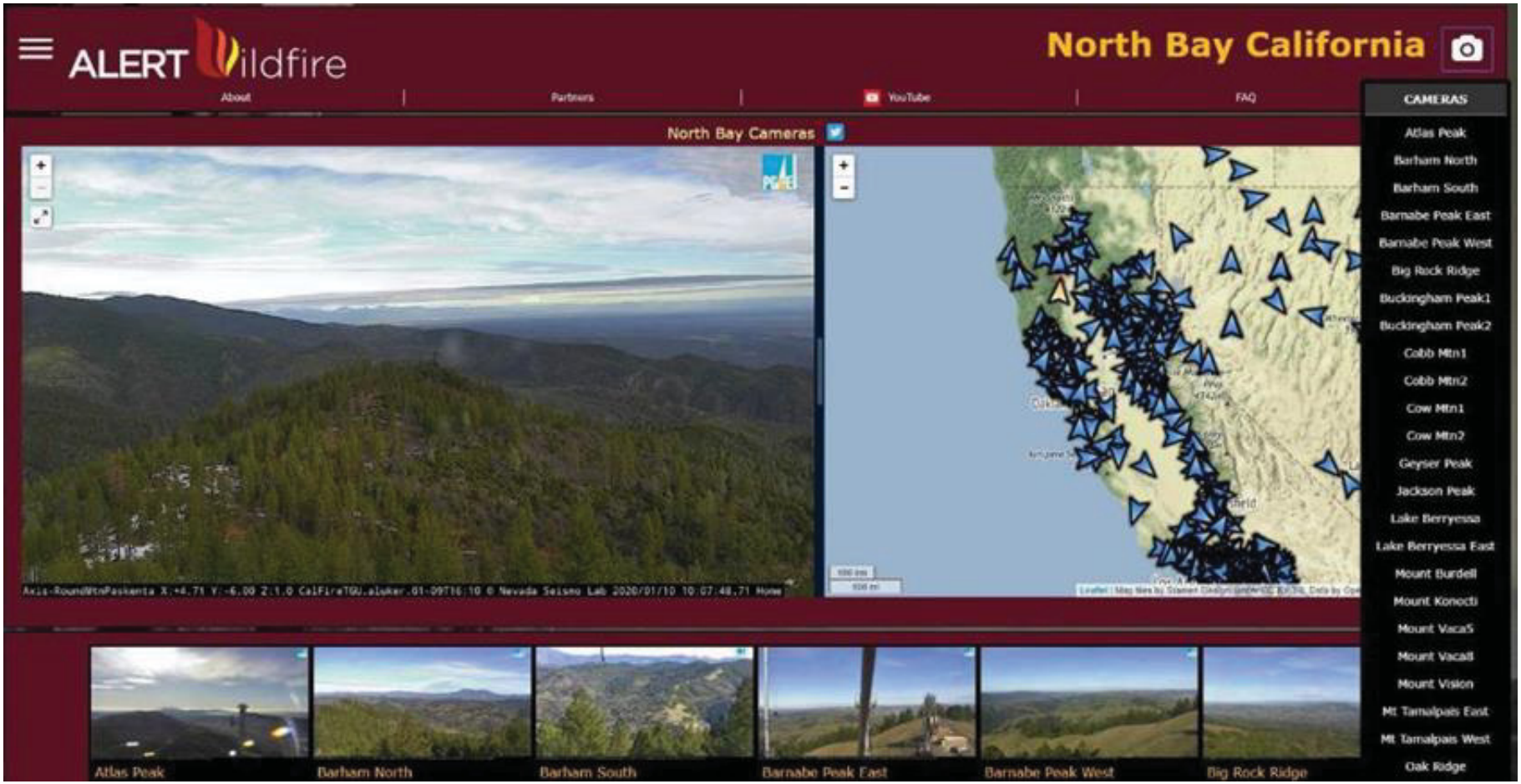
ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Installation goals should be completed by 2022. At that point, the project is expected to go into a steady state mode, which includes operational maintenance of the cameras. After that, there will be incremental additions to support agency location requests and PG&E location optimization. In addition, PG&E continues to look for opportunities to pilot nascent technologies such as enhanced AI camera software capabilities. If the pilots are successful, we expect to invest in these technologies.

FIGURE PG&E-7.3.2-9: EXAMPLE CAMERA OUTPUT, WEB INTERFACE, AND CAMERA NETWORK DENSITY FROM ALERTWILDFIRE.ORG



7.3.2.1.5 Fire Detection & Alerting

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

PG&E needs to be situationally aware of all wildland fire activity occurring within our territory regardless of causation. Satellite fire detections provide valuable information to the utility regarding the presence of new fires and the spread of existing fires in a timely fashion. This information can be used to ensure the safety of utility workers in the area, help identify assets at risk and provide situational awareness as to the burn severity and rate of spread. A satellite-based fire detection system is also much more cost effective than the prior solution, which was fixed-wing flight patrols.

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:***

Satellite technology has matured to a point where data from geostationary and polar-orbiting satellite data can be utilized to monitor fires in near-real time. PG&E's Meteorology team deployed a fully operational state-of-the-art satellite-based fire detection and alerting system in 2019 and enhanced the system in 2020 by adding more polar satellite data. As of January 1, 2021, the system ingests and reconciles fire detection data from 2 Geosynchronous Satellites (GOES-West, GOES-East), and four polar-orbiting satellites (MODIS-AQUA, MODIS-TERRA, Suomi NPP), and NOAA-20). PG&E developed the system to incorporate new fire detection data feeds as they become available. PG&E is working directly with industry-leading fire detection algorithm developers and experts from the SSEC at the University of Wisconsin-Madison to procure a customized feed of satellite fire detection data just for California with the lowest latency available. SSEC has deployed primary and backup servers in SSEC data centers specifically for PG&E that process the raw satellite data to produce fire detections.

To visualize and interact with the fire detection data, PG&E developed a proprietary application in-house in 2019 and an external application available to the public in 2020 that combines and displays fire detections as they arrive. The internal web application also disseminates new fire detection alerts via the internal web-application and through email. The web application displays each location where fire was recently detected and PG&E meteorologists or analysts with the WSOC can quickly review live feeds from the nearest wildfire cameras to confirm fire and/or smoke in an area. The satellite data also contains a measure of the fire intensity called FRP, and the web-app allows the user to retrieve an FRP timeseries in order to track the intensity of fires in each location. The applications also display current incidents available from CAL FIRE as well as fire perimeters from federal agencies. PG&E is actively sharing fire alerts with CAL FIRE through the California National Guard and with numerous county and local fire departments. PG&E is also sharing this data with other California utilities and CAL FIRE through Technosylva Wildfire Analyst Enterprise software.

PG&E is committed to sharing this data with interested stakeholders and to the general public. This tool helps PG&E respond to new and emerging events quickly and make faster operational decisions.

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"):***

There is no regional prioritization with regards to this work. The GOES-West and GOES-East satellites scan the entire continental United States every five minutes and thus provide new fire detection data in five-minute intervals. In addition, each satellite has two mesoscale sectors that scan a regional area every minute. PG&E does not have control or input on where the mesoscale sectors are located as these are controlled by federal sources.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

In 2020, PG&E added NOAA–20 data into the suite of fire detection data. NOAA-20 is the first spacecraft of NOAA's Joint Polar Satellite System, the new generation of polar-orbiting satellites that carries the Visible Infrared Imaging Radiometer Suite (VIIRS). VIIRS is a proven tool for fire detection.

In 2020, PG&E developed an external application available to the public where satellite detection data can be found: https://pgefdp.lovelytics.info/pge_fire_app/. In addition, PG&E is actively sharing this data with Technosylva, who has developed an application called Wildfire Analyst Enterprise. This application is used by other California utilities and CAL FIRE. PG&E has allowed all stakeholders using this application in California to access and visualize PG&E's fire detection data free of charge. PG&E is also interested in receiving fire detection data available from Fire Guard, which is produced by the California National Guard and available to CAL FIRE.

In 2021, PG&E plans to operate the system with no major enhancements or planned changes. However, if new satellite data becomes available, such as Fire Guard outputs, we may incorporate it into the system, time and data permitting.

Below PG&E provides example of: (1) output of the PG&E Fire Detection and Alert System (FDAS) (Figure PG&E-7.3.2-10); (2) fire detection alert email distributed automatically by the PG&E FDAS (Figure PG&E-7.3.2-11); and (3) integration of PG&E wildfire cameras and the PG&E FDAS (Figure PG&E-7.3.2-12).

FIGURE PG&E-7.3.2-10: EXAMPLE OUTPUT OF THE PG&E FDAS – SNAPSHOT TAKEN ~3:45 PM 9/9/2019 AND ACTIVE FIRE SHOWN IS THE WALKER FIRE – VIIRS AND MODIS FIRE DETECTIONS ARE NOT SHOWN

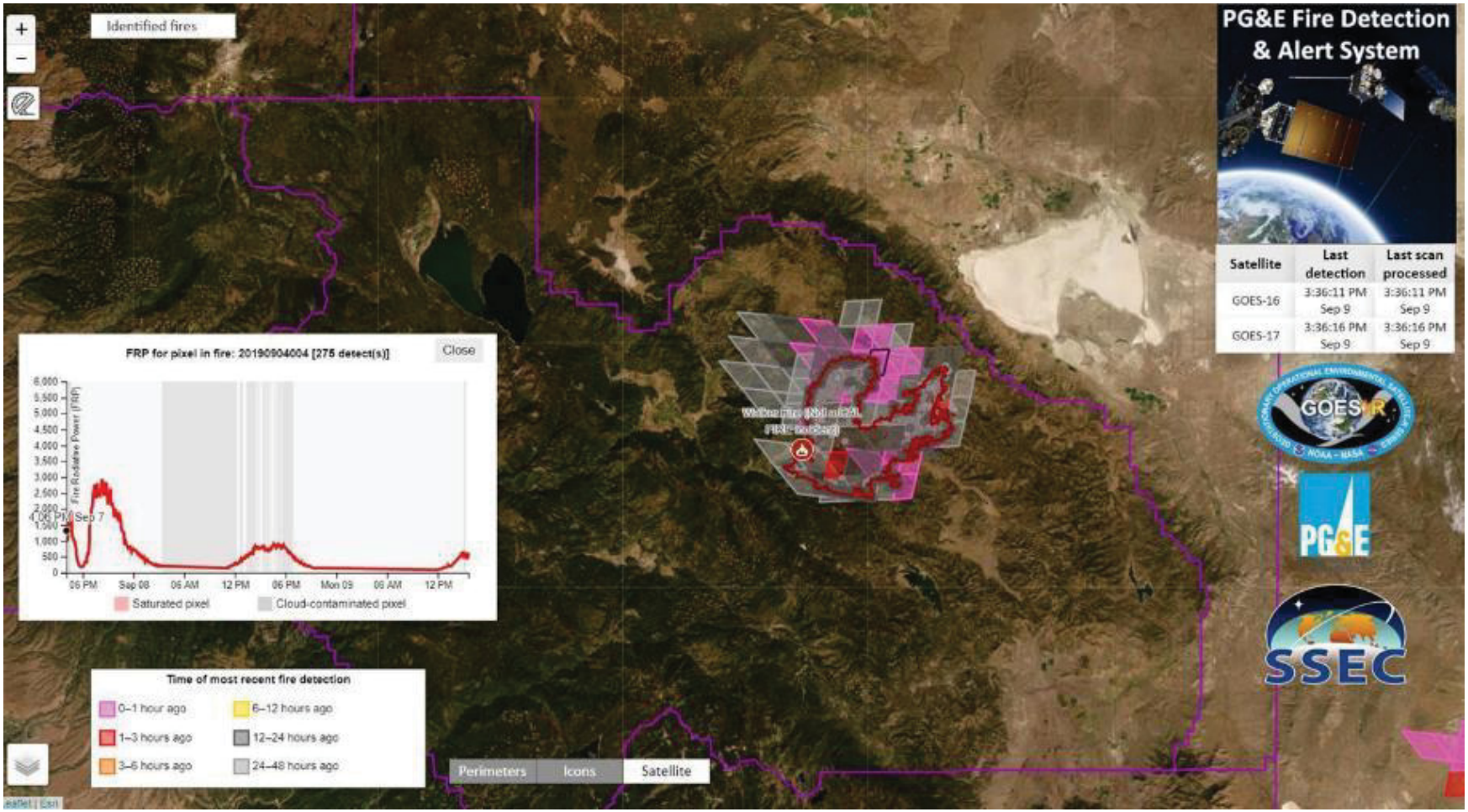


FIGURE PG&E-7.3.2-11: EXAMPLE FIRE DETECTION ALERT EMAIL DISTRIBUTED AUTOMATICALLY BY THE PG&E FDAS – THIS INCIDENT WAS THE MARSH FIRE THAT WAS REPORTED IN CONTRA COSTA COUNTY ON AUGUST 3, 2019

Sat 8/3/2019 3:31 AM

WA Weather Alerts <wx-alerts@pge.com>

New Fire Detection in PG&E's Diablo Division (Contra Costa County)

A new GOES17 fire detection has occurred in PG&E's Diablo Division (Contra Costa County) in a Tier2-Elevated CPUC High Fire-Threat District. The possible fire has been assigned an internal ID: 20190803003

Visit the PG&E Fire Detection web page (internal PG&E only) to see a map of this detection.

Detection latitude/longitude centroid: 37.893333/-121.834908 (note fire could be up to 3 miles away from the centroid point).

Additional Links:
Google Maps
Local Weather Station Data
Alert Wildfire Cameras

Alert Issued at: 08/03/19 3:31 (Local Pacific Time).

Please note:
These alerts are disseminated only if multiple satellite detections occur in a given space/time. No more alerts will be sent for this possible fire with internal ID: 20190803003. Note that alerts are only generated for fire detections in the PG&E service territory. In addition, no alerts are generated for fires in the agricultural and urban areas in the Central Valley due to over-alerting related to planned agricultural fire activities. This satellite-based system will not detect all fires and some false detections are possible and typically occur near bodies of water or near large solar installations.

This notice was sent by PG&E Meteorology Operations and Analytics (925-244-4630). If you have any questions, please contact WeatherDeptAdmins@pge.com.

FIGURE PG&E-7.3.2-12: EXAMPLE INTEGRATION OF PG&E WILDFIRE CAMERAS AND THE PG&E FDAS –THIS EXAMPLE SHOWS A SMOKE PLUME VISIBLE FROM A FIRE DETECTED FROM FDAS – THIS EXAMPLE IS FROM THE FIRE THAT OCCURRED IN THE NUSTAR ENERGY FACILITY IN CROCKETT, CALIFORNIA

5) Future improvements to initiative:

Beyond 2020, NOAA plans to launch three additional polar-orbiting satellites in this new generational fleet, with the next satellite launch presently scheduled for 2022. PG&E may incorporate additional fire detection data into the suite once available. PG&E may also evaluate adding other public and proprietary data sources as they become known or available.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E will continue operating the satellite fire detection and alerting system for the next decade. The program has proven to be a cost-effective way to monitor and track new fires across PG&E's territory automatically using satellite data. New sources of fire detection data are likely to come online over the next decade, such as NOAA satellites and privately owned options as well. These new sources of data likely will be evaluated for inclusion based on efficacy and costs.

7.3.2.1.6 Other Meteorology Tools and Upgrades

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

In addition to the tools and programs discussed in the previous sections, the meteorology tools and upgrades outlined below help PG&E gain further situational awareness as it relates to weather intelligence across the PG&E service area.

- High Performance Cloud Computing, Model Validation, and other initiatives
- Medium- to Seasonal-Range Diablo Wind Forecasting
- Addressing Weather Forecast Model Uncertainty
- PG&E Lightning Detection Network (PLDN)
- Information Sharing

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:

Each of the initiatives described below allows us to advance situational awareness capabilities as well as enable process and computation of extremely large datasets.

High Performance Cloud Computing, Model Validation and other initiatives

The meteorology data PG&E processes and computes exceeds multiple terabytes per day. In order to process, store and visualize these large datasets, we migrated our weather prediction capabilities to the cloud. This migration allows us to expand our processing and data storage needs dynamically and prepare for the near future where data sizes and computation demands are expected to increase.

PG&E actively partnered with multiple external experts in numerical weather prediction to develop POMMS V3.0, which is run and post-processed entirely in the AWS cloud.

In 2020, PG&E deployed a scalable, high-performance cloud computing environment in AWS to achieve the significant increase in computation required to run the higher-resolution weather models and post-process data multiple times per day. PG&E's POMMS model is now run and entirely post-processed in the cloud. This was a major accomplishment in 2020 and will allow PG&E to continue to advance our numerical weather prediction and data science fronts in this scalable environment. The POMMS model was built to be run across multiple AWS regions for redundancy and PG&E's model post-processing environment consists of development, quality assurance and production computing environments to develop, test, and deploy operational code.

Medium- to Seasonal-Range Diablo Wind Forecasting

Diablo winds have been responsible for most of the catastrophic fires in Northern California history. These are analogous to Santa Ana winds across Southern California. In 2020, PG&E developed an experimental short-range (2 – 4 weeks) Diablo wind forecasting system. PG&E evaluated if teleconnections such as El Nino, the Pacific Decadal Oscillation and the Madden Julian Oscillation, to name a few, provided predictive skill to forecast Diablo wind events outside the range of global weather models.

Addressing Weather Forecast Model Uncertainty

To address uncertainty in weather forecast modeling, PG&E employs multiple methods. First, PG&E leverages numerous sources of global and high-resolution forecast model data and compares results to determine forecast alignment. For example, if all weather forecast models agree a certain weather event will transpire, then confidence is generally high. In Figure PG&E-7.3.2-13 below, PG&E provides an example of tools it employs to quickly compare pressure gradient forecasts and wind speeds from multiple sources of forecast data. Another method applied is ensemble prediction. PG&E leverages outputs and visualizations from the European Centre for Medium-Range Weather Forecasts (ECMWF) EPS, which is comprised of 50 model members.

FIGURE PG&E-7.3.2-13: EXAMPLE OUTPUT FROM THE PG&E PRESSURE GRADIENT TRACKING TOOL THAT SHOWS OBSERVATIONS (BLACK DOTS) VERSUS PRESSURE GRADIENT FORECASTS FROM SEVERAL DETERMINISTIC FORECAST MODELS

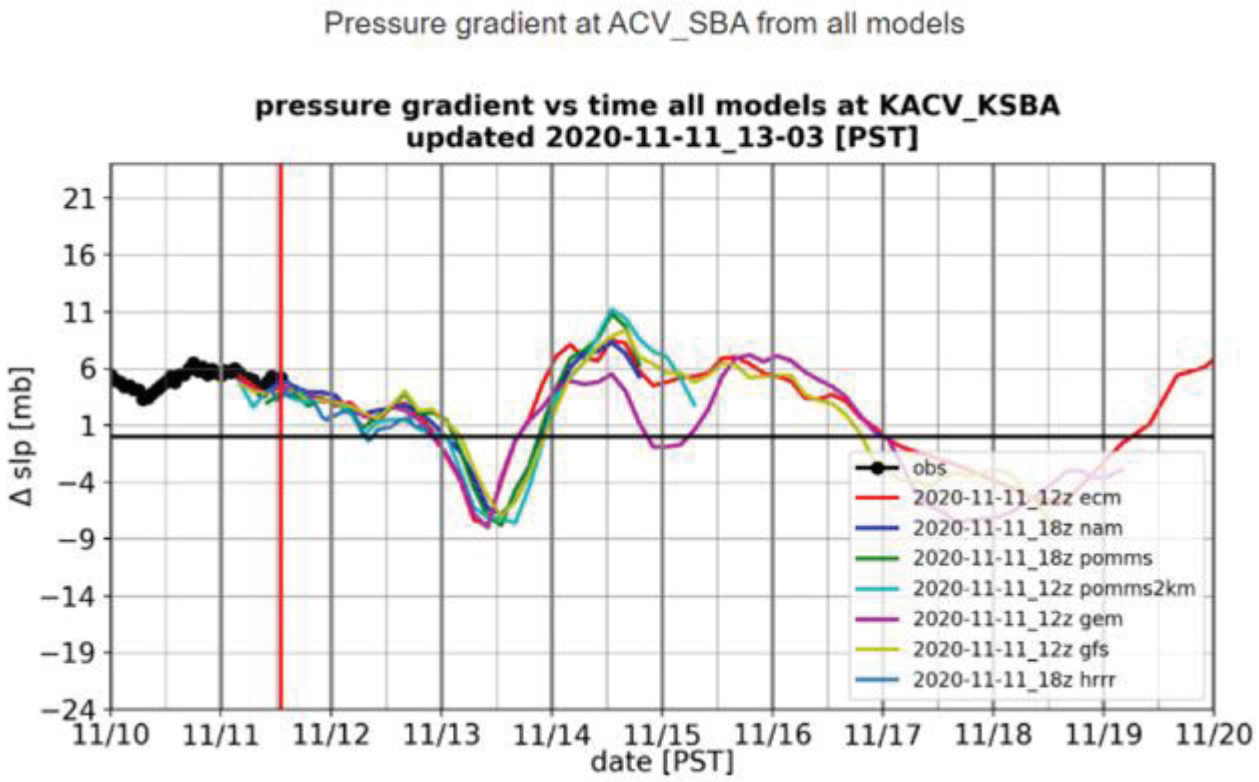
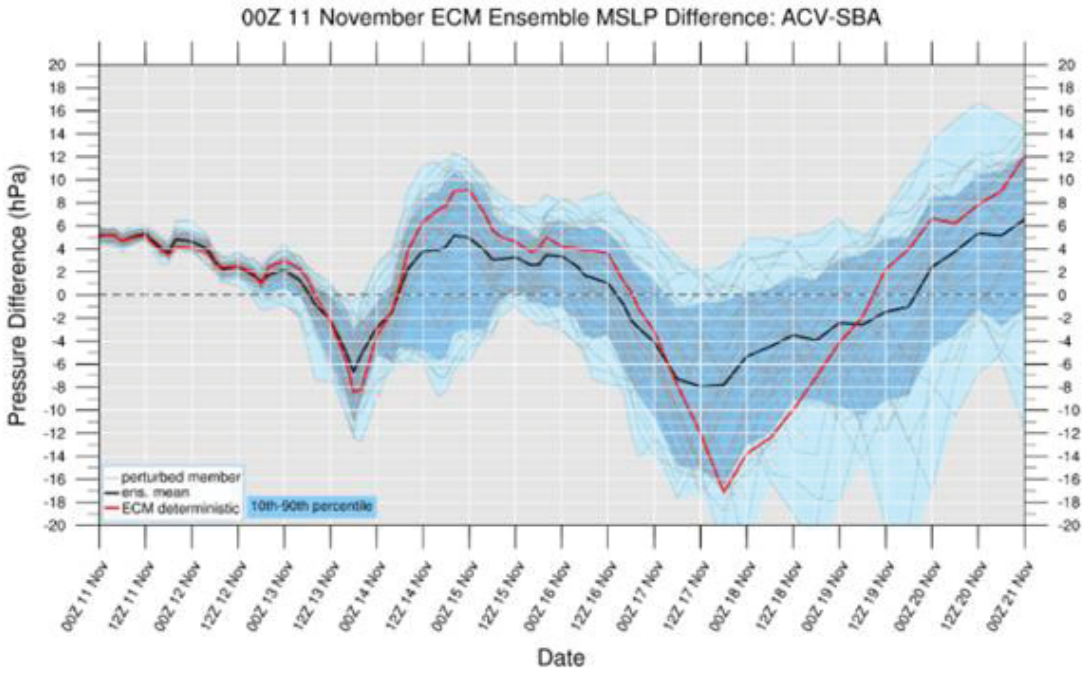


Figure PG&E-7.3.2-14 below shows the forecasted Arcata, California to Santa Barbara, California pressure differential from every ECMWF ensemble member. This Arcata to Santa Barbara pressure differential is an important predictor of outage activity during winter storms while other pressure differentials have been found to be important predictors of other weather patterns. One can generally see very good alignment (thus high confidence) in the near-term forecast, following by increased dispersion (lower confidence) in model solutions generally farther out in time. PG&E also leverages the ECMWF EPS for precipitation forecasting.

FIGURE PG&E-7.3.2-14: EXAMPLE OUTPUT FROM THE PG&E ECMWF EPS GRADIENT TOOL THAT SHOWS MODEL RESULTS FROM 50 EPS MEMBERS (GRAY LINES) THE TOP AND BOTTOM 10 PERCENT (LIGHT BLUE SHADING), THE EPS MEAN (BLACK LINE) AND THE DETERMINISTIC ECMWF MODEL (RED LINE)



PG&E also processes and visualizes data from the Global EPS (the GFS ensemble) in a similar way as described above. Figure PG&E-7.3.2-15 and Figure PG&E-7.3.2-16 below present operational examples of the GEFS and POMMS-EPS.

FIGURE PG&E-7.3.2-15: EXAMPLE OUTPUT FROM THE PG&E GEFS GRADIENT TOOL THAT SHOWS MODEL RESULTS FROM GEFS MEMBERS (GRAY LINES) THE TOP AND BOTTOM 10 PERCENT (LIGHT BLUE SHADING), THE MEAN (BLACK LINE) AND THE DETERMINISTIC MODEL (RED LINE)

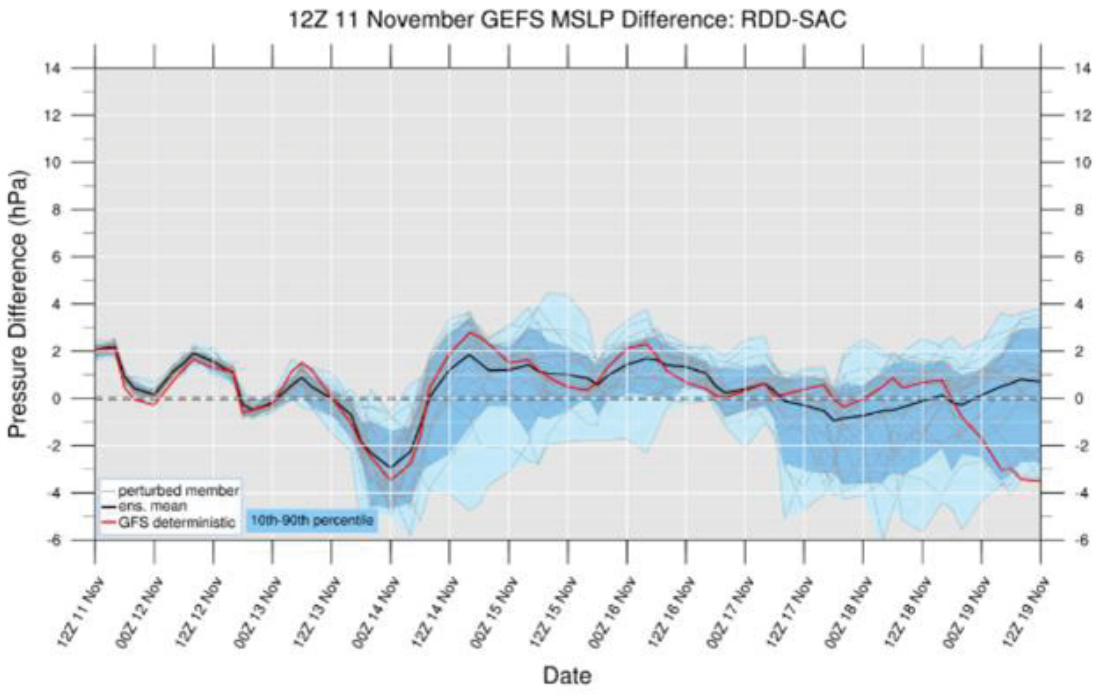
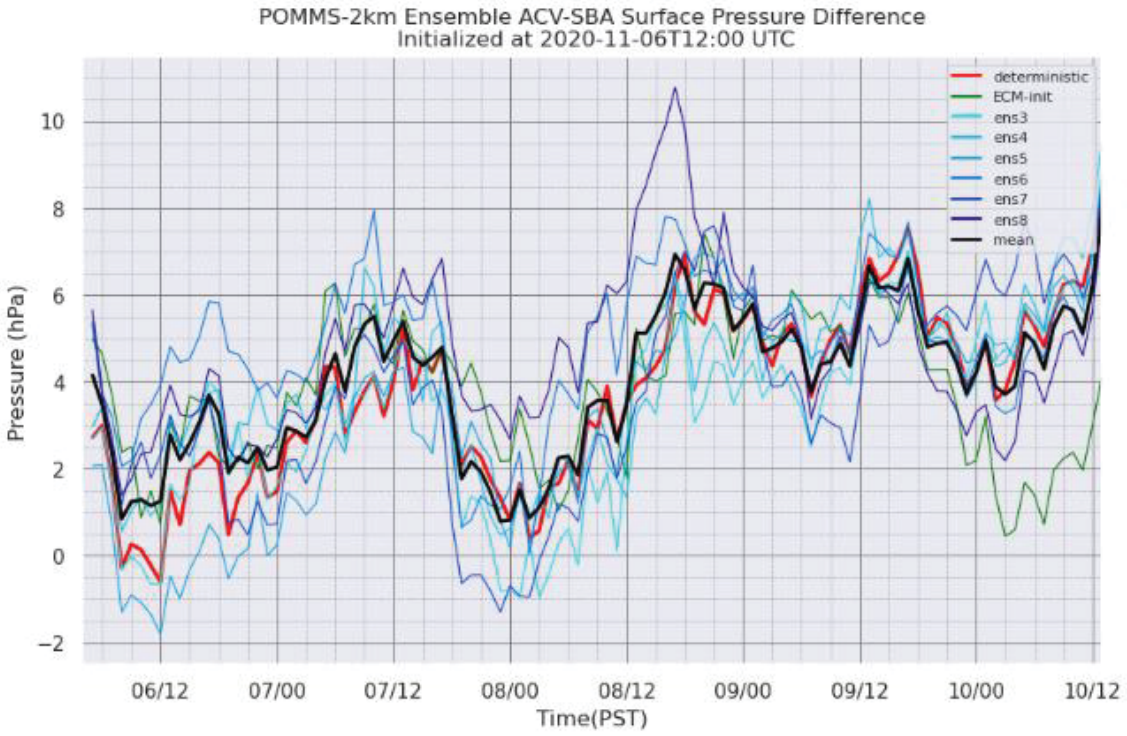


FIGURE PG&E-7.3.2-16: EXAMPLE OUTPUT FROM THE PG&E POMMS-EPS GRADIENT TOOL THAT SHOWS MODEL RESULTS FROM ALL MEMBERS (COLORED LINES), THE ECMWF-INITIALIZED FORECAST (GREEN LINE), THE MEAN (BLACK LINE) AND THE DETERMINISTIC MODEL (RED LINE)

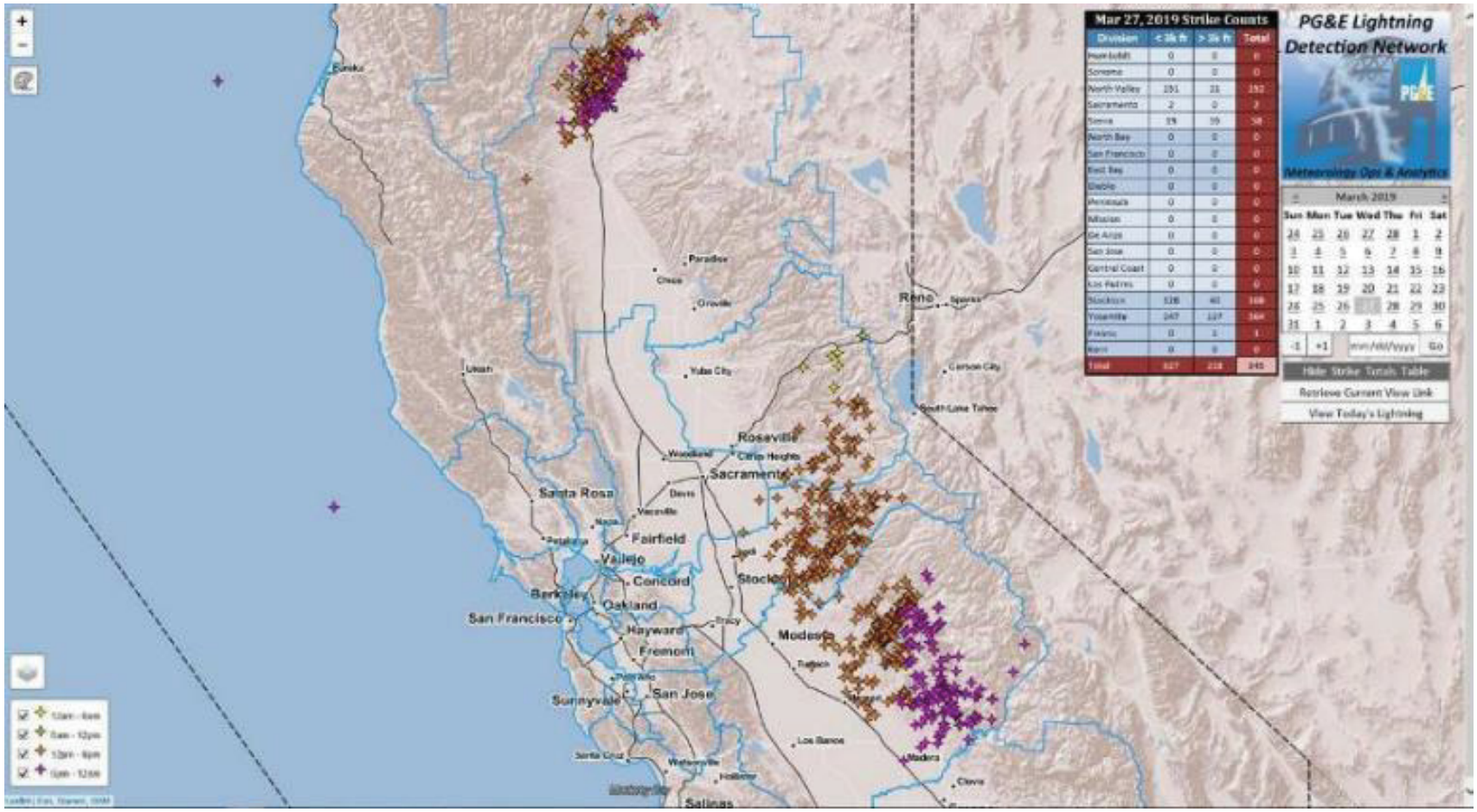


PG&E Lightning Detection Network (PLDN)

PG&E operates several lightning detection sensors that feed into a larger network: The Global Lightning Network. Cloud to ground lightning strikes can cause utility outages as well as result in fire ignitions. For example, from June 20 to 21, 2008 more than 20,000 lightning strikes occurred resulting in more than 2,000 fires. Another catastrophic lightning outbreak occurred in 2020, resulting in many of the largest fires in California history. PG&E also developed a custom internal application that displays lightning strikes in real time and allows a user to customize alerts received for just specific areas of interest. The application also gives the user the ability to see historical lightning as well as the peak lightning stroke amperage.

In Figure PG&E-7.3.2-17 below, PG&E provides example output from the PLDN showing historical lightning from March 27, 2019.

FIGURE PG&E-7.3.2-17: EXAMPLE OUTPUT FROM THE PLDN SHOWING HISTORICAL LIGHTNING FROM MARCH 27, 2019



Information Sharing

PG&E is committed to sharing weather, fire detection information, camera data and PSPS potential forecasts with stakeholders and the public. PG&E values the role state, county and federal agencies (e.g., CAL FIRE, NWS, Predictive Services) play in communicating fire danger and risk to the general public. In 2019 and 2020, several meetings were held with agencies and stakeholders to better align on how PG&E would share information with the public. PG&E currently shares the following information daily:

- Data collected from > 1000 weather stations every 10 minutes
- Live feeds from alert wildfire cameras
- Fire detection information publicly, and directly with the California National Guard, CAL FIRE, other investor-owned utilities and county and municipal fire agencies
- PG&E's 7-day PSPS forecast and discussion

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"):

We perform this work across the entire service territory. There is no regional prioritization for this work.

4) Progress on initiative (amount spent, regions covered) and plans for next year

High Performance Cloud Computing, Model Validation and other initiatives

In 2020, the National Center for Atmospheric Research (NCAR) experienced issues distributing the GFS model data used to initialize PG&E's high-resolution forecast data. Although this did not impact PG&E in 2020, it showed that our high-resolution modeling efforts are dependent on NCAR's ability to deliver the initialization datasets to the public. However, PG&E has been exploring the ability to run the POMMS model using the ECMWF (European model) initialization as part of the POMMS Ensemble Prediction System. During the NCAR outage in 2020, PG&E determined it can shift the operational POMMS model configuration to use the ECMWF initialization rather than GFS. This new capability will mitigate the risk that future NCAR and other upstream data outages would prevent PG&E POMMS model from running correctly.

In 2020, PG&E developed the ability to put forecasts in context with history. For example, PG&E can evaluate the forecast, hour by hour and by each grid point, including where the forecasted wind speed ranks historically over the past 30 years. To accomplish this, PG&E developed wind-speed distributions at 2 x 2 km grid point across 30 years of historical data and can use the forecasted wind speed to rank the forecast by percentiles. This allows PG&E meteorologists to quickly determine if models are forecasting a tail-end or extreme event.

In Figure PG&E 7.3.2-18, Figure PG&E 7.3.2-19, and Figure PG&E 7.3.2-20 below, PG&E provides an example product menu for the POMMS v3.0 model showing a sample array of model output. Model output visualizations of wind gusts and RH

below. Figure PG&E 7.3.2-21 shows an example wind speed forecast translated to percentile ranked against the 30-year climatology.

FIGURE PG&E-7.3.2-18: SAMPLE PRODUCT MENU FOR THE POMMS MODEL

FIGURE PG&E-7.3.2-19: POMMS MODEL OUTPUT, WIND GUSTS/WIND SPEED BARBS

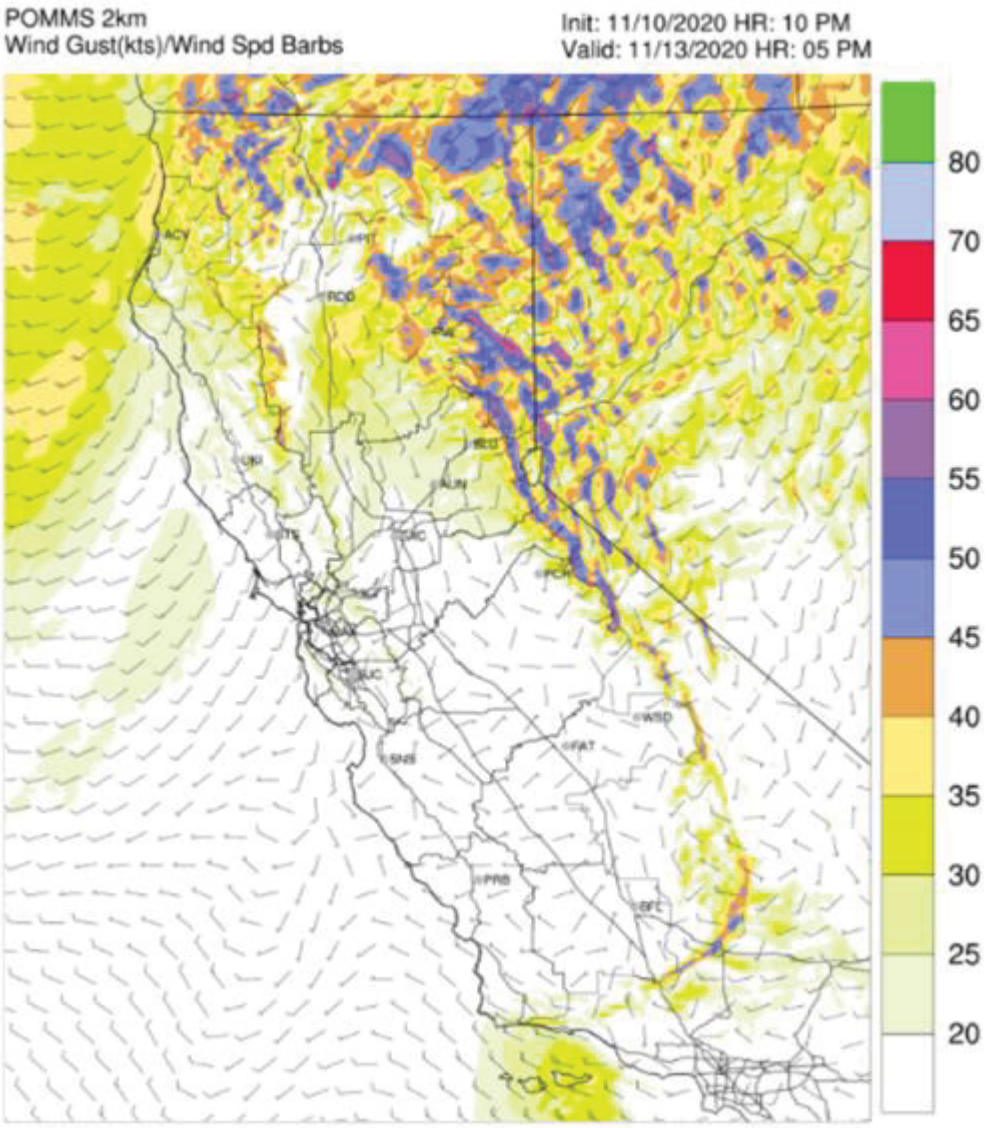


FIGURE PG&E-7.3.2-20: POMMS MODEL OUTPUT, 2M RH/WIND BARB

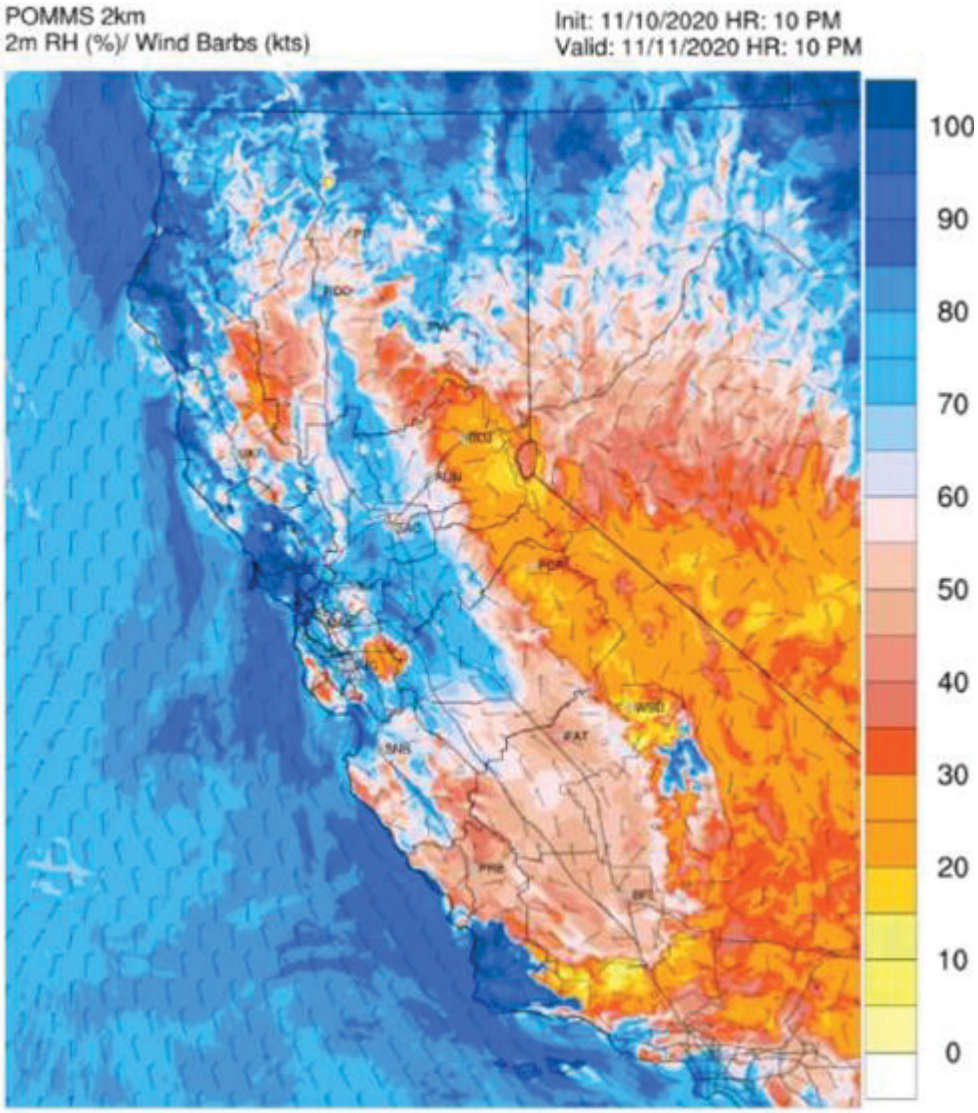
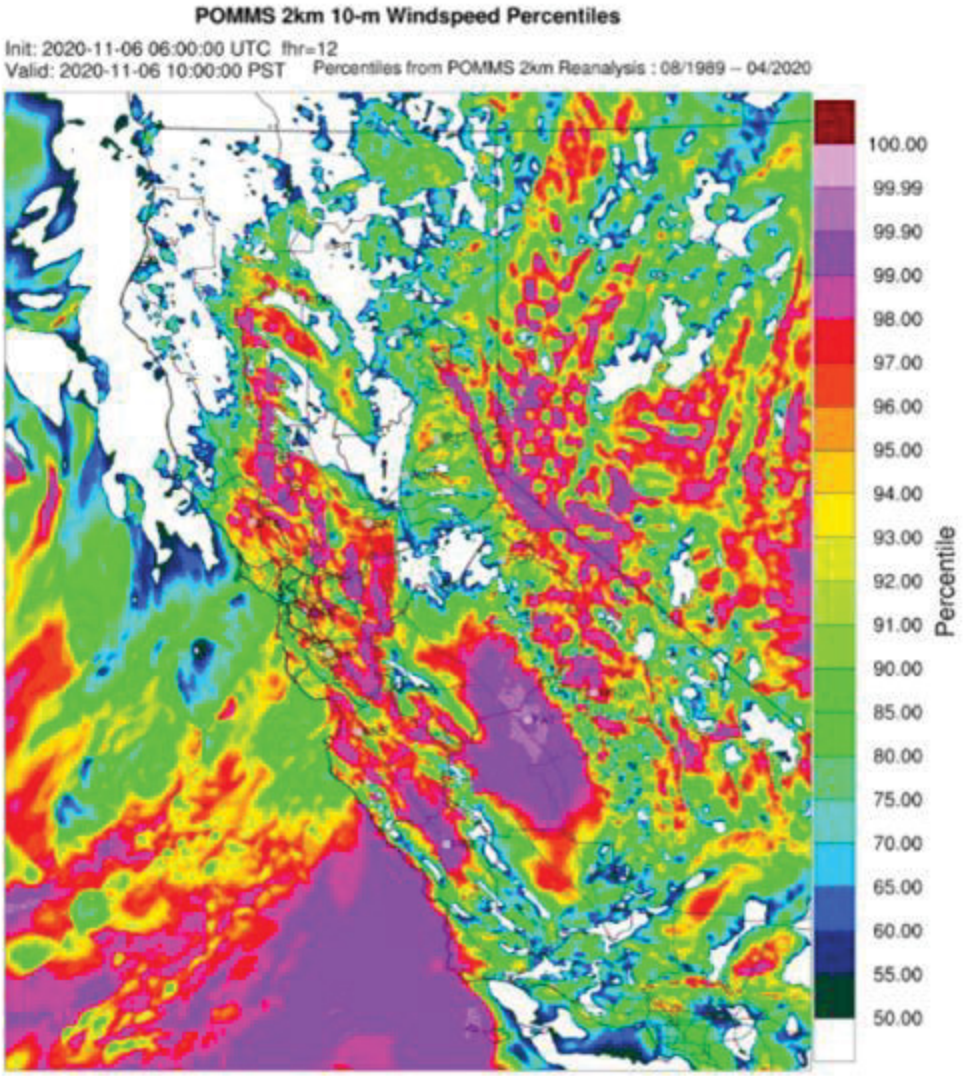


FIGURE PG&E-7.3.2-21: POMMS MODEL OUTPUT, FORECASTED WIND SPEED REPRESENTED AS PERCENTILES (BASED ON 30-YEAR CLIMATOLOGY)



Medium - to Seasonal-Range Diablo Wind Forecasting

As indicated in response to Question 2 above, in 2020, PG&E developed an experimental short-range (2 – 4 weeks) Diablo wind forecasting system. PG&E evaluated if teleconnections such as El Nino, the Pacific Decadal Oscillation and the Madden Julian Oscillation, to name a few, provided predictive skill to forecast Diablo wind events outside the range of global weather models.

Addressing Weather Forecast Model Uncertainty

In 2020, PG&E deployed an in-house high-resolution model POMMS-EPS that is based on the POMMS model. This package includes eight model members that provide hourly forecasts at 2 km resolution across the PG&E territory. This will significantly increase the amount of forecast data generated daily near the surface from 100 million data points in 2019 to over 1 billion in 2020.

PLDN

There are no 2020 improvements to note as part of this initiative. PG&E plans to continue operating and maintaining lightning sensors deployed across the PG&E territory in 2020 and 2021.

Information Sharing

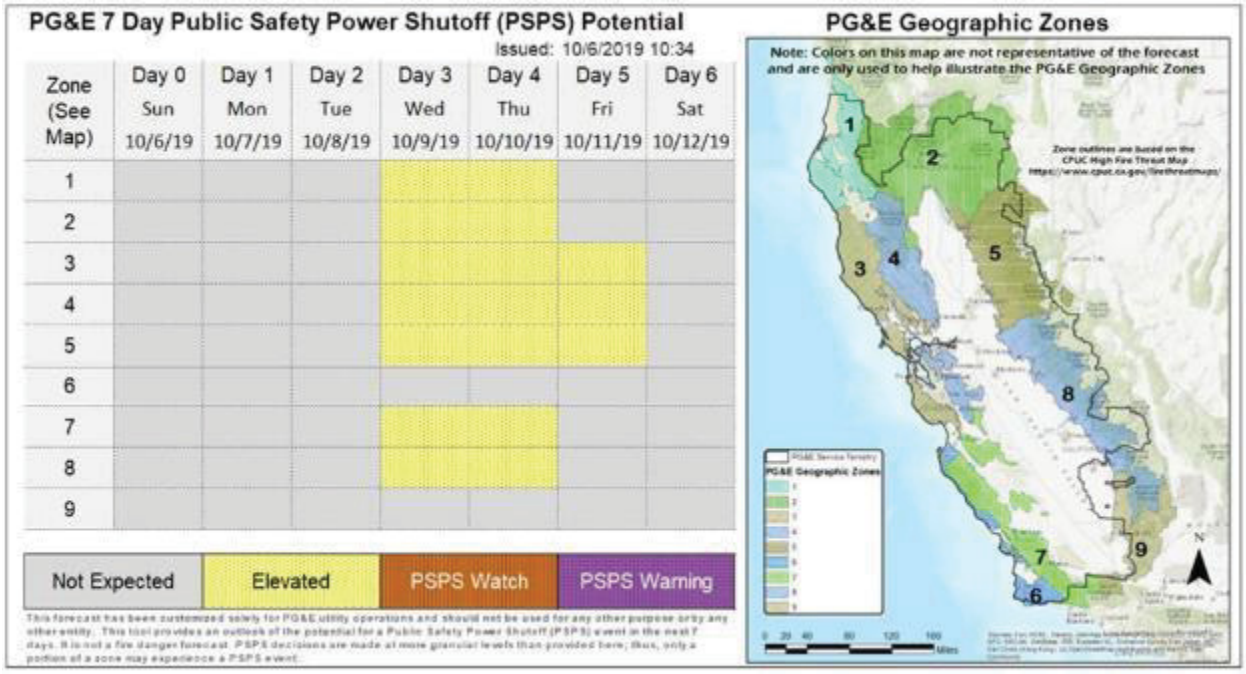
Starting in 2019 and through 2020, PG&E developed and then operationally implemented a publicly available 7-day forecast on the potential of implementing a PSPS. This forecast is published daily by an operational meteorologist or fire scientist from PG&E. The forecast is customized for PG&E utility operations and provides an overview for a potential PSPS event in the next seven days as determined from an analysis of forecasted weather, the potential for wind-related damage, and fuel moisture content in dead and live vegetation.

The forecast is broken down by broad PG&E Geographic Zones numbered 1-9; however, PSPS decisions are made at more granular levels with more detailed information shared with state, county and local officials as well as the public, once more detailed analysis is performed. The forecast is presented in one of four discrete categories for each geographic zone:

- Not Expected: Conditions that generally warrant a PSPS event are not expected at this time.
- Elevated: An upcoming event (typically a period of adverse weather combined with dry fuels) is being monitored for an increased potential of a PSPS event.
- PSPS Watch: The PG&E Emergency Operations Center (EOC) is activated for a reasonable chance of executing PSPS to reduce public safety risk in a given geographic zone due to a combination of adverse weather and dry fuel conditions. A PSPS watch is typically only issued within 72 hours before the anticipated start of an event.
- PSPS Warning: The PG&E EOC is activated and customers in areas being considered for PSPS have been or are being notified. This level indicates execution of PSPS is probable given the latest forecast of weather and fuels and/or observed conditions. PSPS is typically executed in smaller and more targeted areas than PG&E Geographic Zones. This level does not guarantee a PSPS execution as conditions and forecasts may change.

Figure PG&E-7.3.2-22 below provides an example of a PSPS forecast.

FIGURE PG&E-7.3.2-22: EXAMPLE OF A PSPS FORECAST ISSUED ON 10/6 FOR AN UPCOMING PERIOD OF FIRE RISK ON 10/9-10/11



As indicated in response to Question 2 above, in 2020, PG&E held meetings with agencies and stakeholders to better align on how PG&E would share information with the public. PG&E also continued to develop and then operationally implement a publicly available 7-day forecast on the potential of implementing a PSPS. This forecast is published daily by an operational meteorologist or fire scientist from PG&E.

5) Future improvements to initiative:

High Performance Cloud Computing, Model Validation and other initiatives

In 2021, PG&E will expand the historical weather climatology at 2 x 2 km resolution to back-fill all of 2020 and explore a methodology to back-fill the climatological data each quarter moving forward. We will also evaluate extending the deterministic forecast to provide another 24 hours of forecast data (from 105 hours currently to 129 hours). Finally, we will evaluate if the POMMS-EPS ensemble mean is more or less accurate than the deterministic POMMS model.

Medium - to Seasonal-Range Diablo Wind Forecasting

In 2021, PG&E plans to continue these projects as well as work with an external partner to develop and deploy a seasonal Diablo wind report based on statistical, machine learning and/or AI techniques. A longer lead-time of an upcoming offshore, Diablo wind events would provide crucial preparation time for PG&E and potential communities impacted by these events.

Addressing Weather Forecast Model Uncertainty

PG&E has found value in evaluating output from multiple deterministic and ensemble weather models to assess forecast uncertainty. The complete list of models that PG&E leverages can be found in Section 7.3.2.1. We will continue to leverage multiple weather models to determine the uncertainty in a forecast as well as continue to evaluate our own POMMS ensemble prediction system. One of the ways we will evaluate this is determining if the POMMS ensemble mean provides more statistical forecast skill than the deterministic model.

PLDN

No major changes to this initiative are anticipated at this time in the next 3-10 years.

Information Sharing

In 2021, PG&E plans to adjust the public 7-day forecast to provide more granularity and clarity around the potential for a PSPS event possibly by county. This forecast is aimed at providing as much lead time as possible for the public to prepare for a possible PSPS event.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

No major changes to this initiative are expected in the next 3 – 10 years. Additional tools will likely be incrementally improved or created to enhance situational awareness.

7.3.2.2 Continuous Monitoring Sensors

WSD Initiative Definition: *Installation, maintenance, and monitoring of sensors and sensorized equipment used to monitor the condition of electric lines and equipment.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.2.2.1: Electric Transmission SEL T400L
- 7.3.2.2.2: SmartMeter™ Partial Voltage Detection
- 7.3.2.2.3: Distribution Fault Anticipation (DFA) Technology and Early Fault Detection (EFD)
- 7.3.2.2.4: Sensor IQ (SIQ)
- 7.3.2.2.5: Line Sensor Devices
- 7.3.2.2.6: Distribution Arcing Fault Signature Library

7.3.2.2.1 Electric Transmission SEL T400L

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Bolted transmission electrical faults (when the conductors are considered connected to ground) can result in extreme heat, sparks and molten material with a potential to cause a wildfire ignition. To help predict developing problems on PG&E's electric transmission system, PG&E will implement more proactive maintenance protocols, such as using data from transmission monitoring technology, to reduce potential hazards and improve public safety. PG&E will also continue to evaluate, deploy and operate technological applications that provide data of real time continuous sensor monitoring and analytics of asset health and performance.

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.

Line monitoring non-tripping travelling wave relays (SEL T400L's) are being installed on selected transmission lines to capture high frequency travelling waves emitted by faults or other electric system anomalies (high corona for example). High Corona is a low-level electric field discharge that is present on areas of the electric system with metallic sharp edges or other surface discontinuities. System Protection and the relay vendor are evaluating the relay data to determine if vulnerable locations along the transmission line can be identified prior to the condition evolving into a bolted transmission electrical fault. The SEL T400L relay is the only device providing automatic line monitoring for incipient faults using a C37.94 communication channel.

***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")**

To implement this pilot initiative, PG&E installed the subject relays on transmission lines in Northern and Southern Sierra regions in both HFTD and Non-HFTD areas. PG&E chose these transmission lines because they lent themselves to quick installation of the relays on a limited budget, which provided the fastest path to data acquisition. The lines were also selected based on their historically high level of fault activity.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2019, PG&E defined the scope of this pilot installation to include 16 transmission lines (60 kilovolt (kV) to 230kV). PG&E has completed installation on 10 lines (and data is available per a daily download). Installation on 6 lines is in progress. However, IT dependencies are required to complete five of the six lines "in-progress" (as the electrical installation and settings are complete). PG&E estimates completing installation on five lines by end of first quarter of 2021. The

SEL T400L relay installation that will not be completed in 2021 has dependencies on another project that is scheduled to be completed in 2022.

The installed relays have not yet produced any actionable incipient fault data. However, the devices have been used to validate and improve on fault location estimates. This has helped troublemen find fault locations and issue repair tags for at-risk equipment. The data analysis of this pilot initiative could validate this technology's viability and allow PG&E to broaden the scope to include critical wildfire transmission lines.

5) Future improvements to initiative:

PG&E will continue to collaborate with subject matter experts at SEL, the equipment vendor. This includes PG&E providing relay data to SEL showing traveling wave signature anomalies, including double ended fault locations and histogram bin counts. PG&E and SEL will evaluate the PG&E data periodically downloaded from these devices to provide actionable data when possible. PG&E will implement recommendations from SEL resulting from the evaluations as the data may help identify relay problems, firmware problems, or provide other insights. For example, one existing benefit from this technology is in providing more accurate estimated fault locations.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E has not yet determined a long-term plan for this initiative. The 2021 data will provide actionable direction in order to make long term plans.

7.3.2.2.2 SmartMeter™ Partial Voltage Detection (Formerly Known as Enhanced Wires Down Detection)

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Prior to implementing SmartMeter™ technology, Control Center Operators and Dispatch were not provided with information on partial voltage conditions which indicate loss of phase/conductor on the distribution circuit. In addition, SmartMeters™ only informed Control Center Operators of full power out conditions. PG&E has now enabled Single-Phase SmartMeters™ to send real time alarms occurring in the Distribution Management System under partial voltage conditions (25 percent-75 percent of nominal voltage). Detection of partial voltage conditions allows Control Center Operators to dispatch field personnel to locations where equipment may be in a condition that increases wildfire risk.

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:

This enhanced situational awareness can help detect and locate downed distribution lines more quickly to enable faster response. Faster response may reduce the amount of time a line is down and allow first responders to more quickly extinguish wire down-related ignitions, if they occur.

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"):

SmartMeter™ technology is software-based and can be deployed across PG&E's service territory, including all HFTDs. That said, deployment will not be limited to HFTDs.

The continuation of partial voltage expands coverage of the detection algorithm from the initial 4.5 million single-phase meters to an additional 365,000 Three-Phase SmartMeters™ (as explained below). This will provide coverage to more areas and allow for the detection of additional types of partial voltage conditions, including four-wire circuits.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

Coverage of single-phase meters was completed in 2019. In 2020, PG&E initiated plans to continue developing this solution to extend the partial voltage detection enhancement to 365,000 Three-Phase SmartMeters™ and 4-Wire distribution systems. Once implemented, the coverage for partial voltage detection will extend across PG&E's service territory, including HFTDs. In PG&E's 2020 WMP, the three-phase deployment of partial voltage detection was planned to be completed in 2020. However, due to technical, software issues discovered during testing, the schedule for this implementation has been revised to complete by June 30, 2021.

This deployment schedule change was articulated in PG&E's December 11, 2020 Change Order Report which WSD approved on January 28, 2021.

On February 1, 2021 PG&E received a pre-release version of the revised Partial Voltage Detection software from the vendor that addresses the previously identified defects and has commenced functional testing. PG&E remains on track to meet the June 30, 2021 implementation date, in alignment with the previously filed and approve Change Order.

5) Future improvements to initiative:

The data gathered from SmartMeters™ are being consolidated and displayed to the operators and dispatch, who will then identify partial voltage impacted areas. The information helps operators and dispatch decide on how and where to respond. As such, only the phase one technology for single phase meters has been expanded to cover all 4.5 million single phase meters in our service areas, in both HFTD and non-HFTD areas. Phase 2 technology for three phase meters will be implemented by June 30, 2021. Note that these are exploratory technologies that may require refinements, and timeline commitments are based on best available information at the time of filing.

PG&E continues to use this technology to investigate ways to improve the partial voltage detection algorithm abilities. Some of these concepts include detection of short-duration, high-frequency outages and increasing sensitivity of alerting on higher risk days.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E will have completed all planned implementation of this technology to all applicable meters by June 30, 2021. At that point, the technology will be in full operation. PG&E will continue to investigate ways to enhance the functionality as part of the continuous improvement process but has not determined a long-term plan for this initiative.

7.3.2.2.3 DFA Technology and EFD

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

In some cases, non-equipment failure type outages (where no problems are found) indicate the presence of latent conditions that can result in more significant issues or a fire risk in the future, if left unresolved. There are also other power flow anomalies/disruptions that are indicative of incipient faults. Since these issues lack visibility and sensitivity, they are difficult to perceive using existing detection methods and patrol techniques. More advanced monitoring methods – such as the utilization of DFA technology and EFD that measure different electrical parameters over the distribution circuits can harness advance sensors, along with analytical methods, to detect these issues early in their degradation mode.

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.

Addressing latent or incipient issues in their early stages may remove many of the conditions that cause wildfires. With the ability to proactively detect failing conditions as they evolve and eliminate them quickly, PG&E can better reduce the risk of wildfire. The DFA and EFD sensors may also be able to more quickly detect and locate aggressively failing components during high-risk conditions and allow field crews and fire protection personnel to more immediately respond and minimize wildfire risks.

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")

The technology deployment will be prioritized to the highest fire risk areas, beginning with the highest fire risk circuits. PG&E will then roll out the technology to all fire risk areas on a full circuit-based deployment.

4) Progress on initiative (amount spent, regions covered) and plans for next year

This pilot project was completed in 2020 with the recommendation to continue deployment. EFD was deployed on one additional circuit in 2020, Silverado 2104. DFA was deployed in one additional circuit in 2020, Calistoga 1102.

Each of these technologies is emerging. 2021 is the start of a ramped-up mass deployment. DFA will be scaled up to a level higher than previously operated by any utility. It will require additional process refinements and operational enhancement. EFD is also being deployed on a larger scale than seen before. There is additional development required to simplify deployment, along with operational enhancements to utilize the data generated. As we have seen with other emerging technologies, these challenges may impact the scope and speed of deployment.

The intent is to deploy EFD and DFA sensors on a total of 600-800 circuits in Tier 2 and Tier 3 HFTD areas, mitigating 28,000 total line miles (20,200 miles in Tier 2, 7,800 miles in Tier 3), across several General Rate Case (GRC) cycles.

5) Future improvements to initiative:

The technology is nascent and provides data that has not been previously available.

These two technologies each have different evolution paths.

- The DFA technology is more established, with some of its foundation being rooted in Texas A&M Electrical Power System Engineering research team for over 20 years. Within the past five years, DFA has evolved into a more commercialized product that is readily deployed in larger volumes.
- The EFD system is an emerging technology that still requires refinement to make it commercially deployable and operable on a large scale. As such, PG&E believes that it will be a year or two before there is an operational path to expand coverage.

As these systems continue to be implemented, new methods, accuracy and efficiencies will be applied. PG&E continues to work with each of the technology vendors to increase effectiveness of the locational and predictive functionality and to develop more operationally efficient platforms with the vision of deploying the technology to all HFTD circuits. It has also been observed that the two technologies are complimentary in that they each detect different elements of failure conditions. The intent is to seamlessly integrate them together and automate the functionality into existing operating systems.

ACTION *PGE*-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As PG&E continues to evaluate the two technologies, it is simultaneously building a strategy to deploy this technology to 600+ HFTD circuits over the next 8-10 years covering multiple GRC planning cycles. These technologies will also be increasingly incorporated into wildfire detection and prevention operational applications as they mature and are available.

7.3.2.2.4 Sensor IQ (SIQ)

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The Sensor IQ or SIQ software works with existing SmartMeters™ to capture and store high resolution, RT, and granular load, voltage and outage data to enable predictive maintenance data analytics. SIQ does not currently have a direct impact for wildfire reduction. However, we anticipate the additional data source may provide an analytical methodology to detect early-stage equipment failure resulting in voltage and other meter-detectable conditions including, loose conductor splices, failing/overloaded transformers, momentary secondary and primary vegetation contact. The goal is to decrease overall wildfire ignition risk by detecting early-stage equipment failure and conducting repairs before infrastructure fails.

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.

PG&E believes useful and valuable wildfire related data can be obtained from SmartMeters™. The current SmartMeters™ are only able to capture limited lower frequency and less comprehensive real time data. PG&E has worked to harness as much intelligence from the meters as possible in the current configuration. The SIQ software is expected to provide higher resolution data and additional data fields that can be set to report in real time, allowing for a more insightful view of undesirable changes that could negatively impact PG&E equipment. Early awareness of degrading conditions can allow for a prompt response and help reduce the risk of potential wildfire ignition sources.

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"):

The pilot will be prioritized to cover circuits in the HFTDs. Since this is a software solution, it can be deployed almost concurrently over the entire area.

4) Progress on initiative (amount spent, regions covered) and plans for next year

PG&E began this new technology development and implementation pilot in 2020. The original plan identified in the 2020 WMP was to complete deployment for 500,000 SmartMeters™ in HTFD areas in 2020. Due to the new development of this technology, the original program milestones were missed due to a combination of circumstances: (1) a vendor product interoperability issue was identified during testing and deployment activities that required redevelopment to resolve; and (2) the SIQ application is a component of the base SmartMeter™ operations system which is being migrated from a hosted system to an internal data center. This migration was also impacted due to PG&E's bankruptcy and delayed part of the SIQ implementation schedule. In PG&E's September 11, 2020 Change Order Report, we identified a proposed change to our SIQ Pilot under Section 5.3.2 of our

2020 WMP. At that time PG&E's proposed time frame to complete the Sensor IQ pilot was: to have Sensor IQ (SIQ) functionality in place 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. WSD approved PG&E's Change Order on January 5, 2021.

In January 2021, PG&E completed implementation of SIQ head-end software, data interfaces, and data repository for analyzing meter data. PG&E attempted our first deployment of Sensor IQ profiles to 1,000 in-field, production SmartMeters™ on January 22, 2021. This initial deployment was unsuccessful on 10 percent of those meters, and the root cause for this failure is still being investigated. Learnings from the initial deployment also identified the need to do additional performance tuning in the production metering system to ensure that customer billing and outage management capabilities are not impacted when SIQ is deployed to meters.

Based on the initial deployment experience of Sensor IQ, and the iterative learning nature of technology pilots, PG&E is taking a more measured approach to the large- scale deployment of this technology to avoid adverse impact to existing production capabilities. We cannot put at risk the existing billing and operational functions of SmartMeters™ by deploying Sensor IQ if identified potential issues have not been fully resolved. Due to the issues identified to date and the uncertainty related to further challenges with this new technology, PG&E now expects to have Sensor IQ capability deployed on all planned SmartMeters™ (500,000) by 12/31/21 and to complete the full evaluation for how to use this technology by Q1 2022. PG&E will move as quickly as is feasible based on the stability and performance of the Sensor IQ and overall SmartMeter™ systems.

5) Future improvements to initiative:

PG&E will use an advanced data analytics and machine learning platform to evaluate the data from the SIQ pilot. The data from the pilot will be ingested into an advanced data analytics and machine learning platform. Several focused efforts on the various event types will be conducted to determine if we can improve our ability to find loose conductor splices, failing/overloaded transformers, momentary secondary and primary vegetation contact.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

If the technology proves to be effective in early detection of fire risks, the deployment of this tool may be extended to continue coverage past the currently planned pilot for the 500K pilot meters, including possibly deploying to all 5.5M electric SmartMeters™ across PG&E's service territory.

7.3.2.2.5 Line Sensor Devices

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Existing detection methods and patrol techniques miss non-equipment failure types since they lack visibility and sensitivity. Non-equipment failure-type outages (no problem found) are indicators, in some cases, of latent conditions that could result in more significant issues or fire risks if left unresolved. There are also other power flow anomalies/disruptions that may be indicative of incipient faults. Advanced monitoring methods that measure different electrical parameters over the distribution circuits can harness these advanced sensors with analytical methods to find conditions early in their degradation mode.

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.

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 (covered in Section 7.3.2.3 below) with additional functionality and communication capabilities.

We can remove many of the conditions that could cause a wildfire by addressing latent or incipient issues in their early stages. By proactively detecting and resolving failing conditions quickly before they evolve, we can reduce risk of causing a wildfire.

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"):

Building from our Smart Grid Pilot Program, PG&E began deploying 801-line sensing devices on 60 key circuits in 2019 at Tier 2 and Tier 3 HFTD areas in Humboldt, North Bay, North Valley, Sierra, Sonoma, and Yosemite. Efforts were focused on reducing wildfire risk and improving public safety by monitoring the grid continuously, performing analytics on captured line disturbance data, identifying potential hazards and, when necessary, dispatching field operations to proactively patrol, maintain, and repair failing field conditions or assets. These efforts intend to expand coverage of the technology first to the highest fire-risk areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, line sensors have been deployed on 46 additional feeders (60 total for 2019/20) in Tier 2 and Tier 3 HFTD areas. The deployment included 612 additional sensors (801 total for 2019/20) on an additional 4,131-line miles (4,898 total for 2019/20).

5) Future improvements to initiative:

PG&E began operationalizing line sensors in 2019 to proactively monitor and locate distribution grid disturbances and analyze times to dispatch field inspectors. PG&E continues to use data from line sensor technologies to bolster asset health and performance.

Using an engineering approach, PG&E will identify additional circuits in Tier 2 and Tier 3 HFTD areas and redesign an optimal line sensor device footprint to further support wildfire mitigation. PG&E will strategically deploy, gain further experience, and operate state-of-the-art systems and technologies to continuously monitor the grid and analyze data to prevent asset failures and reduce risk. The intent is to deploy line sensors on a total of 600-800 circuits in Tier 2 and Tier 3 areas, mitigating 28,000 total line miles (20,200 miles in Tier 2, 7,800 miles in Tier 3), across several GRC cycles. To handle the additional amount of data, we will need to integrate into an automated analytics and detection platform. This analytics platform will cross analyze the data from other relevant sources including SmartMeters™, other distribution sensors, asset history, and meteorology. Our goal is to access as much visibility of circuit conditions as possible so we can react and correct issues as they happen and remove incipient issues before they become fire risks. Other areas of improvement include refining sensor settings and detecting methodologies based on continuous evaluation of event data.

In 2021, PG&E will continue to benchmark other leading utilities and manufacturers to learn alternatives to improve our predictive analytics and preventative operational practices, while evaluating new and/or emerging technologies.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As PG&E continues to evaluate this technology, it is simultaneously building a strategy to deploy the technology on 600-800 HFTD circuits over the next 8-10 years covering multiple GRC planning cycles. This technology will also be increasingly incorporated into wildfire detection and prevention operational applications as they mature and are available.

7.3.2.2.6 Distribution Arcing Fault Signature Library

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Until recently, the ability to collect extremely high-resolution data waveforms (the unique signature) from a broad range of fault events and precursors has been limited to the equipment available. In addition, deconstructing and analyzing these waveforms requires significant analytics and computer processing power. This level of effort has been a challenge within a utility environment. In order to have analytical and machine learning tools that can react to specific types of events the faults need to be known and understood. Utilization of this method on a distributed analytics platform allows the high volume of data to be locally processed and improves detection time, enabling future control technologies to take accurate segmentation action.

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:

This Research & Development (R&D) project is the foundation for this data collection. This project is intended to better identify the signatures of incipient fault conditions. Once this high-resolution sensor data waveform library is built it will assist in identifying events caused by incipient fault conditions as they occur. By understanding and detecting these conditions, PG&E can build better tools and methods to reduce or correct risks by proactive maintenance or real time protective circuit de-energization. This project takes advantage of a cooperative effort between PG&E's distribution operational system subject matter experts and two Department of Energy national labs using technologies originally built for Department of Defense analytical expertise used to solve hyper complex problems. The technology includes installing a high-fidelity optical sensor technology on a distribution feeder. The optical sensors, with immunity to electromagnetic interference and instrument transformer saturation, will provide high frequency sampling of voltage, current, temperature, pressure, vibration, and acoustic variables. The Distribution Arcing Fault Signature Library will inform PG&E about the types and resolutions of sensors needed to detect incipient fault conditions on the distribution system and intervene with proactive maintenance to reduce wildfire risks.

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"):

Since this is purely an R&D project, the initial scope of deployment will be on a single circuit that has a high occurrence of faults with a wide range of causes. The circuit includes sections that are within the Tier 2 and Tier 3 HFTD areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

The specialized sensor installation was completed in December 2020. By end of 2021, the project will have completed a 6-month minimum analytic stage capturing all events on the installed circuit (Half Moon Bay 1103).

5) Future improvements to initiative:

Once the R&D project is complete at the end of 2021, the team will perform a strategic assessment of the results. If the team can develop a comprehensive fault signature library, this information will be fed into the larger incipient fault analytics tools that will be used to proactively detect and mitigate conditions that could result in a wildfire. The team will also assess for further potential deployment and applications.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As detailed in the Future Improvement section above, a long-term plan for this initiative is contingent on the strategic assessment arising out of the R&D project.

7.3.2.3 Fault Indicators for Detecting Faults on Electric Lines and Equipment

WSD Initiative Definition: *Installation and maintenance of fault indicators.*

1) Risk to be mitigated/problem to be addressed:

Fault indicators are used to help troubleshooters in the field to locate where conductors have failed. Fault indicators are also installed to shorten outage times and facilitate restoration.

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.

Protective devices de-energize faulted conductors when fault indicators are activated. Fault indicators show a blinking light when large fault currents pass through them. Troubleshooters follow the blinking lights to find the fault, typically where a branch has fallen across the conductors or the conductor has fallen on the ground. In very rare instances when protective devices do not sense faults and do not act, fault indicators are still able to direct first responders to the faulted conductors so that the lines can be safely de-energized more quickly.

Fault indicators help PG&E narrow the scope of patrols and inspections in response to an outage, thus increasing efficiency and limiting the scope of area that Troublemen need to patrol. By narrowing the area to patrol, it shortens the outage duration for PG&E's customers.

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")

If you have SCADA, fault indicators are not needed because you can look at SCADA screens in the distribution control centers to see if a fault occurred. If you do not have SCADA, you must send out a Troubleman to see where fault indicators are blinking. There is not proactive plan to install fault indicators. However, fault indicators are placed either by a Troublemen during outage restoration, or after outages, engineering and operator teams decide where to place them based on how to best troubleshoot outages on a particular circuit in the future. Fault indicators are generally installed where SCADA visibility is limited, which is primarily in rural areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In areas where fault indicators are not present, restoration workers install them as needed. Fault indicators are placed either by Troublemen or, after outages, engineering and operator teams decide where to place them based on how to best troubleshoot outages on a particular circuit in the future. Installation of fault indicators is ongoing, but we do not have a specific installation goal as the fault indicators are installed when needed.

5) Future improvements to initiative:

Technology such as Line Sensors is being explored (see Section 7.3.2.2.5). Line Sensor technology is not new in the industry, but it is a relatively new implementation at PG&E. In addition to Line Sensors, PG&E is looking at additional fault indicating methods utilizing more SCADA or SmartMeter™ technologies. This would enable remote communication of fault locations to expedite outage responses.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

We have not yet determined a long-term plan for fault indicators and their detection of faults on electrical lines and equipment. Long-term plan milestones are still under development with Electric Operations and Asset Management as we evaluate our current protection and automation standards/initiatives. The purpose of this evaluation is to drive informed decisions based on past performance and data-related performance of fault indicators as part of our broader fault detection schemes.

7.3.2.4 Forecast of a Fire Risk Index, FPI, or Similar

WSD Initiative Definition: *Index that uses a combination of weather parameters (such as wind speed, humidity, and temperature), vegetation and/or fuel conditions, and other factors to judge current fire risk and to create a forecast indicative of fire risk. A sufficiently granular index shall inform operational decision-making.*

1) Risk to be mitigated/problem to be addressed:

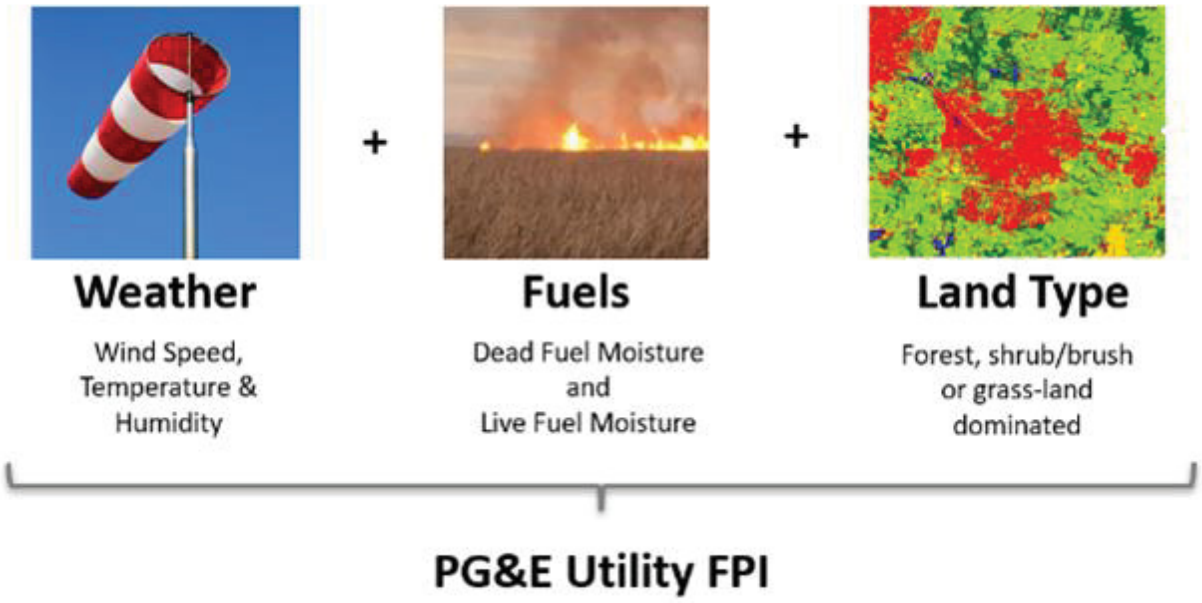
Current publicly available fire danger forecasts available from WFAS.net only provide a one-day-out forecast of fire danger and are only available at the few hundred RAWS stations deployed in the state. To understand the potential for large fires to occur across the PG&E territory at a high resolution and hourly, four days in advance, PG&E developed the FPI Model in 2015 and significantly enhanced the model in 2018 and 2019. The current FPI Model is modeled on historical fires using PG&E's 30-year downscaled climatology, DFM and LFM Models, fire weather indices, and other models and data. The FPI framework, model, features, and evaluation are discussed at length in this section.

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.

The PG&E FPI Model was built and calibrated by PG&E data scientists, meteorologists, and fire weather experts. First, the conditions contributing to large and catastrophic fires were studied in detail. PG&E combined a USFS fire occurrence dataset with fires in the PG&E territory from 1992 – 2018 as well as PG&E's robust high-resolution climatology of weather and fuels. For each fire, PG&E extracted weather, fuel moisture and land-type and ruggedness features from the climatology and other GIS datasets. When constructing the FPI model, PG&E wanted to understand which variables and variable combinations provided the most predictive skill. To that end, PG&E built and evaluated over 4,000 FPI models using different combinations of weather components, fire weather indices (FFWI, the Hot-Dry-Windy Index, the Santa Ana Wildfire Threat weather index), outputs from NFDRS, Nelson DFM model, a machine-learning derived LFM model, and 'containment' and 'land characteristic' features such as road density, distance to nearest fire station, and land-use type among several others.

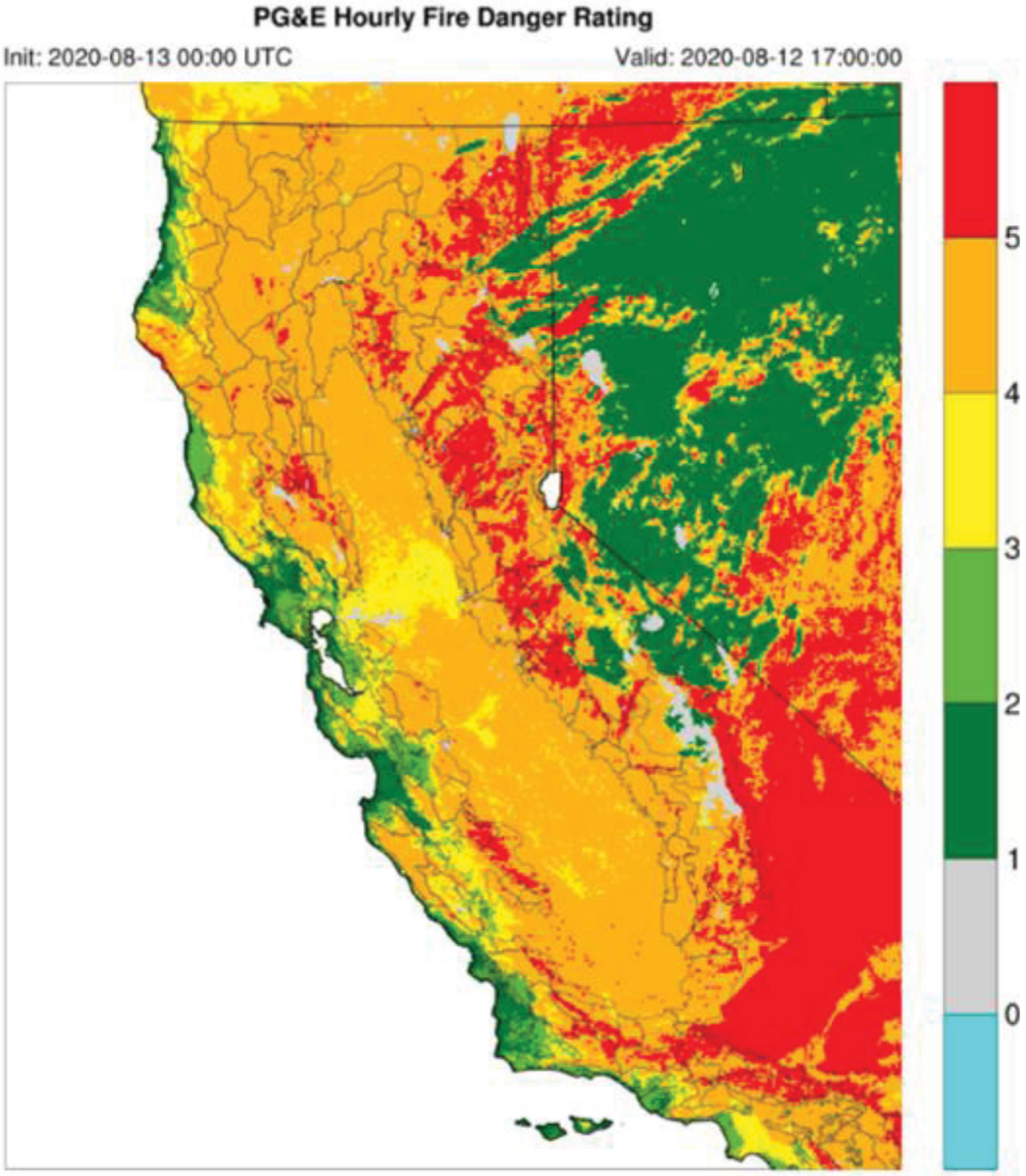
The PG&E FPI deployed in 2019 combines fire weather parameters (wind speed, temperature, and RH), dead and LFM data, and land use type, as depicted in Figure PG&E-7.3.2-23 below.

FIGURE PG&E-7.3.2-23: PG&E UTILITY FPI



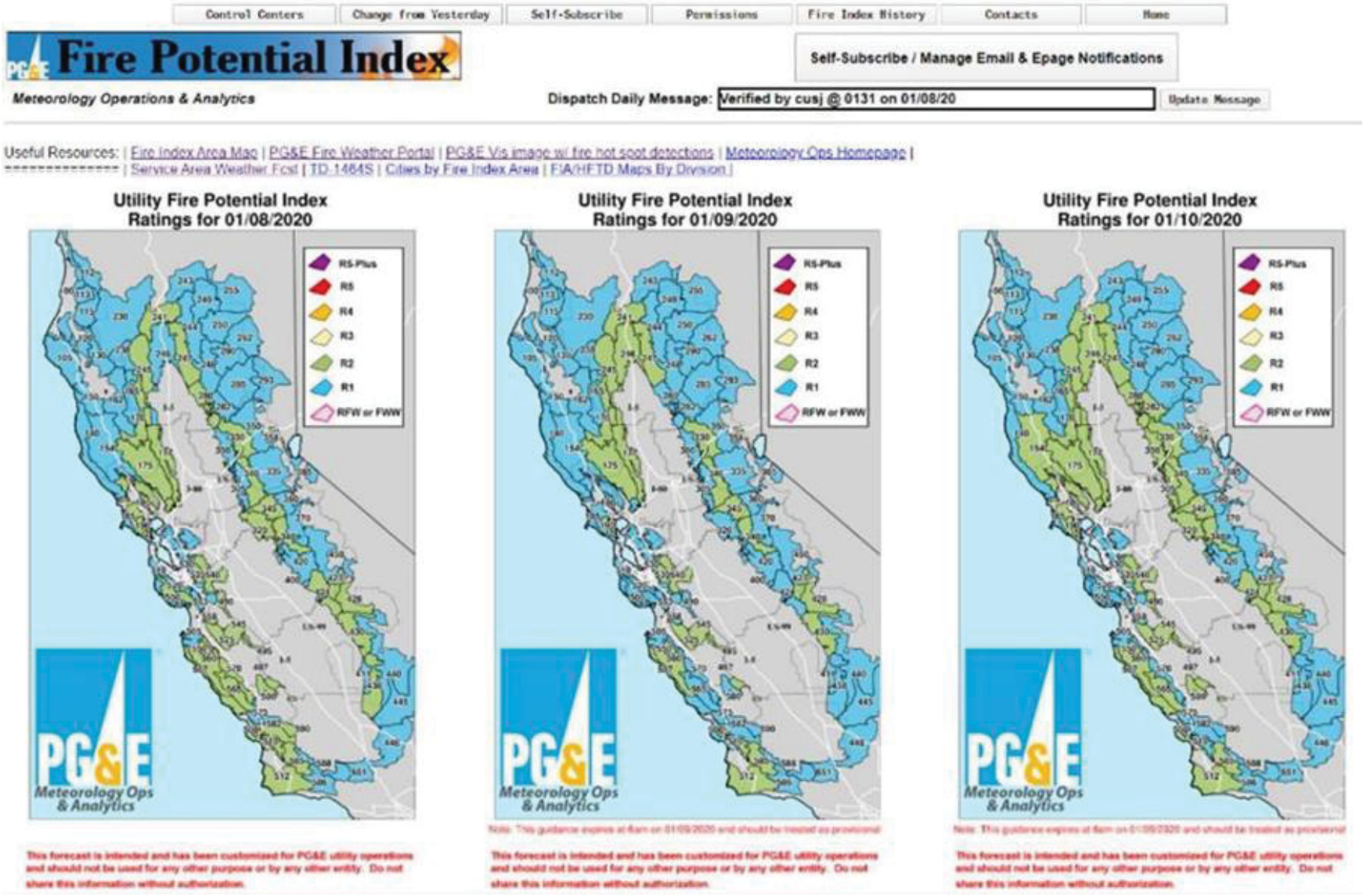
The FPI Model is run at 2 x 2 km resolution using PG&E's high-resolution weather and fuels coupled models and provides hourly forecasts out four days currently. The FPI Model outputs the probability from 0 – 100 percent of observing a large fire (>1000 acres), given an ignition. Figure PG&E-7.3.2-24 below is an example of FPI Model forecast for hourly fire danger ratings.

FIGURE PG&E-7.3.2-24: EXAMPLE FPI MODEL FORECAST AT 2 X 2 KM MODEL RESOLUTION (1 = R1, 5 = R5)



The FPI Model is used as an hourly input to PG&E's PSPS framework and is also used as a daily tool to drive operational decisions to reduce fire risk. The FPI Model informs daily operational actions to reduce the risk of fire ignition per company standards. Some of these daily actions include placing restrictions on higher risk field activities such as welding and grinding. For these day-to-day operational decisions, the granular FPI data are aggregated to FIAs. Maps and data available in GIS formats are available for the next three days via a web application. Figure PGE-7.3.2-25 below is an example output of the FPI Model web application.

FIGURE PG&E-7.3.2-25: EXAMPLE OUTPUT FROM THE PG&E UTILITY FPI WEB APPLICATION



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")

The FPI Model is run for all POMMS grid cells in HFTD areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

PG&E plans to enhance the FPI Model by September 1, 2021 using additional data and an enhanced fire occurrence dataset. In 2020, PG&E partnered with Sonoma Technology Inc. to produce an enhanced fire occurrence dataset using satellite fire detections from MODIS and VIIRS. This enhanced dataset that combines traditional data sets but augments them with granular satellite information to provide daily growth metrics for each fire. PG&E plans to evaluate if the FPI Model predictive skill is improved by using this new dataset over previous USFS datasets.

2020 was also an extreme year with over 4 million acres burned. This has resulted in significant changes in California landscape, which ultimately changes the fire risk profile in many areas. Once the climatology data is back-filled for 2020, PG&E plans to re-calibrate the FPI with 2020 data at 2 km resolution. In addition, PG&E will evaluate using an updated fuel map produced by Technosylva in the FPI land-type classification. In 2020, Technosylva make significant upgrades to the fuel map used in fire spread simulations. This fuel map is based on the latest LANDFIRE fuel model map and is significantly enhanced by incorporating more recent satellite data as well as burn-severity analysis to account for recent fires.

5) Future improvements to initiative

As indicated above, PG&E plans to enhance the FPI Model by September 1, 2021 using additional data and an enhanced fire occurrence dataset. PG&E is open to sharing daily FPI data with interested stakeholders but greatly values the role state and federal agencies play in communicating fire danger and risk to the general public. As a result, PG&E's data sharing strategy centers not on communicating the fire potential, but rather the potential for executing PSPS. Before the 2022 WMP, PG&E plans to recalibrate the FPI Model using the 2 km climatology with 2020 included. PG&E also plans to evaluate if the new fire occurrence dataset provides more predictive skill and incorporate the new Technosylva fuel mapping layer into FPI calculations if it provides more predictive skill of large fires.

In 2021 and beyond, PG&E is open to working directly with external stakeholders to refine how information in this area is shared and distributed.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E expects to continue to operate, maintain and incrementally improve the FPI Model and its components over the next 3 to 10 years. Due to the recent catastrophic fires in California and across the world, there is more research being devoted to being able to better forecast fire risk. PG&E is partnering with SJSU to perform some of this needed research. The long-term vison is to leverage the best available high-resolution weather and fuel models, and the latest scientific methods to more accurately and granularly forecast the fire potential across Northern and Central California for PSPS and day-to-day operations.

7.3.2.5 Personnel Monitoring Areas of Electric Lines and Equipment in Elevated Fire Risk Conditions

WSD Initiative Definition: *Personnel position within utility service territory to monitor system conditions and weather on site. Field observations shall inform operational decisions.*

1) Risk to be mitigated/problem to be addressed:

PG&E's SIPT consists of two-person International Brotherhood of Electrical Workers (IBEW) crews who are trained and certified in safety and infrastructure protection. The SIPT supports fire risk mitigation by:

- Providing standby resources for PG&E crews performing work in Tier 2 and Tier 3 HFTD areas
- Performing fire risk mitigation work proactively around PG&E assets
- Pre-treating PG&E assets to protect from wildfire loss and reduce risks from pole failures during an ongoing wildfire

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.

In response to Senate Bill 901, PG&E established in-house fire protection services and began planning for the program in December 2018.

At the discretion of PG&E Leadership, the SIPT plays an important role during PSPS events. When PG&E activates for a PSPS event, SIPTs are deployed to collect valuable weather and fuel data. This information is then reported to the WSOC. With input from meteorology, the WSOC makes decisions related to resourcing and locating Field Observers to determine where the SIPT is sent within a targeted PSPS zone. The number of field observers vary depending on the total number of miles, surrounding terrain, facility attributes and quantity of PSPS zones within the scope of the event. SIPT resources may also be redeployed from performing Field Observations to support other safety needs during a PSPS event.

On-the-ground, real time field observations provide details on weather and field conditions regarding potentially impacted PSPS circuits to help determine where SIPTs should be sent before wind-event start and end times. Observations provide qualitative information (i.e., flying debris, downed trees/branches, conductor movement) on the potential of experiencing R5-Plus conditions (the most critical fire weather) and the possibility of triggering a PSPS event sooner than expected. Observations also provide information to support weather "all clear" conditions necessary to authorize patrol and restoration activities.

Potential hazards related to wind conditions, which may lead to outages, are noted. Additional recorded observations include date/time and location specifics on the following conditions: downed trees/branches, flying debris, conductor movement, and wind speed.

The SIPT also collects localized LFM data, which informs PG&E Meteorology's Utility FPI model and guides PG&E's operational decisions. Furthermore, SIPTs utilize weather data and local conditions to calculate ignition potential based on existing firefighting standards.

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")

SIPTs are located throughout the PG&E service territory but are primarily focused within Tier 2 and Tier 3 HFTD areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

During the establishment of the SIPT program in 2018, PG&E employees:

- Developed a custom SIPT engine design based on existing PG&E fleet vehicles
- Designed custom-built pumps capable of applying fire retardant
- Acquired and outfitted temporary engines
- Specified and acquired firefighting tools, radios and personal protective equipment
- Developed software applications for monitoring resource locations, scheduling SIPTs and documenting work activities
- Developed a three-week new employee training program and adopted procedures to ensure maintenance of Emergency Medical Technician certification
- Established routine and emergency operational procedures
- Implemented a comprehensive change management program to integrate SIPTs with PG&E's field operations

In 2020, the SIPT program grew from 28 crews in 25 locations and three supervisors, to 40 crews in 32 locations, one manager, seven supervisors, two clerks and one analyst. The growth of the program was driven by a need to:

- Reduce span of control issues and improve balance for supervisor/employee ratios
- Decrease the physical size of supervisorial areas
- Reduce response times in underserved areas
- Provide additional response capacity to support wildfires and PSPS events
- Distribute program administrative workload

5) Future improvements to initiative

In 2021, the SIPT Program will implement minor technology improvements to the SIPT Viewer to improve data capture for both routine and emergency work. SIPTs will maintain staffing levels to support fire prevention and mitigation activities. Currently, the targeted staffing level equates to 40 crews and 40 engines and associated equipment.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

The SIPT has proven to be very valuable in filling a gap by providing fire prevention and mitigation services. It has also demonstrated that asset protection, using fire retardant, prevents asset loss and results in safety improvements and cost savings. At this time the long-term plan is to maintain the SIPT program with the current staffing level with the potential to expand as we further refine the fire prevention and mitigation needs of PG&E.

7.3.2.6 Weather Forecasting and Estimating Outage Probability on Electric Lines and Equipment

WSD Initiative Definition: *Development methodology for forecast of weather conditions relevant to utility operations, forecasting weather conditions and conducting analysis to incorporate into utility decision-making, learning and updates to reduce false positives and false negatives of forecast PSPS conditions.*

1) Risk to be mitigated/problem to be addressed:

The Storm Outage Prediction Model (SOPP), a storm outage prediction program and model developed, maintained, and operated by the Meteorology team on behalf of Electric Emergency Preparedness and Response, is one of the primary tools PG&E uses to mitigate operational risk from all adverse weather drivers that create an increased volume of outages above "blue sky" weather days. These drivers are primarily heat, wind, rain, and snow. This model guides PG&E to be proactive and thus prepared for storm events of any type. In addition, unplanned outages can also pose a fire ignition risk when surface fuels are extremely dry. Thus, elements of the SOPP project, specifically aimed at better understanding the probability of wind-related outages, support the PSPS program.

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.

Functionally, the SOPP is a collection of tools, techniques and utility subject matter expertise that are employed to predict unplanned outage activity on the distribution and transmission system every day. This model guides PG&E to be prepared in advance of inclement weather by forecasting the volume, timing and location of unplanned outage activity. This helps drive staffing decisions, crew allocation and relocation and EOC activations if required. This model has been operational at PG&E since 2011 and forecasts are produced 365 days a year by PG&E's meteorology department.

The SOPP is a combination of sub-models that seek to understand the following weather-related outage drivers:

- Northerly/offshore wind events (PSPS events)
- Southerly wind events
- Winter storms (rain and wind combination)
- Low-elevation snow events
- Heat events
- Rain and flooding events

The purpose of this initiative is to enhance the SOPP and sub-models by leveraging our rich historical weather datasets to better understand the weather to outage drivers. PG&E is evaluating the two main sources of error as it relates to outage prediction: (1) error or bias in the weather forecast and (2) errors or bias in the weather-outage models/relationships. As described in detail in Section 7.3.2.1.1, as part of this project, PG&E has actively worked with external

experts to improve our numerical weather prediction systems and historical datasets. In addition, this section also speaks to some work performed to address the weather-outage models and relationships.

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")

There is no regional prioritization associated with this work.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2019, PG&E's meteorologists and data scientists developed the Dynamic Pattern and Analog Matcher (DPAM) tool that automatically matches GFS forecasts for the next seven days against the NARR from January 1995 through July 2019. DPAM dynamically utilizes seven atmospheric fields: 500- and 700-hPa geopotential height, 250- and 500-hPa winds, 700-hPa temperature, precipitable water, and sea-level pressure to return the top 20 historical weather days and the outage patterns on those days. These days can be studied in more detail by PG&E meteorologists to help guide the SOPP outage forecast. This is a technique utilized in the meteorology industry called analog-forecasting.

In order to better model the wind-outage relationships and to develop a tool that can be used to guide PSPS decisions, PG&E developed an Outage Producing Wind (OPW) Model to support mitigation of utility caused wildfire risk through PSPS and other wildfire risk mitigation programs. The OPW Model forecasts the probability of unplanned outages associated with wind events occurring in PG&E's service area. The OPW Model is based on an analysis of windspeeds from PG&E's 30-year weather climatology and approximately 400,000 sustained and momentary outages occurring on distribution grid from 2008 to 2020, which includes wire down events. There is not a single relation between wind speeds and wire down events, as the wind speed required for an outage vary across PG&E's system based on differences in topography, vegetation and climatological weather exposure. Further details concerning the OPW Model can be found in Section 4.2.A(f).

Figure PG&E-7.3.2-26 below provides an example of an exploratory dashboard from the OPW Model and Figure PG&E-7.3.2-27 provides example output from the DPAM tool.

5) Future improvements to initiative

In 2021, PG&E plans to recalibrate the OPW Model using the 2 km climatology that will be extended to capture all outage events in 2020. This will include all 2020 sustained and momentary outages, as well as damages found during post-PSPS event patrols in 2020. An annual or biennial calibration is recommended to account for recent changes to the wind-outage relationship due to grid-hardening efforts, vegetation management, and other factors.

After 2021, PG&E will continue to investigate methods to make the OPW Model more granular without sacrificing predictive skill. In addition, other SOPP

sub-models will be explored for improvement, such as the heat-outage model and snow-outage model.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

PG&E expects to continue to operate, maintain and incrementally improve the SOPP and its components over the next three to 10 years. PG&E has been focused on better understanding and modeling the wind-outage relationship to leverage in PSPS; however, better forecasting of other weather drivers can be achieved. The SOPP will continue to be generated and used daily as an outage prediction and storm preparation tool to ensure PG&E is prepared in advance of storms of any type and magnitude.

FIGURE PG&E-7.3.2-26: OPW MODEL EXPLORATORY DASHBOARD EXAMPLE

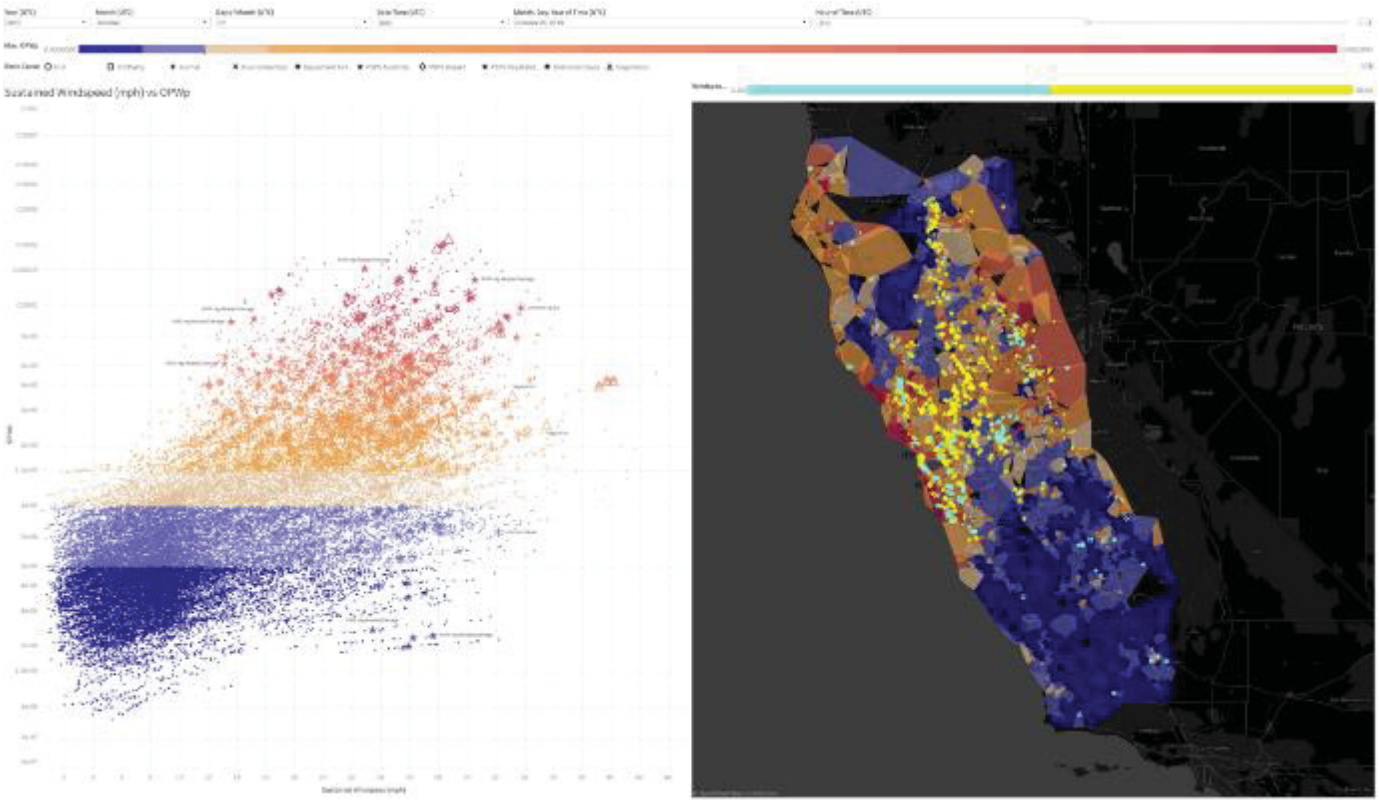
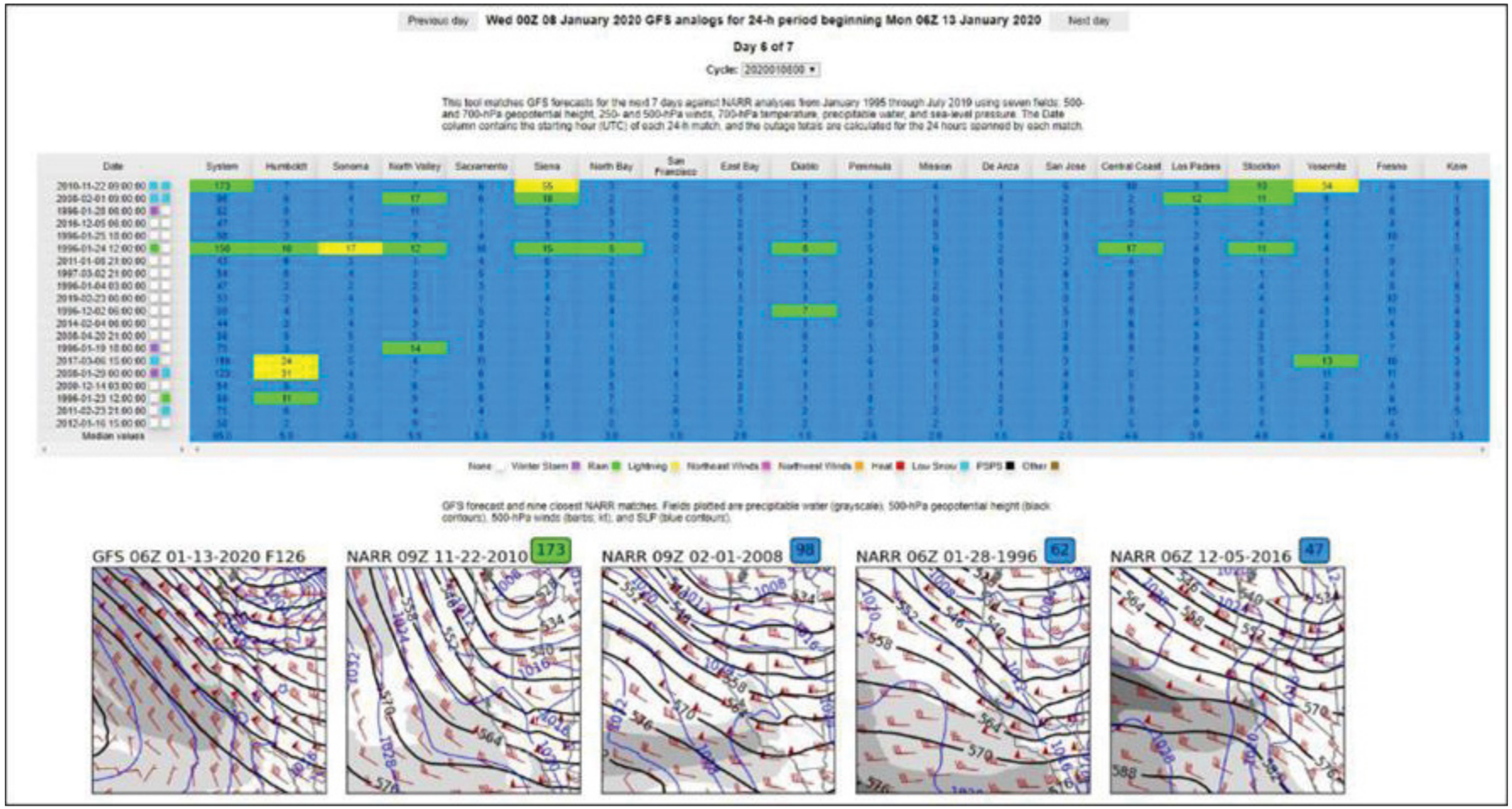


FIGURE PG&E-7.3.2-27: EXAMPLE OUTPUT FROM THE DPAM TOOL



7.3.2.7 Wildfire Safety Operations Center

WSD Initiative Definition: *N/A This is not a WSD-defined initiative. This is an initiative that PG&E is adding to the 2021 WMP to describe the WSOC.*

1) Risk to be mitigated/problem to be addressed:

To more effectively and efficiently respond to wildfire threats within the service territory, PG&E established the WSOC. The WSOC is a physical facility which serves as PG&E's central information hub for all wildfire-related data. The WSOC team monitors, analyzes, and initiates wildfire mitigation and response efforts throughout the service area.

The WSOC team monitors for fire ignitions across PG&E's service area in real time using weather information collected by PG&E weather stations, wildfire camera data, publicly available weather information, as well as data from local and state first responders. The WSOC also collects on-the-ground data from PG&E field personnel, including the Public Safety Specialists (PSS) and the SIPT.

Once it has confirmed that wildfire activity (including size and spread) may impact assets and communities in the service territory, the WSOC communicates this information to company leadership and impacted operating centers. PG&E then deploys utility resources to affected areas to further assess the size and spread of the wildfire, as well as support wildfire mitigation and other emergency efforts.

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.

The data gathered at the WSOC serves as a critical source of information regarding ongoing wildfire conditions for PG&E and emergency responders. The WSOC generates and distributes notifications or reports via text message or email on incidents that have met established criteria, such as wildfire status, threatened or involved PG&E assets and incident location. The report is sent to a pre-determined internal distribution list made up of PG&E field staff, control center personnel, executive staff, supporting lines of business (LOBs) and other emergency responders. These notifications facilitate the sharing of critical incident information in order to effectively respond to fire threats in a coordinated fashion internally.

The WSOC has established notification protocols for communicating fire threat information to various operations centers within PG&E, such as Gas Control, Electric Grid Control, Electric Distribution Control, IT, Security and Power Generation.

The WSOC also coordinates with PG&E's PSS team, which interfaces with CAL FIRE, USFS and other agency having jurisdiction incident commanders to oversee the organizational response to wildfire threats. The WSOC and PSS team engage in information sharing regarding ongoing fires and new ignitions that have a potential impact to PG&E facilities. The real time risk information communicated

to internal operation centers, field employees and affected public safety partners allows PG&E to act swiftly to protect PG&E assets and communities from wildfires.

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")

The WSOC monitors the entire PG&E service territory for wildfire threats.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, PG&E continued to mature WSOC capabilities. The WSOC reviewed and updated monitoring, analysis, communications and logging procedures based on lessons learned in 2019 and discussions with internal stakeholders. Onboarding and technical training programs were introduced to better prepare WSOC analysts. This training included scenario-based monitoring and fire analysis, PSPS processes and tools and PG&E internal notification triggers.

Technology enhancements were also implemented to improve situational awareness capabilities. Examples of these enhancements include the inclusion of IRWIN, satellite detection information such as GOES 16 and 17, and fire perimeter maps of ongoing and historic wildfires into the Wildfire Incident Viewer, a tool used by PG&E to log and monitor fires.

5) Future improvements to initiative

In 2021, PG&E will update the WSOC Procedural Documentation to include the expansion of WSOC into the All Hazards Center (“Center”). Like the WSOC, this Center will be staffed 24/7, with employees monitoring and reporting on broader real time events. The core capabilities include monitoring, assessment and communications. The Center will continue to serve as the central information hub which communicates emergency and hazard intelligence to internal stakeholders. That said, the Center would not replace existing communication processes within the respective LOBs; it will instead serve as a “one-stop shop” communicating real time situational awareness and intelligence to all relevant stakeholder groups.

The WSOC owns and maintains an Active Incidents Dashboard, which displays event information in a read-only fashion to internal PG&E employees. In 2021, the team will be expanded for additional stability and to incorporate new data streams and expand the number of viewers.

Through the Center, PG&E will monitor internal and external information sources for issues and emerging risks. This will help PG&E develop and regularly update real time information on dashboards which will be made available to all relevant key stakeholders.

The Center will produce periodic internal situational awareness reports and briefing documents, as well as initiate two-way communications with key LOBs to share and receive intelligence information and initiate notifications according to established protocols. PG&E will also establish communications protocols for information-sharing with external entities.

Lastly, PG&E will establish hazard risk awareness and escalation protocols for potential emergency situations. Based on agreed-upon triggers for scope of emergency situations, the Center will initiate escalated responses by engaging with the PG&E EOC Duty Officer and other key points of contact.

In 2021, PG&E will begin phase one of the expansion (with future plans to stabilize and mature the Center in 2022). Anticipated staffing levels to support the Center include 36 full-time employees, consisting of one director, one manager, one principal, two business analysts, one admin clerk, 16 wildfire analysts, five supervisors, three technology specialists and six all-hazard analysts.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

The WSOC will continue to expand and develop into an All-Hazards Warning Center, in which the center will alert and communicate various types of emergency events to company leaders and employees. The WSOC will be doing this in a phased approach to incorporate various hazards into the scope of the center and will continue to grow and stabilize this program over the next three years. Within the next 10 years, the WSOC will assess new technologies that can be incorporated into the Center's functions.

7.3.2.8 Meteorology Analytics/Operations Center

***WSD Initiative Definition*:** *N/A This is not a WSD-defined initiative. This is an initiative that PG&E is adding in the 2021 WMP to describe the Margaret Mooney Meteorology Analytics/Operations Center (MMAC).*

1) Risk to be mitigated/problem to be addressed:

Before 2020, the PG&E Meteorology and Fire Science team operated out of separate offices and lacked a space to collaborate in person on in-flight initiatives and monitor real time conditions.

In 2020, PG&E broke ground on the MMAC, which will allow for better communication and collaboration between PG&E Meteorology and the Fire Science team.

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.

The MMAC is named after Margaret Mooney, who was one of the first female utility meteorologists in the nation and worked at PG&E from 1966 – 1994. The MMAC will act as a central hub where PG&E Meteorologists, data scientists and fire weather experts can monitor real time and forecasted weather impacts as well as collaborate on projects. This center will feature a large video wall, where weather conditions can be monitored in RT, as well as six pods for meteorologists and data scientists. This center was also built to be used as an emergency backup for the WSOC.

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")

There is no regional prioritization for this program as it relates to weather monitoring across PG&E's system territory.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, PG&E broke ground on the MMAC at the PG&E San Ramon Technology Center in San Ramon, California. The MMAC construction was completed in 2020 and will be staffed and utilized in 2021 once COVID restrictions are lifted.

5) Future improvements to initiative:

Once the MMAC is fully operational, it will be staffed by PG&E personnel in order to foster better in-person collaboration on in-flight initiatives and to monitor real time conditions. PG&E does not anticipate that the MMAC will be fully staffed onsite until COVID restrictions are lifted.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E plans to operate the MMAC through the next decade. No changes are expected.

7.3.3 Grid Design and System Hardening

7.3.3.1 Capacitor Maintenance and Replacement Program

Wildfire Safety Division (WSD) Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing capacitor equipment.*

In addition to providing responses to below five questions for Initiative 7.3.3.1 – Capacitor Maintenance and Replacement Program, Pacific Gas and Electric Company (PG&E) is including our response to Class C Condition PGE-4 at the bottom of this section.

1) Risk to be mitigated/problem to be addressed:

Low voltage conditions can cause increased current loads on conductors, potentially leading to excessive wire sag, which is a fire ignition risk and leads to damage to customer and PG&E equipment. Capacitors can improve low voltage conditions. Once deployed, capacitors are maintained to ensure proper operations and mitigation of any risks associated with the failure of the capacitor itself.

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:

Capacitors are placed on the distribution system based on engineering capacity studies that target low voltage areas where installing capacitors can improve low voltage conditions. Once installed, PG&E's capacitor maintenance, inspections, and replacements are governed by Utility Procedure: TD-2302P-05. This utility procedure classifies maintenance tasks for electric overhead and underground equipment, including capacitor banks, fault indicators, interrupters, reclosers, voltage regulators, Supervisory Control and Data Acquisition (SCADA) and Primary Distribution Alarm and Control controls, sectionalizers, streetlights, and sump pumps. The capacitor inspection and replacement program are intended to reduce the risk of capacitor failure. A failed capacitor can impact wildfires by causing a low voltage condition as described above. This condition can cause wire sag or wire failure which in turn can ignite a fire. In addition, if a capacitor fails during operation it has the potential to spread molten material from the various parts that make up a capacitor on the pole.

Individually, capacitor banks in the distribution system, both overhead and pad-mounted, are tested and inspected annually. The visual part of the inspection includes verifying conditions on the bushings, switches, capacitor tanks, cut-outs, fuses, control cabinets. Within the control cabinet, PG&E further visually inspects the controller, controller box socket and rack to make sure it is properly grounded, as well as inspecting the potential and current transformers.

Annual testing entails recording a clamp-on ammeter reading on the primary jumper on each phase of the bank while the capacitor bank is energized. These values are compared to standard expected ranges based on the tank size and circuit voltage. If recorded values exceed the normal ranges, further inspection is required to determine the possibility of a failed capacitor unit or a bad connection. This comprehensive annual testing validates the proper operation and wildfire safety of capacitors deployed in PG&E's system.

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"):***

Annual capacitor maintenance is performed on all distribution capacitors regardless of geography or other factors. As noted above, the actual location of capacitors is determined based on system conditions. Planning engineers perform capacity reviews generally targeting capacitor for areas with known low voltage conditions such as long rural circuits or areas with high inductive loads due to large air conditioning or industrial power usage.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

Work on this initiative is done annually. The testing typically starts in the first quarter and is completed by April 1. PG&E annually tests and inspects approximately 11,400 capacitors, approximately 10 percent of which require corrective action in any given year based on inspection results. All repairs or replacements are required to be completed by June 1 before peak summer conditions increase electric load. PG&E plans to continue this annual inspection and testing approach going forward.

5) ***Future improvements to initiative:***

PG&E is developing a program to remove unneeded capacitors and other voltage regulating equipment. Engineering studies of system capacity needs for this equipment are ongoing. In certain instances where loads have been removed or conductor sizes have been increased, removal of capacitors and voltage support equipment may be feasible. By removing this equipment, the risk of a fire ignition caused by capacitors is reduced. Complicating these analyses, however, are the changing dynamics of the electric distribution system. Photovoltaic (PV) generation (rooftop solar) as well as LED lighting is changing voltage requirements on the distribution system. In some instances, these changes support analyses that some capacitors are no longer needed. However, further industry studies are required to develop overall policies to address long-term PV (rooftop solar) effects on the distribution system as it relates to capacitor needs. We are also investigating approaches to add updated and SCADA-enabled controllers to all capacitors so that they can be operated

remotely to address operational needs.

In addition to removing no longer needed capacitors, PG&E is investigating removing or using switches on one type of equipment: fixed bank capacitors. Fixed bank units pose a potential safety risk to utility personnel.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

The long-term plan for this initiative is aligned to the future improvements described above. Industry studies, benchmarking and other industry involvement are critical in driving any ensuing possible changes to long-term planning for this class of voltage regulating equipment.

Class C Condition:

PGE-4 is one of the Class C conditions that Wildfire Safety Division (WSD) directed PG&E to address in the 2021 Wildfire Mitigation Plan (WMP). We are including our response below:

DEFICIENCY (PGE-4) (Class C): *PG&E capacitor bank failures on its distribution system cause 500 percent higher rates of ignition compared to other large electrical corporations. Although capacitor bank failures only comprise 2 percent of total PG&E ignitions, the average rate of ignition per incident is high at 15 percent. This means that 15 percent of the time a capacitor bank fails, the failure leads to an ignition.*

CONDITION: *In its 2021 WMP update, PG&E shall list and describe mitigation measures that it is undertaking to reduce the likelihood of a capacitor bank ignition.*

RESPONSE TO CONDITION PGE-4:

The mitigation measures that PG&E is undertaking to reduce capacitor bank failures are described in the response above. PG&E performs annual maintenance on capacitor banks to ensure proper operation and wildfire safety. PG&E is also undertaking the analyses described above in the response to Question 5 to potentially remove capacitors where they are no longer needed, thereby removing the wildfire-related risk posed by that asset.

7.3.3.2 Circuit Breaker Maintenance and Installation to De-Energize Lines Upon Detecting a Fault

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing fast switching circuit breaker equipment to improve the ability to protect electrical circuits from damage caused by overload of electricity or short circuit.*

The below narrative for Section 7.3.3.2 covers the circuit breaker program, including distribution and transmission. In Table 12 (see Attachment 1 – All Data Tables Required by 2021 WMP Guidelines.xlsx), we provide financial and RSE analysis for each initiative. However, Initiative 7.3.3.2 is split into the following 4 categories to accurately reflect the financial spend and RSE information for each of the following circuit breaker programs:

- Baseline – Maintenance Substation Distribution (ongoing base control work that are identified through routine inspection via ground in distribution substations);
- Baseline – Maintenance Substation Transmission (ongoing base control work that are identified through routine inspection via ground in transmission substations);
- Enhanced – Maintenance Substation Distribution (maintenance work that are identified through supplemental inspection via drone in distribution substations); and
- Enhanced – Maintenance Substation Transmission (maintenance work that are identified through supplemental inspection via drone in transmission substations).

1) Risk to be mitigated/problem to be addressed:

PG&E's maintenance program ensures that circuit breakers are properly maintained to prevent operational failures. Improper operation of a circuit breaker may result in a variety of problems including increased time to interrupt a line fault and failure to restore power after an outage. Failures may also result in an increased risk of ignition.

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:

Prior to releasing a new circuit breaker for service, it is tested to meet all performance requirements, including opening time. Once a circuit breaker is released for service, the maintenance program oversees its performance to ensure that the circuit breaker operates within its design specification.

When a circuit breaker is identified as no longer being able to reliably operate as designed through the maintenance program, corrective action is initiated to repair or replace. In addition, the proactive replacement program evaluates, prioritizes, and replaces circuit breakers based on wildfire risk, equipment condition, age, manufacture, and model.

The maintenance of circuit breakers is governed by PG&E Utility Standard TD-3322S Circuit Breaker Maintenance Template and PG&E Utility Procedure TD-3322M Substation Maintenance and Construction (SM&C) Manual Circuit Breakers Booklet. This standard defines the required maintenance tasks and the frequency in which the tasks are performed. This procedure defines maintenance tasks for circuit breakers from visual inspections to more complex mechanism, compressor, hydraulic system services, and overhauls.

Different maintenance tasks have different time-based frequencies. In addition to the time-based requirements, additional condition-based maintenance may be triggered. An example of a time-based maintenance task is a monthly visual inspection. An example of a condition-based task is a Breaker Oil Analysis performed when an oil circuit breaker reaches 50 percent of the Accumulated Critical Current (ACC) trigger, which is an estimate of the total fault current interrupted by the circuit breaker.

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")****:*

Substation circuit breaker maintenance is not targeted based on regional location. This maintenance program applies to all substation circuit breakers in the PG&E system, including those installed in substations located in High Fire Threat District (HFTD) areas. Circuit breakers targeted for replacement program are ranked based on wildfire risks, equipment condition, age, manufacture, and model.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

In 2020, the existing maintenance program as defined in PG&E Utility Standard TD-3322S Circuit Breaker Maintenance Template and PG&E Utility Procedure TD-3322M SM&C Manual Circuit Breakers Booklet has been followed. For 2021, we plan to follow our existing maintenance program for all circuit breakers in the PG&E system. This includes both the time-based and condition-based triggers for circuit breaker maintenance.

5) Future improvements to initiative:

The circuit breaker maintenance program is periodically evaluated and adjusted based on equipment performance trends. Currently, there are no planned changes to the maintenance program for 2021. Improvements to the proactive replacement program include factoring in overstress and percent ACC as ranking criteria for replacement. These improvements will be in place for circuit breakers targeted in 2021 and beyond.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

The circuit breaker maintenance program works in conjunction with planned (capital) circuit breaker replacement program to maintain operation and service reliability. Planned replacements are identified through a ranking and prioritization based on circuit breaker condition. Recent efforts include enhancing condition data inputs, which will continue in the short-term, as data gaps are closed. The replacement program shifted priority in recent years to address increases in substation emergency work, effectively reducing the annual planned implementation rates. The 10-year plan is to slowly increase annual replacement rates to reach approximately 50 to 60 distribution and 30 to 45 transmission breakers systemwide.

For the long term, we will continue with periodic evaluations of both the circuit breaker maintenance and replacement programs. These evaluations typically include circuit breaker performance trends, emerging technology, and other risk factors. Updates will be made to the programs based on these evaluations.

7.3.3.3 Covered Conductor Installation

WSD Initiative Definition: *Installation of covered or insulated conductors to replace standard bare or unprotected conductors (defined in accordance with General Order (GO) 95 as supply conductors, including but not limited to lead wires, not enclosed in a grounded metal pole or not covered by: a "suitable protective covering" (in accordance with Rule 22.8), grounded metal conduit, or grounded metal sheath or shield). In accordance with GO 95, conductor is defined as a material suitable for: (1) carrying electric current, usually in the form of a wire, cable or bus bar, or (2) transmitting light in the case of fiber optics; insulated conductors as those which are surrounded by an insulating material (in accordance with Rule 21.6), the dielectric strength of which is sufficient to withstand the maximum difference of potential at normal operating voltages of the circuit without breakdown or puncture; and suitable protective covering as a covering of wood or other non-conductive material having the electrical insulating efficiency (12 kilovolts per inch (kV/in) dry) and impact strength (20 foot-pound (ft-lb)) of 1.5 inches of redwood or other material meeting the requirements of Rule 22.8-A, 22.8-B, 22.8-C or 22.8-D.*

In this section, PG&E discusses our covered conductor installation initiative and addresses Action PGE-14 (Class A).

1) Risk to be mitigated/problem to be addressed:

The installation of covered conductor in both primary and secondary systems can help to reduce the occurrences of phase-to-phase contact (when lines come in contact with each other) either directly or through a medium such as a tree branch, eucalyptus bark, palm fronds, animal/bird, or a foreign object which may result in a wildfire ignition.

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:

PG&E installs covered conductor and replaces existing poles, cross-arms, and other equipment as part of our System Hardening Program. Because this installation also includes covered jumpers, animal protection, and eliminates most exposed energized components, it is also effective to mitigate many phase-to-ground type outages. This is an effective mitigation in areas prone to these types of impacts where undergrounding or other mitigations are not as cost-effective. In addition to wildfire related safety benefits, the elimination of these numerous transient type outages also has the potential to improve reliability, the overall health of the power systems, and life expectancy. PG&E's System Hardening Program is described in more detail in Section 7.3.3.17.

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"):

Covered conductor installation is being performed as part of PG&E's System Hardening Program and in reconstruction work performed in the HFTD designated areas to address the risk of wildfire ignition. While system hardening is not currently being performed in non-HFTD areas, it can be an effective mitigation for reliability issues in non-HFTD areas to limit the impacts due to recurring outages.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

See the discussion of the System Hardening Program in Section 7.3.3.17.1 for program details, future improvements, and financial analysis.

5) Future improvements to initiative:

See System Hardening Program in Section 7.3.3.17.1 for program details, future improvements (including long-term planning), and financial analysis.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

Please reference Section 7.3.3.17.1 for more information on future improvements for this initiative.

ACTION PGE-14 (Class A)

In its 2021 WMP update, PG&E shall 1) provide an explanation as to how it is prioritizing replacing aluminum conductors in areas that overlap both corrosion zones and the HFTD, 2) if PG&E is not prioritizing aluminum conductors located in overlapping corrosion zones and HFTDs, explain why, and 3) explain whether any higher priority is given to aluminum conductor within corrosion zones outside of HFTDs.

Response:

The prioritization, tracking, and funding of conductor replacement projects in HFTD vs non-HFTD areas is done through two separate Major Work Categories (MWC). Circuit hardening within HFTD areas is completed under MWC 08W while reconductoring of deteriorated conductors within non-HFTD is completed under MWC 08J.

The MWC 08W (HFTD program) is informed by risk modeling that takes many consequence and probability factors into account. Specifically, PG&E's Vegetation Probability of Ignition and Equipment Probability of Ignition Models focus on vegetation and equipment failure modes as they represent a high percentage of the overall ignitions by cause. Combined with the Wildfire Consequence Model, the initiatives are designed to reduce ignitions in the highest wildfire risk areas. These models are described in more detail in Sections 4.3 and 4.5.1.

The focus of MWC 08J (non-HFTD program) is small conductor with high wire down rates and small Aluminum Conductor Steel-Reinforced (ACSR) conductor within severe and moderate corrosion zones because this combination deteriorates the health of the conductor at a higher rate than outside of the corrosion zone. Approximately 70 percent of targeted 4 ACSR conductor within corrosion zones is in the non-HFTD areas.

While aluminum and corrosion are significant indicators of conductor failure, they do not necessarily align with the key factors for wildfire risk. In cases where they do align, they are prioritized by the models described above that used in the prioritization of the MWC 08W program. In general, the criticality of the MWC 08W program is a higher priority than the MWC 08J program given the potential wildfire impact and consequences.

7.3.3.4 Covered Conductor Maintenance

WSD Initiative Definition: *Remediation and adjustments to installed covered or insulated conductors. In accordance with GO 95, conductor is defined as a material suitable for: (1) carrying electric current, usually in the form of a wire, cable or bus bar, or (2) transmitting light in the case of fiber optics; insulated conductors as those which are surrounded by an insulating material (in accordance with Rule 21.6), the dielectric strength of which is sufficient to withstand the maximum difference of potential at normal operating voltages of the circuit without breakdown or puncture; and suitable protective covering as a covering of wood or other non-conductive material having the electrical insulating efficiency (12 kV/in dry) and impact strength (20 ft-lb) of 1.5 inches of redwood or other material meeting the requirements of Rule 22.8-A, 22.8-B, 22.8-C or 22.8-D.*

1) ***Risk to be mitigated/problem to be addressed:***

   Covered conductor maintenance, which occurs as part of routine overhead maintenance conducted through PG&E's GO 165 Program, is focused on the identification, assessment, prioritization, and documentation of the current condition of PG&E's covered conductor facilities. This maintenance would help reduce the risk of water egress into the insulated line and to identify any locations where the jacket could be damaged reducing its insulative properties.

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:***

   Covered conductor maintenance occurs as part of PG&E's GO 165 Program and looks to identify potential conditions during patrols and inspections of PG&E's distribution facilities, and any conditions that may occur as a result of operational use, degradation, deterioration, environmental changes, or third-party actions.

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")****:*

   Covered conductor maintenance will be performed anywhere covered conductor is installed and found to have conditions requiring maintenance. The majority of the covered conductor would be found in the Tier 2 and Tier 3 HFTD areas and Buffer Zones.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   Maintenance on covered conductors will occur as a part of PG&E's GO 165 program, including maintenance in Buffer Zones. As more covered conductor is installed, this equipment will be inspected as a part of that program.

5) Future improvements to initiative:

PG&E will continue to inspect and monitor covered conductor systems and enhance the requirements in the GO 165 program as needed.

ACTION PGE-25 (Class B)

Response:

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Since this initiative is closely related to GO 165 requirements, any long-term changes will be guided by changes/updates to GO 165. PG&E does not currently have any plans to change this initiative in the long-term.

7.3.3.5 Crossarm Maintenance, Repair, and Replacement

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing crossarms, defined as horizontal support attached to poles or structures generally at right angles to the conductor supported in accordance with GO 95.*

1) Risk to be mitigated/problem to be addressed:

PG&E does not have a formal program to replace cross-arms. PG&E replaces cross-arms as they are deemed necessary for replacement as part of our Electric Corrective (EC) maintenance. Crossarm failure has the potential to drop energized conductors to the ground as well as other falling hazards from the top of utility poles, which can create the potential for an ignition.

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:

PG&E has an extensive condition monitoring program for overhead assets, including crossarms, in accordance with requirements in GO 165. PG&E conducts annual patrols in urban areas and bi-annual patrols in rural areas, visually looking for damaged equipment and other defects on the distribution overhead system. A detailed inspection is performed every five (5) years in non-HFTD, (every year (1) in Tier 3 and every three (3) years in Tier 2) looking for any damaged or deteriorated equipment.

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"):

GO 165 mandated inspections and patrols, lead to the identification of cross-arms that require replacement. This work has been prioritized because it can prevent fire ignition and hazards to public from falling wire and parts. HFTD areas receive a higher frequency of GO 165 inspections so these regions receive more attention to address failing assets such as cross-arms. In addition, the work being done for this program also includes maintenance in Buffer Zones.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

Progress continues towards completion of identified EC tags including cross-arm EC tags, especially in HFTDs. PG&E prioritizes the completion of EC tags based on risk ranking which includes the evaluation of Facility Damage Action (FDA). The cross-arm facility in FDA typically receives high prioritization for replacement. PG&E inspectors and construction supervisors conduct post-job reviews for crossarm maintenance work performed by contract and internal crews to

ensure the work matches the work called for in the job order and is in compliance with GO 95 requirements regarding how overhead facilities should be constructed.

5) Future improvements to initiative:

PG&E identifies failing crossarms primarily through GO 165 inspections and patrols. Through these inspection programs, PG&E identified and completed repairs or replacements of approximately 6,500 crossarms in 2020. Implementation of composite cross-arms is providing an additional level of longevity for cross-arms as the strength and ultimate life span of composite is significantly longer than older standard wood cross-arms.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E will continue to inspect and monitor crossarms and enhance the requirements in the GO 165 program as needed. PG&E does not currently have any plans to change this initiative in the long-term.

7.3.3.6 Distribution Pole Replacement and Reinforcement, Including with Composite Poles

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing distribution poles (i.e., those supporting lines under 65 kilovolts (kV)), including with equipment such as composite poles manufactured with materials reduce ignition probability by increasing pole lifespan and resilience against failure from object contact and other events.*

1) Risk to be mitigated/problem to be addressed:

Distribution poles need to be inspected and evaluated to determine their condition to support conductors and keep energized conductors in the air, which reduces ignition probability.

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:

The failure of a distribution pole creates the risk of a potential wires down event and ignition risk. To address the risk of a distribution pole failure, PG&E has an extensive condition monitoring program for wood poles in accordance with requirements of GO 165. We conduct annual patrols in urban areas and bi- annual patrols in rural areas, visually looking for damaged poles and other defects on the distribution overhead system. PG&E performs a detailed inspection every 5 years in non-HFTD, (every year (1) in Tier 3 and every three (3) years in Tier 2) to look for external damage or deterioration, as well as an intrusive inspection approximately every 10 years to identify internal or below ground decay that may be present in the pole. PG&E also identifies and repairs pole top damage especially woodpecker damage.

The pole replacement program replaces poles that that PG&E has determined are overloaded or need to be upgraded to support the attachment of telecommunications or cable companies' facilities. PG&E has used both wood and non-wood or composite poles as replacements. Composite poles in conjunction with covered conductor and exempt equipment are less susceptible to cause an ignition, if branches or trees fall onto the conductor, they are less likely to spark and start a fire. Ancillary benefits of composite poles are that they retain their strength if exposed to wildfire temperatures, they are lighter to carry into remote areas, they are less prone to woodpecker, insect, and fungus rot, they do not need intrusive pole testing, and they do not need hazardous disposal when removed.

As a facet of pole replacement, PG&E has been concerned about the lack of current industry standards concerning the performance of distribution poles in wildfire conditions. As referenced in the 2020 WMP, PG&E began exploring new options for pole replacements. Comparative data gathering was performed in 2019 on 11 different sets of poles (33 total) from 7 different manufacturers as a result of a cooperative

evaluation between PG&E and various manufacturers. One of the best performing products, per the test report, was the wood pole with an intumescent mesh covering. PG&E has been working with the manufacturer and as a result of the information gained from the comparative data gathered in 2019, additional evaluations concerning the toxicity of the intumescent mesh covering, the ability to determine the pole condition after a fire and the reusability of the pole, PG&E has selected the wood pole with an intumescent mesh covering as our standard pole for use in the Tier 2 and 3 HFTD areas, including new pole installations, routine pole replacements, and the System Hardening Program described in Section 7.3.3.17.1.

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"):***

Poles identified for remediation each year by the various inspection programs are scheduled for replacement. Replacements are prioritized using a risk-based approach. Specifically, poles replacements are prioritized based on probability of consequence and probability of failure. Probability of consequence takes into account HFTD and circuit density (count of customers). Probability of failure takes into account some pole factors, such as age, class (class 5 poles are smallest) and treatment (cellon).

We use these factors to score each pole and prioritize their replacement accordingly. PG&E scores each of the poles with replacement tags and ranks them based on their scores. The poles that score the highest get worked first. Please note that this is for E/F Tags only. Priority A/B tags are prioritized first, and we try to work them within the time specified by the inspector (e.g., 30 days for A tags and 90 days for B tags). In addition, the work being done for this program also includes maintenance in Buffer Zones.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

PG&E works on poles identified for remediation by various inspection programs. Poles that require reinforcement are typically worked the following calendar year. So, poles identified in 2020 will be reinforced in 2021. Through these inspection programs, PG&E identified at least 9,800 poles for replacement and at least 4,100 poles for reinforcement in 2020. Poles identified for reinforcement are in good condition, except for decay around the ground line. By installing a steel truss and banding it to these poles PG&E can restore the strength of the pole to 100 percent.

5) Future improvements to initiative

PG&E continues to review and evaluate improved manufacturing techniques from composite pole manufacturers that participated on the 2019 pole testing with third-party test facilities. However, at this time, we have no plans to expand the application of composite poles except for areas that require them such as environmental or extreme loading conditions.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

At this time, there is no specific long-term plan that is applicable to this initiative other than the pole selection for HFTD Tier 2 and Tier 3 areas described above in the response to Question 2). Programs associated with this initiative are funded by the General Rate Case and discussed in the California Public Utilities Commission (CPUC or Commission) compliance plan quarterly. Industry guidance and availability of alternative pole materials may help guide any future long-term initiatives.

7.3.3.7 Expulsion Fuse Replacement

WSD Initiative Definition: *Installations of new and California Department of Forestry and Fire Protection (CAL FIRE)-approved power fuses to replace existing expulsion fuse equipment.*

In this section, PG&E discusses our covered non-exempt fuse replacement initiative and addresses Actions PGE-46 (Class B) and PGE-48 (Class B).

1) ***Risk to be mitigated/problem to be addressed:***

   To address increasing wildfire risks, PG&E created a program to replace non-exempt fuses and cutouts. Replacing non-exempt fuses with exempt fuses reduces wildfire risk. If a non-exempt fuse fails, it has the potential to spread hot molten metal material which could cause one or more ignitions, while exempt fuses are designed to internalize any molten material which may result from a fuse failure.

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:***

   Non-exempt equipment is equipment that may generate electrical arcs, sparks, or hot material during its normal operation. The replacement of non-exempt equipment with exempt equipment will further reduce fire risk since the exempt equipment is considered “non-expulsion” and does not generate arcs/sparks during normal operation. By using exempt fuses, we can reduce the potential for vegetation ignitions due to molten material spread.

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"):***

   HFTD areas are the focal point for the non-exempt fuse replacement program, specifically Tier 2 and 3 HFTD areas.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In 2019 and 2020, PG&E completed 708 and 751 fuse replacements, respectively.

   PG&E forecasts replacing approximately 1,200 fuses/cutouts, and other non-exempt equipment identified on poles in Tier 2 and Tier 3 HFTD areas in 2021.

5) Future improvements to initiative:

The pace of PG&E's fuse replacement program after 2021 will be determined based on available funding and prioritization of other wildfire initiatives.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E plans to keep replacing fuses with the total target of replacing approximately 10,000 fuses in the next 7-8 years. The pace and scope of replacement will depend on funding and prioritization.

ACTION PGE-46 (Class B)

1) Explain whether it is increasing the scope of fuse replacements and, if so, why,

2) Explain whether the replacement of the originally identified fuses (i.e., 625 per year) are being prioritized before replacement of those in the increased scope (i.e., 1,200 per year), and

3) Describe how prioritization has changed since the initial scope in 2019.

Response:

1) PG&E is increasing the scope of our fuse replacement program in 2021. The target in 2019 and 2020 was 625 fuses per year (which PG&E exceeded in both years). The target in 2021 is replacing 1,200 fuses. The pace of replacement after 2021 will be determined based on available funding and prioritization of other wildfire initiatives. The scope of the program is expanding in order to expedite the replacement of non-exempt fuses (which are all located in HFTD areas) to mitigate ignition risks, as well as mitigate ongoing Vegetation Management (VM) at these non-exempt locations. Fuses will play an important role in hardening our infrastructure against unanticipated surges of energy and the replacement of non-exempt fuses with exempt fuses can mitigate wildfire ignition risks.

2) The increase in the fuse replacement target from 625 in 2020 to 1,200 in 2021 is not the result of replacing different kinds of fuses. Instead, PG&E is replacing non-exempt fuses in HFTD areas in both years. PG&E has increased the pace of the program, but this does not result one group of fuses (i.e., the 625 fuses) being prioritized over other fuses (the additional fuses beyond 625). PG&E is prioritizing non-exempt fuses in HFTD areas for replacement, as explained in more detail in response to subpart (3) below, and sets a program target and funding for each year.

3) As this program evolves and matures, so will the prioritization framework, which is shifting to become more targeted as more data is increasingly integrated into the decision-making process; this means that replacement targets will change and become better-informed from year to year. Prior to 2020, the targeted 625 replacements were based on execution risk and inputs from the engineering department. In 2020, as the program exceeded the original 625 replacement target to hit 751 total units replaced, PG&E placed an increased emphasis on particularly at-risk districts as part of our prioritization framework. As the program expands in 2021 to replace 1,200 units, detailed Geographic Information System (GIS)-based inputs from Technosylva models around the highest fire ignition risks will determine priority replacements going forward.

ACTION PGE-48 (Class B)

1) Provide the cost/benefit analysis performed regarding fuse replacements, including the calculation of reduction of VM costs per fuse replaced.

Response:

Fuse replacements occur periodically as those that are end-of-life need to be substituted for new ones, while VM is an annually recurring cost that includes high outliers in specific instances.

On average, a single fuse installation costs approximately $12,500 per unit, which includes approximately $4,000 in equipment costs and $8,500 in all other costs, such as labor, permitting, and traffic control. Once installed, the fuse-holding device (i.e., cut-out) will not need to be replaced for up to 40 years. On the other hand, the annual base cost for vegetation replacement is approximately $900 per tag, but can range as high as $5,000 per tag, depending on complications that arise from "refusals" from disputing property owners who aim to prevent VM work.

As a result, in the most conservative estimate for a low-cost VM scenario of $900 per tag, the fuse installation would break even in less than 14 years. However, the costs of a fuse replacement can break even as quickly as under three years should there be high-cost refusals, a reasonably likely scenario within PG&E territory. There are ancillary benefits in terms of customer satisfaction when vegetation is not removed and instead a fuse is replaced.

This cost/benefit analysis does not take include the benefits associated with wildfire ignition risk reduction associated with a wildfire that could potentially be ignited by a non-exempt fuse.

7.3.3.8 Grid Topology Improvements to Mitigate or Reduce Public Safety Power Shutoff (PSPS) Events

WSD Initiative Definition: *Plan to support and actions taken to mitigate or reduce PSPS events in terms of geographic scope and number of customers affected, such as installation and operation of electrical equipment to sectionalize or island portions of the grid, microgrids, or local generation.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.3.8.1: Distribution Line Sectionalizing;
- 7.3.3.8.2: Transmission Line Sectionalizing; and
- 7.3.3.8.3: Distribution Line Motorized Switch Operator (MSO) Pilot.

7.3.3.8.1 Distribution Line Sectionalizing

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The installation of remote operated SCADA sectionalizing devices on PG&E's distribution system can support our ability to segment the distribution circuits near the HFTD area boundary to reduce the impact and scope of PSPS events.

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:

PSPS events can cause significant disruption to communities and customers and therefore we are working to minimize the number of customers impacted. PG&E plans to continue enhancing our distribution segmentation strategy to minimize the number of customers impacted during future PSPS events by being even more precise on what areas of the circuit to shutoff.

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"):

Distribution sectionalizing device installations have been focused on all circuits that traverse into HFTD areas. PG&E plans to incorporate learnings from past events and focus efforts primarily on counties and specific areas that are repeatedly impacted by PSPS. This includes (but is not limited to) Butte, Yuba, Sonoma, Napa, Nevada, and El Dorado counties.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

a. PG&E installed 603 SCADA commissioned distribution sectionalizing devices by September 1, 2020.

b. In 2021, PG&E plans to 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.

5) Future improvements to initiative:

As each yearly wildfire PSPS season concludes, PG&E will integrate learnings from actual PSPS events and feedback from county leaders and critical customers to become even more precise on what areas of circuits to target for shutoff to minimize customer impact and outage duration. With this data and feedback PG&E can continue to install new SCADA

automated sectionalizing devices closer to the refined meteorological shutoff boundaries and learn what areas of the community to analyze for even further granular sectionalizing.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

Response:

Since PG&E has already installed over 800 SCADA-enabled distribution sectionalizing devices in years 2019 and 2020 and plans to install at least 250 additional new devices in 2021, it is anticipated that future segmentation needs will be greatly reduced. PG&E plans to install at least 100 new distribution sectionalizing devices annually starting in 2022 and beyond, and within 10 years, it is expected that all HFTD/High Fire Risk Area (HFRA) locations will be fully sectionalized with remote-capability where beneficial.

7.3.3.8.2 Transmission Line Sectionalizing

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) ***Risk to be mitigated/problem to be addressed:***

   PG&E has been installing remote-operated SCADA sectionalizing devices on our transmission system to support the ability to segment the transmission circuits within the HFTD boundary. This will allow operational flexibility to reduce the scope and impact of PSPS events.

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:***

   PSPS events can cause significant disruption to communities and customers. PG&E plans to continue implementing our transmission segmentation strategy to minimize the number of customers impacted during future PSPS events by narrowing down the segments of a circuit to de-energize.

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"):***

   Prioritization of new or upgraded transmission sectionalizing devices is based on HFTD location, likelihood of potential de-energization during future PSPS events (based on a study of 10 years of weather data), and potential customer impact. Switch upgrades are typically identified at line junctions and substations, where operational flexibility may be most beneficial.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In 2020, we installed 54 transmission switches for PSPS mitigation. Some of these switches were redirected from non-HFTD to the HFTD locations. Of these devices, over 23 were installed before the 2020 wildfire season, as committed to in the 2020 WMP.

   For 2021, PG&E is planning on installing 29 additional switches impacting HFTD areas. All 29 switches are planned for installation by September 1, 2021.

5) ***Future improvements to initiative:***

   Future installation of all identified HFTD transmission sectionalizing devices will be prioritized based on potential PSPS benefit (such as expected frequency of a line being de-energized and impact of de-energization) to provide operational flexibility during future PSPS

events. These switches also contribute to overall reliability outside of PSPS events. Approximately 200 additional switches are planned in the next three to five years.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

Response:

Within 10 years, it is expected that all HFTD/HFRA locations will be fully sectionalized with remote-capability where beneficial. Switches will continue to be prioritized based on potential operational benefit during PSPS events and funded at engineering and/or constructing approximately 60 switches per year.

7.3.3.8.3 Distribution Line Motorized Switch Operator Pilot (MSO)

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Motorized Switch Operators (MSO) switches were initially installed on PG&E's distribution system as sectionalizing devices with the ability to reduce the scope of PSPS events. Despite these switches being understood to meet CAL FIRE's exempt criteria for not posing an ignition risk during normal operation, PG&E crews identified a risk that some MSO switches were reported to exhibit an arc flash during the opening (de-energizing) operation. Based on this feedback and subsequent testing PG&E is undertaking this sub-initiative to remove or retrofit MSO switches to address this potential risk.

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:

After some concerns regarding MSO switches were identified in the field, PG&E undertook an evaluation of this equipment. During testing of an MSO switch in PG&E's lab environment to replicate the reported field conditions, the MSO switch exhibited an arc flash during its opening operation. PG&E immediately halted further installations of MSO switches. After further testing, PG&E determined that the current version of MSO switches would no longer be installed and is taking the remedial steps described in Question 4 below. This sub-initiative seeks to determine the best alternative for removing this equipment going forward.

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"):

PG&E installed over 100 SCADA automated MSO switches during 2019 to be utilized as PSPS sectionalizing devices to deenergize lines traversing into the Tier-2 and Tier-3 HFTD areas. PG&E discovered the problems with these switches in late 2019, as described above. This initiative is focused on just those locations and is not otherwise prioritized or targeted regionally.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

Until all installed MSOs can be replaced or retrofitted, PG&E has issued guidance document TD-076253-B004 "Limited Use of Inertia SCADA MSO" which sets controls in place to mitigate wildfire risk. This control requirement mandates that any MSOs in the field are to be only operated with a Qualified Electrical Worker present during OPEN and CLOSE operations to handle any onsite issues that might arise.

During 2021, PG&E will be assessing various alternatives to address the identified risk with MSOs. PG&E plans to explore several pilot options that will help inform which are the best alternatives and select the appropriate corrective action for MSOs for the next WMP update. Specifically, PG&E will explore corrective actions to prevent any potential arc flash including retrofitting the MSO with new vacuum-break technology or replacement with either new automated Line Reclosers or new automated SCADAMATE-SD switches.

5) Future improvements to initiative:

Based on the results of the pilots in 2021 described above, a strategy to retrofit or replace all MSO switches in HFTD areas and/or intended for use to reduce the scope of PSPS events. This sub-initiative will then be complete once all the MSO switches have either been retrofitted to address the potential arc flash risk or replaced.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E forecasts that all MSO switches used for PSPS will be either retrofitted or replaced by the end of 2022 and there will not be a long-term need for this sub-initiative.

7.3.3.9 Installation of System Automation Equipment

WSD Initiative Definition: *Installation and replacement of electric equipment with remote capability that provides operations with the ability to control and monitor circuit status. This includes the ability to remotely change device settings like disabling automatic reclose on recloser and FuseSavers (switching devices designed to detect and interrupt faults and can reclose automatically to detect if a fault remains, remaining open if so).*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.3.9.1: Installation of system automation equipment; and
- 7.3.3.9.2: Installation of single phase reclosers.

7.3.3.9.1 Installation of System Automation Equipment

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) ***Risk to be mitigated/problem to be addressed:***

   High impedance faults are conditions where line to ground faults do not draw a full fault current that a protective device can reliably sense and trip (function of contact resistance to ground) creating a potential ignition source. The replacement of the legacy SCADA recloser controls protecting fire Tier 2 and 3 HFTD areas with new recloser controllers will enable the use of protective features designed to address high impedance fault conditions as well as integrating with current communication protocols.

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:***

   Under this distribution system automation initiative, the existing oil filled reclosers and controllers will be replaced with a solid dielectric recloser and new micro-processor controller with protection elements like Downed Conductor Detection, Sensitive Ground Fault, and platforms that allows for future protection elements that are under development to reliably detect high impedance faults.

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"):***

   There are approximately 80 remaining distribution line legacy 4C controllers and PG&E will replace all those remaining that are located throughout PG&E's service territory serving Tier 2 and 3 HFTD areas. These 4C distribution line controllers will be replaced prior to the end of 2021.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   PG&E's 2020 WMP indicated that we would pursue system automation initiatives including the replacement of legacy 4C controllers. In order to meet the 2021 goal of replacing all 84 4C controllers, the design and estimating started in 2020. With the devices' locations having been identified, work packages were submitted to estimating and locations will be ready for construction in early 2021. Under this initiative, the 84 remaining 4C recloser controls within the Tier 2 and 3 HFTD areas will be replaced.

5) Future improvements to initiative:

This sub-initiative will be completed by the end of 2021 after which time no further improvements are currently planned.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

As stated in the section above, this sub-initiative will be completed by the end of 2021 after which time no further improvements are currently planned.

7.3.3.9.2 Single phase reclosers

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

A single phase recloser is a cost-effective intelligent device which can replace fuses and act as a single phase recloser with the capability to trip all phases (i.e., open all phases) eliminating the risk associated with wire down events where a downed wire remains energized by a back-feed condition.

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:

Distribution laterals are single phase or three phase taps off the mainline distribution circuit that serve single or small groups of customers. The laterals are protected by fuses (one per phase) which isolate faults keeping the mainline energized limiting outages to a smaller number of customers. Fuses are designed to trip open for a fault condition on the phase or phases that experience a fault condition. Fuses are a practical and cost effective way to isolate faults from the mainline, but there is a risk when a fault event like a wire down condition trips the faulted phase but transformers connected to the faulted phase and an un-faulted phase can keep the wire down energized by a "back-feed" condition. The way to mitigate this problem is trip all phases on the faulted lateral. However, fuses do not have the capability to trip all phases.

This sub-initiative will install single phase reclosers on laterals that have a history of energized wire down conditions. The single phase recloser will open all phases for the initial line to ground fault and eliminate the risk of ignition from a back-feed condition. A single phase recloser can be installed with SCADA allowing for remote operation including non-test and open and close capability.

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"):

PG&E piloted a single phase recloser device in 2019, and it was used in 2020 as an automatic sectionalizing device for potential PSPS areas where field conditions did not require a three phase recloser. In 2020, we identified locations for 2021 single phase recloser device installations based on the following criteria: (1) in Tier 2 or Tier 3 HFTD areas; (2) three or more wire down outages in the last 10 years; (3) fused cutout experienced FIA fire potential days (R4, R5, or R6, which are elevated fire risk classifications); (4) load on all phases greater than 1 ampere (amp); and (5) fault duty below 6,000 amps symmetric.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, locations were selected based on the above criteria and estimating is in progress. By the end of 2021, PG&E plans to install 70 sets of single phase reclosers. PG&E is working with the manufacturer to make design improvements to the existing device that allows more universal application of the device within the fire areas.

5) Future improvements:

The current version of single phase reclosers and similar brands are powered from the energized line and require a minimum of a few amps to function. In many locations, the off-peak load falls below the minimum load requirement and the device stops communicating back to the SCADA system. PG&E will continue to work with manufacturers to develop a cost-effective single phase recloser that are voltage powered and do not have minimum load limitations allowing for more universal application.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E is in the process of developing a long-term strategy for single phase reclosers. The device limitations described above restrict the wide-spread deployment within Tier 2 and 3 HFTD areas, but there are locations where the existing technology can mitigate risk associated with back-feed conditions. In the near-term, PG&E will use historical data and risk models for selection and prioritization of suitable locations to install single phase reclosers. The long-term view envisions larger scale deployment of single phase reclosers to address the risk of back-feed conditions when the technology meets all the needs of the distribution system serving the Tier 2 and 3 HFTD areas.

7.3.3.10 Maintenance, Repair, and Replacement of Connectors, Including Hotline Clamps

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing connector equipment, such as hotline clamps.*

1) ***Risk to be mitigated/problem to be addressed:***

   Connector failure can lead to a wires down condition and wires down can lead to a risk of ignition.

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:***

   With regard to connectors generally, through PG&E's infrared patrols distribution connectors are identified that may be compromised, EC tags are generated based on these infrared findings, and connectors are replaced as needed. For PG&E's transmission lines, maintenance of connectors is generally performed as part of the overhead inspection program with repairs and/or replacement done as determined necessary during these inspections. In addition, as part of other programs such as pole replacement, new business, system hardening, and capacity and reliability, distribution lines must be built to current standards which includes new and improved connectors.

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"):***

   Inspection of connectors through infrared patrols or overhead inspection includes maintenance in Buffer Zones and overall throughout PG&E's system. See Sections 7.3.4.4 and 7.3.4.5 for more information on PG&E's infrared inspection program.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   PG&E will continue to maintain, repair and/or replace connectors pursuant to our established condition-based maintenance programs. PG&E will also replace existing connectors with new equipment on facilities that are hardened as part of the System Hardening Program.

5) Future improvements to initiative:

There are currently no expected future programmatic improvements. However, PG&E's standards teams meet regularly with industry representatives at trade shows and Institute of Electrical and Electronic Engineers committees to evaluate new technology and products. Fire resilient connectors are one of the items that has received attention recently in industry discussions.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

At this time, there is no long-term plan that is applicable to this initiative since as previously discussed, connectors/claps are identified/replaced through ongoing inspection and infrared testing. Additionally, replacement of these components through significant amount of ongoing replacement work continue to adhere to our current rigorous standards of improved component material. Future industry guidance/studies may possibly have an impact on any new ensuing long-term plans for this asset class of components.

7.3.3.11 Mitigation of Impact on Customers and Other Residents Affected During PSPS Event

WSD Initiative Definition: *Actions taken to improve access to electricity for customers and other residents during PSPS events, such as installation and operation of local generation equipment (at the community, household, or other level).*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.3.11.1: Generation for PSPS Mitigation:

  This sub-initiative provides an overview of microgrids and back-up generation to mitigate the impact of PSPS events. PG&E then provides more detail concerning five programs as well as responses to certain Action Items:

  A) Generation Enablement and Deployment;

  B) Temporary substation microgrids;

  C) Temporary distribution microgrids;

  D) Back-up power for individual critical customer facilities;

  E) Community Resource Centers; and

  F) Responses to Action Items PGE-49 (Class B) and PGE-50 (Class B).

- 7.3.3.11.2: Substation activities to enable reduction of PSPS impacts; and

- 7.3.3.11.3: Emergency Back-up Generation – PG&E Service Centers & Materials Distribution Centers.

7.3.3.11.1 Generation for PSPS Mitigation

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

This section addresses Actions PGE-49 (Class B) and PGE-50 (Class B).

1) Risk to be mitigated/problem to be addressed:

De-energization due to PSPS can create public safety risks for customers, as well as broader impacts for communities. Keeping communities and "main street corridors" energized helps to mitigate these risks. Temporary microgrids for PSPS mitigation support both the energization of broader communities and specific "main street corridors" with shared services and critical facilities to minimize the impacts of PSPS events.

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:

PG&E has two microgrid initiatives designed to support customers during PSPS, each of which is configured to address a different type of PSPS impact: (1) temporary Substation Microgrids are focused on keeping safe-to-energize customers online when a substation serving them is impacted by an upstream de-energization; and (2) temporary Distribution Microgrids are focused on energizing "main street corridors" with shared services and critical facilities when the distribution line serving these areas is de-energized. These specific initiatives are described below in subsections B and C. There are two other PSPS mitigation workstreams that leverage temporary generation, these are addressed in subsections D and E.

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"):

To determine the appropriate locations for temporary microgrids for PSPS mitigation, PG&E assesses the expected relative frequency of future PSPS impacts through analysis of historical meteorological data, prior PSPS event impacts, and parallel work- in-progress directed at reducing future impacts. The foundational data for selecting temporary microgrid sites for 2021 is an analysis of 10 years of historical weather events and actual 2020 PSPS event data.

Additionally, PG&E seeks to complement our internal location screening process for PSPS microgrids with county and local government collaboration to ensure that local priorities help shape site selection and design where technically feasible.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

Information on the progress of the Temporary Substation Microgrids and Temporary Distribution Microgrids is provided in subsections B and C below.

5) Future improvements to initiative:

In 2021, PG&E intends to expand the pool of contractors and technologies for the development of microgrids, pilot viable non-diesel technologies, and explore opportunities to build a portfolio of non-fossil solutions for the longer term. This improvement is tied to PG&E's desire to meet California's clean energy goals and to increasing the ability of microgrids as one tool to mitigate wildfire risk and increase PSPS resilience.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

***Response**:*

PG&E is in the process of shaping long-term plans for our microgrid initiatives, including microgrids for PSPS mitigation, through the Microgrid Order Instituting Rulemaking (OIR) (i.e., Rulemaking 19-09-009). As directed by the Track 2 Decision in that proceeding,[71] PG&E expects to file an application by June 30, 2021 proposing a long-term framework for using generation at substation to mitigate PSPS outages, including consideration of permanent and temporary solutions, the use of diesel alternatives, and the method of considering long-term microgrid solutions against other wires-based solutions. As part of that forthcoming application, PG&E expects to address the continuing evolution of fire risk modeling, which currently creates significant uncertainty regarding the long-term need for PSPS mitigation at specific locations. The framework will therefore need to be flexible, allowing decisions to be based upon the best information available at any given point in time and identifying, based on that information, any long-term microgrid initiatives that are reasonable and prudent across a range of scenarios. The resolution of that Application will determine long-term plan milestones set in future WMPs for this initiative.

A) Generation Enablement and Deployment

1. Risk to be mitigated/problem to be addressed:

The Generation Enablement and Development organization establishes permanent positions comprised of 10 Full-Time Equivalents (FTE) per the following functions: one Senior Manager to oversee the organization; one manager and four supervisors to ensure the safety of internal and

[71] D.21-01-018, App. A, pp. A-6 to A-8.

contractor crews during deployments, operational readiness and PSPS activations; one Operations Lead to coordinate with the Control Center processes and enhancements; one Substation Strategy manager to study effective and efficient utilization of TG at substations; one Process and Project Management to ensure that processes are developed, financial oversight and any operational readiness activities are appropriately project managed; Testing, Standards and New Technology manager in charge of continually improving and evolving a greener generation program.

Program breakdown of 10 FTE's per the below:

- 9 FTEs of this Temporary Generation (TG) organization are geared toward PSPS readiness and scalability processes for PSPS; and

- 1 FTE of this TG organization will Primarily support the Clean Substation pilot projects contemplated by the Microgrid OIR and more generally the transition to a cleaner fleet of TG as contemplated in that Rulemaking.

The TG Project Management Office (PMO) will reside within the Generation Enablement and Development organization with the purpose to coordinate, organize and establish a single source of reporting to senior leadership the operational readiness of procured TG in relation to the four workstreams incorporated within the TG PMO: Substation; Microgrids & Temporary Microgrids; Back-up Power Support; and Community Resource Centers (CRC). The TG PMO will also staff, coordinate, and train Emergency Operations Center (EOC) TG members for PSPS event response along with other major emergency events.

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:***

Establish a permanent organization structure to ensure uniformity year over year by managing improvement and efficiency gains by capturing, implementing, and documenting the actions taken to support reduction of customer impacts during PSPS events. The new organization structure will also be better prepared to develop and execute longer duration New Technology project pilots and implementation.

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"):***

The TG PMO will perform an annual analysis of generation uses as it relates to other system hardening, grid improvements, historical data, and meteorological study. This analysis will inform the procurement and deployment of generation throughout the PG&E system for the combined four workstreams. The TG PMO will also engage Transmission and Distribution (T&D) planning and other system planning groups and provide suggestions to help improve electrical infrastructure that might reduce the need of TG for PSPS event.

4. ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In Q1 of 2021, PG&E will establish the new Generation Enablement and Development team, post the above positions, and hire successful candidates. The goal of this team will be to procure and deploy TG system wide across the four workstreams as described prior to the start of the 2021 PSPS season. This team will also work closely with stakeholders, vendors, and regulators to ensure a transition to a cleaner TG fleet in 2021. The goal for this team is to establish at least one Clean Substation Project candidate site for testing and demonstration in 2021, and work to deploy the project if bids meet CPUC established cost-effectiveness criteria.

5. ***Future improvements to initiative:***

   - Support for the filing of an application to establish a long-term framework for the procurement of local generation and other solutions to mitigate grid outages; once approved, carrying out the solicitations, grid upgrades, and other work described in the approved framework;

   - The TG department will continue to position the organization to fall into line with the PG&E corporation's goal of meeting the new 60 percent by 2030 Renewable Portfolio Standard (RPS) mandate set forth by Senate Bill 100, as described in our RPS Procurement Plans filed at the CPUC. This will be achieved by continued testing, research, and development by the Generation Enablement and Deployment team to shift current temporary energy solutions to greener solutions that have a significantly lower carbon footprint;

   - Support business continuity needs for other TG use cases such as:

     – Winter Storms;

     – Capacity Shortfall;

     – Planned Outages (T&D); and

     – Catastrophic Events (earthquakes, etc.).

   - Develop internal represented classification that can perform the TG interconnection process that we are currently contracting.

B) Temporary Substation Microgrids

1. ***Risk to be mitigated/problem to be addressed:***

   PG&E transmission lines that run through HFTD areas may be de-energized if weather and operational conditions warrant a PSPS event. It is possible that a distribution substation and its customers could be de-energized even if they physically reside outside of the PSPS event footprint because the transmission line serving the substation is de-energized.

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:***

Temporary substation microgrids are focused on keeping customers online when the substation serving them is impacted by an upstream transmission line de-energization and the substation still has safe-to-energize load. During 2020 PSPS events, PG&E was able to energize all substations impacted by a transmission-level outage that still had some safe-to-energize load.

TABLE PG&E-7.3.3-1: 2020 TEMPORARY SUBSTATION MICROGRIDS ENERGIZED

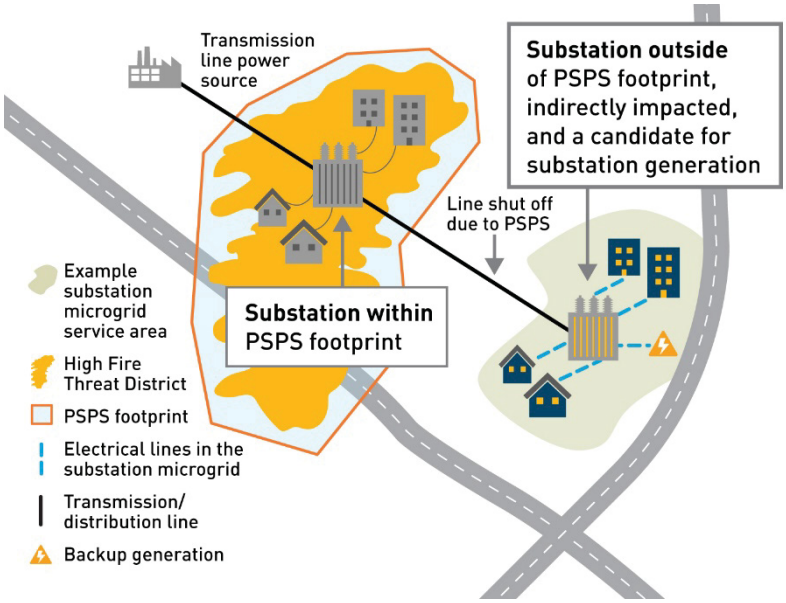
PSPS Event	Substation	Megawatts (MW)	Safe-to-Energize Customer Accounts Served
7-Sep	Brunswick	20	4,191
25-Oct	Hoopa	6	1,791
25-Oct	Willow Creek	12	2,332
25-Oct	Brunswick	20	4,259
25-Oct	Russ Ranch	0.5	2

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"):***

To determine the appropriate locations for substation temporary microgrids for 2021 PSPS mitigation, PG&E assesses the relative frequency of historical PSPS impacts through analysis of historical meteorological data, actual 2020 PSPS event impacts, and parallel work-in-progress directed at reducing future impacts. The foundational data for selecting temporary substation microgrid sites for 2021 is an analysis of 10 years of historical weather events. This "historical lookback" takes historical weather events and builds the associated PSPS events that would have occurred, including both T&D impacts.

This analysis identifies 28 weather events with 18 potential PSPS events involving transmission-level impacts. Through the historical look-back of these 18 transmission-level events, PG&E identifies substations that are most frequently experience de-energization due to a transmission or distribution PSPS outage. The circuits served by those substations that frequently experience PSPS de-energization in the look-back are screened for the presence of safe-to-energize distribution load. In addition, substations and their circuits are reviewed to determine whether other 2021 PSPS mitigations might remove them from scope (e.g., a switching solution, VM, etc.) or whether an existing solution is already in place (e.g., use of the existing Humboldt Bay Generating Station to create a multi-substation island).

FIGURE PG&E-7.3.3-1: EXAMPLE TEMPORARY SUBSTATION MICROGRID CONFIGURATION



4. Progress on initiative (amount spent, regions covered) and plans for next year:

2020

For 2020, PG&E reserved 350 megawatts (MW) (nameplate capacity) of TG for use across 62 substations in 19 counties. As the 10-year lookback analysis was not yet available, 2020 temp gen substation site selection was based on in-scope substations with safe-to-energize load during 2019 PSPS events.

i. The following substation site selection was used:

1. During 2019 PSPS events, 124 substations were de-energized due to transmission impacts but could carry some or all distribution load;
2. Less 51 substations that had fewer than 2 PSPS impacts caused by upstream transmission outages in 2019;
3. 73 substations had 2 or more transmission impacts with safe-to-energize distribution load;
4. Less 16 substations to be served by Humboldt Bay Generating Station;
5. 57 candidate substations for temp gen 2020; and
6. Additional substations added and removed based on analysis from Subject Matter Experts (SME) in Electric Operations.

PG&E prepared substations to receive TG in 3 different ways. This approach ensured PG&E could cover all 62 substations with 350 MW of TG (less than

the total peak load of all the substations). The strategy accounted for several substation characteristics including, historical frequency of impact, available land, proximity to other substations, and travel time. Table PG&E-7.3.3-2 below describes these distinct preparation strategies and the number of substations allocated to each strategy.

TABLE PG&E-7.3.3-2: TEMPORARY SUBSTATION DEPLOYMENT STRATEGIES AND NUMBER OF SUBSTATIONS IMPACTED

Deployment Strategy	Description of Strategy	Number of Substations and MWs of Generation Allocated
"Ready-to-Energize"	Substations that have generation interconnected, tested, and released in advance of a PSPS event.	18 Substations – 225 MW
"Staged at Substation"	Substations that have generation placed at the substation in advance of a PSPS event.	3 Substations – 50 MW
"Hub-and-Spoke"	Substations that have an engineering guide to interconnect generation during a PSPS event. Generators are staged at yards regionally and dispatched to subs as needed.	39 Substations – 75 MW

2021 Planning

While PG&E has not yet completed the substation selection process described above, PG&E is currently planning to prepare at least eight substations to receive TG for 2021 PSPS mitigation. In addition, PG&E plans to pursue at least one clean substation pilot leveraging diesel-alternative technologies. PG&E issued a solicitation for diesel-alternative front-of-the-meter generation in January 2020 and is also exploring potential behind-the-meter and demand response opportunities at substations identified as needing a 2021 PSPS mitigation.

It is likely that a far higher percentage of substations (but not necessarily MWs) will be supported via a "Ready to Energize" (i.e., interconnected and tested) deployment strategy in 2021 than in 2020. This is due to learnings from 2020 PSPS events which indicated that the time between completion of "Playbook D" (identifies substations that will be de-energized) and de-energization can be constrained to less than 48 hours. PG&E's process to select locations and procure temporary generation for 2021 PSPS mitigation is still underway. This forecast and the associated language reflect PG&E's best-available data at the time of this filing. A more complete list of substation candidates for TG in 2021, the total MWs needed to support these substations, and a financial forecast will be submitted in the first quarter of 2021 as part of a Tier 2 Advice Letter required by the CPUC's Track 2 Decision in the Microgrid OIR.[72]

72 D.21-01-018, App. A, pp. A-1 to A-3.

5. Future improvements to initiative:

As described above, the following improvements are being made to substation site selection and deployment strategy:

- Use of 10-year historical lookback and 2020 PSPS event actuals to inform substation selection;
- Transitioning towards greater reliance upon generation that is pre-interconnected at a substation to reduce in-event execution risk; and
- Development of at least one clean substation pilot.

C) Temporary Distribution Microgrids

1. Risk to be mitigated/problem to be addressed:

Temporary distribution microgrids aim to support communities by energizing "main street corridors" with shared services and critical facilities when the distribution line serving these areas are de-energized as a result of a PSPS event.

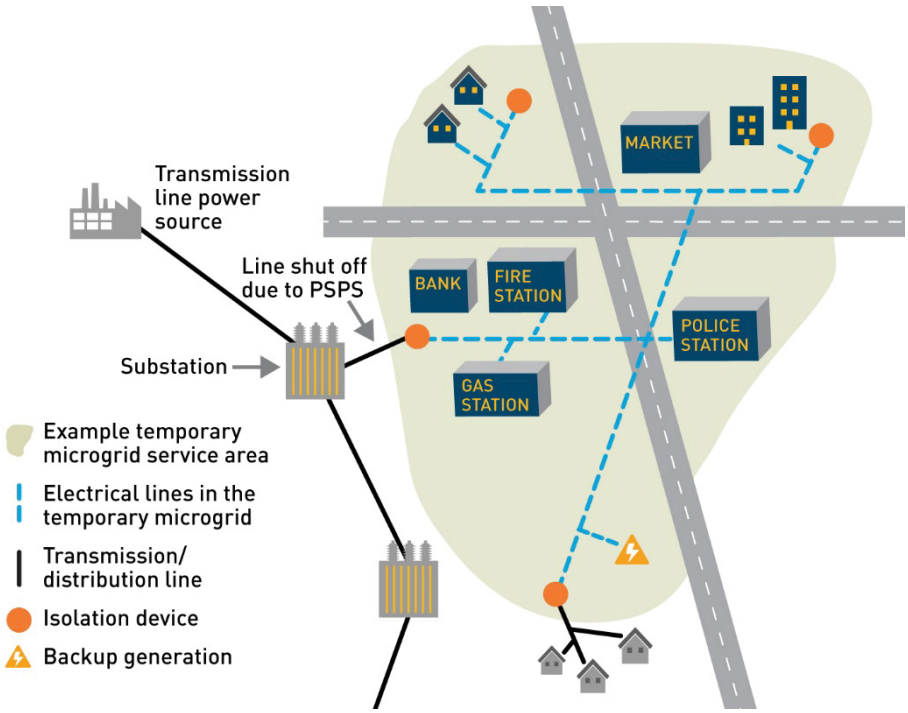
2. Initiative selection ("why" engage in activity) – include reference to a risk informed analysis on empirical (or projected) impact of initiative in comparison to alternatives:

PG&E's temporary distribution microgrids are designed to reduce the number of customers impacted by PSPS events and support community resilience by powering a cluster of shared resources (e.g., commercial corridors and critical facilities within the energized zones) so that those resources can continue serving surrounding residents during PSPS events. Though each distribution microgrid varies in scale and scope, the following design features are likely for each:

- Devices used to disconnect the distribution microgrid from the larger electrical grid;
- A pre-determined space for backup generation and equipment to allow for rapid connections (e.g., pre-installed interconnection hub (PIH)); and
- The use of temporary generators allowing PG&E to shorten the design and construction time typically required to ready a permanent microgrid for operation.

The diagram below represents an approximate layout of a temporary microgrid. With safety being the most critical design factor, each temporary microgrid is unique and is designed based on a number of different variables that dictate the size of the microgrid, what community services are served and what elements are included in the design. The layout and dimensions below are approximate and for illustrative purposes only.

FIGURE PG&E-7.3.3-2: EXAMPLE TEMPORARY DISTRIBUTION MICROGRID



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"):***

   To determine the appropriate locations for distribution microgrids, PG&E identifies distribution circuits most likely to be impacted by PSPS events in the future. PG&E reviews these circuits to identify communities with clusters of shared services (i.e., those involving food, fuel, healthcare, and shelter) and critical facilities served by electrical infrastructure that would likely be safe to energize during PSPS events. To determine whether distribution microgrids present viable, effective near-term mitigation measures for a particular location, PG&E also reviews them for implementation feasibility (i.e., land availability and construction complexity) and the potential to be served by alternative grid solutions.

4. ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In 2020, PG&E operated four distribution microgrids with PIHs; thereby, energizing over 2,000 unique service points (customers) for as many as four PSPS events per service point (approximately 5,600 customer-events). PG&E committed 40 MW of TG to temporary distribution microgrids in 2020. The distribution microgrids are identified in Table PG&E-7.3.3-3 below.

TABLE PG&E-7.3.3-3: DISTRIBUTION MICROGRIDS THAT OPERATED IN 2020

Site	County	Year PIH Constructed	Approx. qty service pts	Number of 2020 PSPS Events Supported
Angwin PIH	Napa	2019 Pilot	48	4
Shingletown PIH	Shasta	2020	79	4
Calistoga PIH	Napa	2020	1554	3
Placerville	El Dorado	In progress for 2021	487	1

In addition, in late October 2020, PG&E readied two additional distribution microgrids in Lake County using a temporary configuration without a PIH. These distribution microgrids in North and South Clearlake were on standby to support customers if needed during the October 25, 2020 PSPS event and subsequent PSPS events.

For 2021, PG&E is planning to develop at least five additional distribution microgrid PIHs by the end of the calendar year. PG&E will continue to follow the methodology described in above to locate these sites, which considers likelihood of PSPS impacts, presence of shared services in corridors that can likely be safely energized during PSPS events, and implementation feasibility. As in prior years, PG&E will collaborate with county and local government to ensure local priorities help shape site selection and design where technically feasible.

5. Future improvements to initiative:

In 2021, PG&E intends to expand the pool of contractors and technologies for the development of microgrids, pilot viable non-diesel technologies, and explore opportunities to build a portfolio of non-fossil solutions for the longer term. This improvement is meant to further California's clean energy goals, rather than an activity tied to wildfire risk mitigation or PSPS resilience.

Additionally, the temporary distribution microgrid initiative will benefit from operational and administrative improvements derived from the Generation Enablement and Development organization being stood up in 2021 (see Section 7.3.3.11.1 subsection A for more information).

D) Back-Up Power for Individual Critical Customer Facilities

1. Risk to be mitigated/problem to be addressed:

The loss of power at certain critical customer facilities during a PSPS event could pose significant public health and safety risks, especially for prolonged outages (48 + hour).

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:

As a general policy, PG&E does not offer backup generation to individual facilities. However, PG&E's policy allows for granting exceptions for critical facilities when a prolonged outage could have a significant adverse impact to public health or safety.

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"):***

   PG&E supports individual critical customer facilities through two distinct processes: (1) pre-planned sites; and (2) ad hoc support during an event. For the 2020 wildfire season, PG&E supported intensive care unit hospitals identified in partnership with the California Hospital Association and the Hospital Council of Northern and Central California that were at higher risk of experiencing one or more PSPS-related outages during the 2020 season. PG&E also supported pre-determined vote tabulation centers from October to December for the 2020 national election.

   In-event ad-hoc backup power support occurs during a PSPS event. Customers submit a request for mobile backup generation through their PG&E contact or account manager to our EOC. The request is reviewed, and a determination is made as to whether a prolonged outage for the requesting customer would either directly or indirectly affect public health or safety. If the request is approved, mobile TG is deployed to the requesting customer. There is no pre-determined prioritization of these customers, and the location of these customers is dependent on the scope and location of the ongoing weather event. While there is no pre-determined prioritization, there are pre-determined "societal Impact" locations (sites where power loss may impact public health and safety) for which designated customer representatives execute in-event additional outreach to ensure they have a backup power strategy in place. If these locations do not have a backup power strategy in place, a request for backup power deployment is routed to the EOC.

4. ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In 2021, PG&E plans to continue to support critical customers with backup power support in exceptional circumstances, utilizing our policy to determine eligibility and prioritization. During the first half of 2021, PG&E will continue our direct engagement with critical customers and in coordination with counties to provide consultative support for readiness and resiliency for all hazard, emergencies, and the 2021 fire season.

5. ***Future Improvement to Initiative:***

   Improvements to the program will include streamlining the outreach process prior to and during a PSPS event by PG&E customer team, utilizing more hub locations for quicker deployments to the edges of the service territory, and explore clean generation solutions where applicable.

E) Customer Resource Centers

1. ***Risk to be mitigated/problem to be addressed:***

   To minimize public safety impacts during a PSPS event, PG&E opens CRCs focused on providing essential services to customers affected by PSPS events. The risk to be mitigated is ensuring all CRCs in potential PSPS areas are fully equipped with backup power throughout the PSPS season.

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:***

   PG&E mobilizes CRCs in counties and tribal communities potentially impacted by PSPS events to provide customers a safe location to meet their basic power needs, such as charging medical equipment and electronic devices.

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"):***

   PG&E closely coordinates with counties, local governments, and tribes to determine appropriate locations for CRCs. Additional details regarding CRC region prioritization can be found in Section 8.2.1.

4. ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   PG&E pre-staged 77 generators to support indoor CRC sites and ultimately activated 62 indoor CRC sites with TG during PSPS events in 2020. More information regarding progress on the CRC program can be found in Section 8.2.1.

5. ***Future Improvement to Initiative:***

   In 2021, PG&E will continue evaluating additions or changes to our indoor CRC portfolio while taking into consideration factors such as potential PSPS scope, communities impacted by 2020 PSPS events and input from counties and tribes. PG&E will continue to review the program for improvements and efficiencies by reviewing elements such as resources provided, the customer journey and CRC staffing.

F) Responses to Action Items

ACTION PGE-49 (Class B)

Provide additional information about its specific backup generation sites, including

a) the number of times used; and

b) challenges faced with the completion of this project and its operation.

Response:

a) The number of times backup generation sites were used during PSPS events:

During 2020 PSPS events, PG&E utilized a total of eight microgrid sites: four temporary substation microgrid locations and four temporary distribution microgrid locations. In addition, PG&E provided backup power support to 31 critical single—customer facilities, including hospitals, water and wastewater plants, and emergency response personnel such as fire and police stations.

Table PG&E-7.3.3-4 below indicates the number of times these sites were energized during the 2020 PSPS events. Some microgrids and single-customer facilities were energized during multiple events, for a total of 53 backup generation site uses across all PSPS events:

TABLE PG&E-7.3.3-4: NUMBER OF TIMES SITES WERE ENERGIZED DURING 2020 PSPS EVENTS

PSPS Event	Temporary Substation MG	Temporary Distribution MG	Individual Critical Customer Backup Power Support	Total
7-Sep	1	2	11	14
26-Sep		1	3	4
14-Oct		4	2	6
25-Oct	4	4	20	28
2-Dec			1	1
Total	5	11	37	53

For additional information regarding microgrids please see Sections 7.3.3.11.1 subsection B (Temporary Substation Microgrids) and 7.3.3.11.1 subsection C (Temporary Distribution Microgrids).

For additional information regarding backup power support to single -customer facilities that were supported with backup power per event please see Section 7.3.3.11.1 subsection D (Back-up power for individual critical customer facilities).

b) Challenges faced with the completion of this project and its operation:

Challenges with Project Completion:

As described in PG&E's First Quarterly Report, there are two broad categories of limitations to microgrid deployment for PSPS mitigation:

1. Limitations related to the safety of energizing microgrids with overhead lines in the context of high wind conditions that trigger a PSPS de-energization (i.e. overhead lines that run through the "wind polygon"); and

2. Limitations related to space constraints for siting generation for microgrids with high peak MW and megawatt -hour requirements over a 24+ hour period.

While the above limitations presented challenges, PG&E largely fulfilled our objective of providing temporary substation microgrids, temporary distribution microgrids, and critical single -facility sites during PSPS events through the use of TG. Energization challenges were managed through the development of site -specific energization playbooks and an in-event scoping process that ensured that only substations with safe-to-energize load outside of the wind polygon were energized. Safe-to-energize limitations for temporary distribution microgrids were managed by limiting energization only to underground lines or short segments of sufficiently hardened overhead lines reviewed by fire safety specialists.

Space constraints were overcome through the utilization of energy-dense, mobile temporary generators and in some instances, collaboration with local governments and landholders to secure temporary easements in advance of 2020 PSPS events which allowed PG&E to place generation outside of our substation fence. In some instances, available land was insufficient, leading to constraints in the number of temporary generators that could be used to serve potential safe -to -energize load from any particular substation. In the case of the Brunswick substation, which was energized during two PSPS events, space constraints meant that only 20 MW of nameplate generating capacity would fit within the substation footprint. The substation has a peak load of 60 MW. Safe -to -energize limitations for temporary substation microgrids led to very few substations being suitable for energization during 2020 PSPS events.

Challenges with Project Operation:

PG&E managed two major challenges in the operation of these sites:

1. PSPS event wind polygons, and thus the PSPS impact scope, can continue to change throughout the event scoping process. Thus, identification of temporary microgrids with safe-to-energize load that will be de-energized can be identified less than 48 hours before de-energization when the final Transmission-level “playbook” is produced, therefore limiting time available to deploy TG to these sites. To manage this operational challenge, PG&E prepared 18 temporary substation microgrids and all temporary distribution microgrids as “ready-to-energize”, with generation interconnected, tested, and released in advance of a PSPS event. In 2021, it is likely that a far higher percentage of substations will be supported via this strategy to further limit in -event operational constraints; and

2. Given the dynamics of event scoping, sophisticated and ongoing real-time coordination was required between PG&E’s EOC, Electric Distribution Emergency Center, field engineers overseeing TG deployment, and TG contractors delivering and connecting generators. To manage this

operational challenge, PG&E created a specialized EOC "Temporary Generation" Branch within the Operations Section. The TG Branch centralized planning, logistics, and operations functions to ensure as many customers would be supported with TG as safely possible during each event. The TG Branch was staffed with four teams of six individuals each. All individuals who served in the TG Branch underwent significant online training and engaged in at least one of PG&E's PSPS exercises in advance of wildfire season. In 2021, PG&E is seeking to increase staffing for our TG organization to provide a more permanent solution to this resource issue.

ACTION PGE-50 (Class B)

In its 2021 WMP Update, PG&E shall: (1) provide the cost/benefit analysis completed for microgrids as a mitigation, and (2) define what is meant by a "bridge" solution and "other solutions," and (3) include a timeline for how long an interim "bridge" solution would be in place.

Response:

This portion of PG&E's First Quarterly Report was referencing temporary substation and distribution microgrids. In this response, PG&E refers to "temporary microgrids" to include both kinds of microgrids (i.e., substation and distribution).

1) Provide the cost/benefit analysis completed for microgrids as a mitigation:

Decisions regarding the development of temporary microgrids for PSPS mitigation are driven by a location's expected relative impact frequency and near-term implementation feasibility rather than a cost/benefit analysis. This is in line with a temporary microgrid's intent to be used to serve safe-to-energize areas where no alternate grid solutions can be feasibly implemented in the near--term (i.e., within the next fire season) to mitigate PSPS impacts.

As described in Section 7.3.3.11.1, temporary microgrids are considered as potential PSPS mitigations for locations with a high expected relative frequency of future PSPS impacts. If the analysis of historical meteorological data and prior PSPS events indicates that a location can be expected to experience future PSPS impacts, and no alternate solution can be implemented within the next fire season to mitigate those impacts, that location can be studied for technical feasibility of implementing a temporary microgrid to support customers in the near-term.

For the PSPS mitigation use case, PG&E does not use a quantitative cost/benefit analysis to supplement the methodology described above. Quantifying the exact benefits of a temporary microgrid is difficult because the CPUC has not adopted a standard "value of resilience" or other methodology to quantify the benefit of keeping customers energized when they would otherwise be impacted by PSPS events. To maximize benefits

derived from these mitigation measures, in addition to considering expected relative impact frequency, PG&E generally seeks to site temporary substation microgrids in locations that maximize the number of customers that can be safely energized, and temporary distribution microgrids in commercial corridors with critical and shared services that can serve surrounding residents (i.e., to energize “Main Street”).

2) Define what is meant by a “bridge” solution and “other solutions”:

In the case of temporary microgrids for PSPS mitigation, PG&E used the term “bridge” solution to refer to the near--term implementation feasibility of temporary microgrids at certain locations where other grid solutions might not be viable prior to the next fire season. Temporary microgrids do not present a “bridge” solution for every location—in some locations, they may not be able to be implemented more quickly than an alternate grid solution under consideration.

PG&E used the term “other solutions” to refer to grid solutions that can reduce PSPS scope, and thereby reduce or potentially eliminate the need for a temporary microgrid for PSPS mitigation. “Other solutions” can include undergrounding overhead lines, as well as measures that improve the health score of a transmission line, allow for more granular meteorological event scoping, and enable distribution and transmission sectionalizing.

3) Include a timeline for how long an interim “bridge” solution would be in place:

As PG&E continues to develop and refine our risk modeling (see Section 4.5.1), these developments will drive changes to PSPS scope (see Section 8), and therefore, mitigation solutions designed to address PSPS impacts. Timelines for how long temporary microgrids will be in place as “bridge” solutions will be driven by improvements to PSPS risk modeling and de-scoping criteria, and will vary by location and the demonstrated effectiveness of “other solutions” to mitigate PSPS impacts in those locations.

At certain locations, some of the “other solutions” listed above might be implemented as soon as the year after a temporary microgrid is made operationally ready. At such locations, PG&E would consider adapting site preparation at the start of PSPS season to reflect the availability of an alternate solution. For example, some of the temporary substation microgrids that were made “Ready-to-Energize” in 2020 based on 2019 event actuals might not have generation interconnected and tested on-site in 2021 based on the reduced expected impacts due to improvements to event scoping and transmission health scores. This, however, may not eliminate the potential need for a temporary microgrid solution at these sites altogether. For these sites, PG&E would retain the engineering guide to interconnect generation if needed, even if generators are not staged on-site given the relatively low probability of impacts.

At some locations, “other solutions” may not be available to reduce the need

for temporary microgrids for multiple years. This is particularly true for temporary microgrid sites near undergrounding projects. Upon completion, undergrounding projects may reduce the need for nearby temporary microgrids to mitigate PSPS impacts. However, due to the time-consuming nature of undergrounding work (see Section 7.3.3.16), PG&E expects to continue to rely on temporary microgrids for PSPS mitigation in these locations for multiple years.

The recent Track 2 Decision in the Commission's Microgrid OIR provides additional upcoming opportunities to evaluate alternative solutions for mitigating PSPS impacts. First, the decision directs PG&E to submit an Advice Letter describing the substations at which PG&E proposes to use TG microgrids to mitigate PSPS outages in 2021.[73] That Advice Letter, which PG&E expects to file in the first quarter of 2021, will describe the process by which PG&E evaluated candidate substations, including our evaluations of near--term solutions other than temporary substation microgrids (and noting where those alternative solutions obviated the need to pre--stage TG at certain substations). Second, the decision requires PG&E to file an application by June 30, 2021 proposing a long-term framework for evaluating the need for generation at substations to mitigate PSPS outages.[74] In that application, PG&E expects to present an analytical methodology to consider the longer-term alternatives for mitigating PSPS outages, including further consideration of whether it is reasonable to continue using temporary or longer-term microgrids as a bridge until other solutions can be put in place.

73 D.21-01-018, App. A, pp. A-1 to A-3.

74 *Id.*, App. A, pp. A-6 to A-8.

7.3.3.11.2 Substation activities to enable reduction of PSPS impacts

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The risk to be mitigated are the potential impacts of PSPS events on communities and customers. Risk mitigation efforts include:

Substations Requiring Protection Upgrades

Substation activities that enable the reduction of PSPS impacts include the installation or upgrade of protection equipment and automatic sectionalizing devices at various substations to improve operating flexibility thereby minimizing the frequency, scope, and duration of PSPS events.

Substation Microgrid Locations

Another activity is substation equipment and protection upgrade to accommodate "Microgrids for PSPS Mitigation" initiative that enables the connection of a generation source or tie line to the substation to serve in an island-configuration during a PSPS event. Additional information about the substation and distribution microgrids initiative can be found in Section 7.3.3.11.1 subsection B and 7.3.3.11.1 subsection C above.

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:

Both these risk mitigation efforts support PSPS events. PSPS events can potentially impact many customers given the configuration of PG&E's electrical system. As a result, a power shut-off may occur in areas that are not directly in the weather zone, but is served by facilities that are impacted by the extreme wind/weather conditions. The substation activities will allow for minimizing the scope of PSPS events, enable faster restoration for those impacted and, in some cases, an alternative power source (generation) during PSPS events.

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"):

Substations Requiring Protection Upgrades

Relays for substation equipment operate within overlapping layers of protection zones that are set in such a way that the timing allows the relay to operate in a structured sequence. For example, when a line is taken out of service, PG&E is required to maintain coordination within the remaining energized zone. If the substation equipment (i.e., fuse) within

the remaining energized zone does not have the ability to coordinate with the upstream relays, then either the decision is made to de-energize the equipment, remain with the coordinating deficiency, or, if the equipment cannot be adequately protected, then remove it from service.

Substation Microgrid Interconnection

The feedback to determine microgrid locations include but are not limited to transfer capability, infringement to future site plans, adherence to design standards and maintenance considerations. For more details please see Section 7.3.3.11.1 subsection B.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

Substations Requiring Protection Upgrades

Based on system protection reviews, PG&E has identified one substation for protection or SCADA installation, or upgrade noted within Table PG&E-7.3.3-5 below. The specific dates for this work to be operative are preliminary and may change depending on the availability of resources and other prioritized work.

TABLE PG&E-7.3.3-5: SUBSTATION ELIGIBLE FOR UPGRADE, PROTECTION OR SCADA INSTALLATION

Line No.	Substation Name	Operative Year
1	Rincon	2021

Substation Microgrid Interconnection

Information regarding substation microgrid efforts can be found in Section 7.3.3.11.1.

5) ***Future improvements to initiative:***

Substation activities are driven by the PSPS and microgrid strategy in Section 7.3.3.11.1. This work is necessary to ensure safe and reliable operations and protection of the electric grid.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Section 7.3.3.11.1 for more information on future improvements for this initiative.

7.3.3.11.3 Emergency Back-up Generation – PG&E Service Centers & Materials Distribution Centers

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

While several PG&E facilities have an existing emergency backup system onsite, very few are configured to back up the entire campus. In most cases, the emergency system will supply backup power to existing critical communications, emergency lighting and possibly a storm room or EOC. While this level of backup may have been enough for shorter duration emergency response events, such as a mild winter storm, it can be inadequate for the longer duration PSPS events, which can last several days.

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:

Because the existing emergency generation systems only backup a select number of circuits within the campus, critical systems such as fuel islands, gate operators, exterior lighting, and operations buildings may not be backed up. This can result in operational inefficiencies during PSPS events. Additionally, because some facilities have limited or no existing emergency generation, personnel who would typically work out of these locations have had to work either remotely or at alternate locations in order to support restoration events.

In order to address this issue, PG&E's Corporate Real Estate Strategy and Services (CRESS) department has initiated a three-year (2020-2022) capital project in order to harden a number of service center locations throughout our service territory against the possibility of extended utility power loss events.

As part of this project, 52 locations will be equipped with an emergency generation system capable of backing up the campus in its entirety. In order to achieve this, it is expected that existing emergency generators, automatic transfer switches, and in most cases, main switchboards, will need to either be replaced or reconfigured in order to achieve emergency generation back up the for the entire site.

In addition to the locations mentioned above, another 43 locations will be equipped with generator tap boxes and transfer switches but will not be equipped with permanent generators. This will also allow for the entire campus to be backed up through emergency generation, with the difference being that these locations will be prepared to accept a portable generator instead of being equipped with a permanent generator.

When completed, the electrical reconfiguration and additional equipment installed at these locations will allow these sites to operate with the same amount of functionality as they would if they were being fed from their normal source (utility power). This will ensure that restoration efforts being performed by operational personnel working out of the site can carry on unimpeded.

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"):***

This three-year project was split into three phases, with one phase being targeted for execution each year (e.g., Phase One (2020), Phase Two (2021), Phase Three (2022)). Each site was evaluated and ranked based on the population of employees working out of the facility and its adjacency to HFTD areas. Sites with higher populations of employees and that are located close to or within an HFTD area were ranked higher and included in Phase One. Sites with lower populations or not adjacent to an HFTD area were ranked lower and included in Phase Three of the project.

Phase One (2020): Phase One of the project will concentrate on the 23 highest priority sites as determined by the facility's location regarding HFTD areas and the workforce population operating out of the facility. As these sites are closest in proximity to the HFTDs they are most likely to be impacted by PSPS event. Prioritizing these sites within the multi-year project thereby presents the greatest benefit to customers since it's most likely that PSPS restoration efforts will be managed out of these locations. By ensuring that these sites are fully operational during an extended power loss events we maximize our operational efficiency during restoration efforts, thereby minimizing outage times for impacted customers.

Phase Two (2021): 2021 will focus on the next highest priorities, again determined by adjacency to HFTD areas and the headcount assigned to the facility. We estimate that approximately 30 sites will be addressed in this phase.

Phase Three (2022): 2022 will focus on the lowest priority sites. These are sites where the likelihood of experiencing a PSPS event is low or the long-term strategy for the facility is currently being evaluated.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

By the end of 2021, at least 23 PG&E Service Centers & Materials Distribution Centers will be equipped to receive permanent or temporary generation. By the end of 2022, the 72 remaining PG&E Service Centers & Materials Distribution Centers will be equipped to receive permanent or temporary generation.

5) Future improvements to initiative:

There are currently no additional plans on this initiative beyond what is described above.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

As stated in the section above, there are no further improvements planned at this time other than the work described above through 2022.

7.3.3.12 Other Corrective Action

WSD Initiative Definition: *Other maintenance, repair, or replacement of utility equipment and structures so that they function properly and safely, including remediation activities (such as insulator washing) of other electric equipment deficiencies that may increase ignition probability due to potential equipment failure or other drivers.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.3.12.1: Distribution substations;
- 7.3.3.12.2: Transmission substations;
- 7.3.3.12.3: Maintenance, Transmission; and
- 7.3.3.12.4: Maintenance, Distribution.

7.3.3.12.1 Distribution Substation

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The primary wildfire risk with substations is an arc flash event within the substation that propagates into adjacent wildlands. PG&E has taken two specific actions to address this risk. First, we have initiated a defensible space program for substations located in Tier 2 and Tier 3 HFTD areas. Second, we have improved our animal abatement program.

In addition to these specific actions, we also perform corrective repairs and equipment replacements identified through the enhanced inspections of substations. This work is intended to correct deficiencies identified and ensure that substation equipment operates as designed.

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:

Defensible Space: Defensible space for substations is a 100' perimeter around substation equipment that includes both a 30' clean zone and a 70' reduced fuel zone. Defensible space is normally achieved by removing combustible material (primarily vegetation) from these areas. Defensible space is intended to reduce the risk of an event within a substation, igniting a fire, that propagates outside of the facility. By implementing these requirements, the risk of fire spreading is significantly reduced and provides a higher probability that a fire can be extinguished without involving third party property.

Substation Animal Abatement: PG&E has been conducting an animal abatement program for our substations, with reliability (i.e., lower customer outage) as the main driver. The program was expanded to address wildfire risks by reducing the probability of an arc flash within the substation. Animal contacts may result in a catastrophic failure of equipment that can project ignited materials into HFTD areas.

Repairs and Replacements from Enhanced Inspections: PG&E conducts enhanced inspections in substations located in HFTD areas. These inspections identify deficiencies with substation equipment and components. The repair and replacement work are performed to reduce the risk of an equipment failure or miss operation.

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"):***

Defensible Space: The program requires defensible space to be established and maintained on substations located in Tier 2 and Tier 3 HFTD areas, where possible. At some locations, it is not possible to attain defensible space due to adjacent structures, third-party property owners, or permitting issues.

Substation Animal Abatement: Animal abatement was identified during the 2019 Wildfire Safety Inspection Program (WSIP) as a mitigation to minimize fire ignition, specifically in Tier 2 and Tier 3 HFTD areas. All substations located in these areas that have achieved defensible space will have animal abatement installed. Substations located in these areas that are not able to achieve defensible space will have additional animal abatement installed to further reduce the likelihood of an animal contact

Repairs and Replacements from Enhanced Inspections: Enhanced inspections are performed at substations located in HFTD areas. As a result of these inspections, corrective work is identified at substations located in HFTD areas. The identified repair and replacement work are prioritized based on risk and completed based on the prioritized schedule.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

Defensible Space: As of December 31, 2020, 96 percent of substations (168 of 175) located in Tier 2 and Tier 3 HFTD areas have attained defensible space. At some locations, it is not possible to attain defensible space due to adjacent structures, third party property owners, or permitting issues.

Substation Animal Abatement: 77 locations have been identified as requiring animal abatement. Of these 77 locations, 18 were completed in 2019, 21 were completed in 2020, and the remaining 38 are being prioritized for completion.

Repairs and Replacements from Enhanced Inspections: PG&E has a total of 126 distribution substations located in HFTD areas. Each of these locations is inspected through the enhanced inspection program. All repair and replacement work identified by the inspections is reviewed, prioritized, and scheduled for completion. In 2020, 47 of these substations were inspected by the enhanced inspection program and in 2021, 57 of these substations are planned to be inspected. The repair and replacement work generated from these inspections will be reviewed, prioritized, and scheduled for completion.

5) Future improvements to initiative:

At this time, no future improvements have been identified; the programs will continue to execute at the substations that have been identified.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

For the long-term, we will continue with periodic evaluations of the defensible space, animal abatement and the repairs and replacement programs. These evaluations typically include performance trends, inspection results, emerging technology, and other risk factors. Updates will be made to the programs based on these evaluations.

7.3.3.12.2 Transmission Substation

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The primary wildfire risk with substations is an arc flash event within the substation that propagates into adjacent wildlands. PG&E has taken two specific actions to address this scenario. First, we have initiated a defensible space program for substations located in Tier 2 and Tier 3 HFTD areas. Second, we have improved our animal abatement program.

In addition to these specific actions, we also perform corrective repairs and equipment replacements identified through the enhanced inspections of substations. This work is intended to correct deficiencies identified and ensure that substation equipment operates as designed.

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:

Defensible Space: Defensible space for substations is a 100' perimeter around substation equipment that includes both a 30' clean zone and a 70' reduced fuel zone. Defensible space is normally achieved by removing combustible material (primarily vegetation) from these areas. Defensible space is intended to reduce the risk of an event within a substation, igniting a fire, that propagates outside of the facility. By implementing these requirements, the risk of fire spreading is significantly reduced and provides a higher probability that a fire can be extinguished without involving third-party property.

Substation Animal Abatement: PG&E has been conducting an animal abatement program for our substations, with reliability (i.e., lower customer outage) as the main driver. The program was expanded to address wildfire risks by reducing the probability of an arc flash within the substation. Animal contacts may result in a catastrophic failure of equipment that can project ignited materials into HFTD areas.

Repairs and Replacements from Enhanced Inspections: PG&E conducts enhanced inspections in substations located in HFTD areas. These inspections identify deficiencies with substation equipment and components. The repair and replacement work are performed to reduce the risk of an equipment failure or miss operation.

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"):***

Defensible Space: The program requires defensible space to be established and maintained on substations located in Tier 2 and Tier 3 HFTD areas, where possible. At some locations, it is not possible to attain defensible space due to adjacent structures, third-party property owners, or permitting issues.

Substation Animal Abatement: Animal abatement was identified during the 2019 WSIP as a mitigation to minimize fire ignition, specifically in Tier 2 and Tier 3 HFTD areas. All substations located in these areas that have achieved defensible space will have animal abatement installed. Substations located in these areas that are not able to achieve defensible space will have additional animal abatement installed to further reduce the likelihood of an animal contact.

Repairs and Replacements from Enhanced Inspections: Enhanced inspections are performed at substations located in HFTD areas. As a result of these inspections, corrective work is identified at substations located in HFTD areas. The identified repair and replacement work are prioritized based on risk and completed based on the prioritized schedule.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

Defensible Space: As of December 31, 2020, 100 percent of substations (40 of 40) located in these areas have attained defensible space. In 2020, PG&E spent $1.7 million and in 2021, we are planning to spend $2.5 million on defensible space for transmission substations.

Substation Animal Abatement: nine locations were identified as requiring animal abatement, two were completed in 2019, two are were completed in 2020, and the remaining five are being prioritized for completion. In 2020, PG&E spent $1.0 million and in 2021, we are planning to spend $3.1 million on animal abatement in transmission substations.

Repairs and Replacements from Enhanced Inspections: PG&E has a total of 60 transmission substations located in HFTD areas. Each of these locations is inspected through the enhanced inspection program. All repair and replacement work identified by the inspections is reviewed, prioritized, and scheduled for completion. In 2020, 29 of these substations were inspected by the enhanced inspection program and in 2021, 22 of these substations are planned to be inspected. The repair and replacement work generated from these inspections will be reviewed, prioritized, and scheduled for completion.

5) Future improvements to initiative:

At this time, no future improvements have been identified; the program will continue to execute at the substations that have been identified.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

For the long-term, we will continue with periodic evaluations of both the defensible space and animal abatement programs. These evaluations typically include performance trends, emerging technology, and other risk factors. Updates will be made to the programs based on these evaluations.

7.3.3.12.3 Maintenance, Transmission

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

Since 2019, PG&E has conducted enhanced transmission inspections (performed with enhanced inspection protocols). Detailed inspections are performed with two vantage points (e.g., by ground and by aerial) to fully capture all asset conditions. These inspections have resulted in a significant increase in the volume of corrective action notifications for maintenance. These maintenance notifications are key to trending, prioritizing, and reducing asset risk by correcting identified asset hazards, poor conditions, and non-standard concerns.

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:

The maintenance (repair or replacement) work done as a result of enhanced inspections is an important step in mitigating risk. Although there are general priority timelines given to maintenance notifications when identified, prioritization and additional field safety assessments may be done in order to reduce the wildfire risk and manage the work of the maintenance notifications resulting from enhanced inspections. Furthermore, analysis of inspection and maintenance data provides opportunities for trending and refinement of risk prioritization.

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"):

PG&E is prioritizing maintenance on the highest risk notifications and using additional Field Safety Reassessments (FSR) to mitigate the risk and manage this large volume of work.

The process for prioritization of these notifications uses the following definitions:

- Ignition-related notification: Notifications related to components included in the 2019 Failure Modes Effects Analysis (FMEA). Ignition risks can be either time-dependent or time-independent, e.g., a bird's nest or steel crossarm that is "no good/out of standard.";

- Non-ignition-related notification: Notifications that do not pose an ignition risk and are not considered to be a failure mode for a component in the 2019 FMEA, e.g., a missing "high voltage" sign;

- Time-dependent notifications: Conditions that will worsen with time, e.g., mechanical degradation including fatigue, corrosion, can all worsen with time and are time-dependent; and

- Time-independent notifications: Conditions that will not worsen with time, e.g., a missing sign or a missing guy insulator.

Using these definitions, notifications are prioritized as follows:

- Ignition-related notifications on structures in HFTD areas are prioritized over non-ignition-related notifications or notifications in non-HFTD areas;

- Ignition-related notifications are divided into time-dependent and non-time-dependent notifications. Time-dependent notifications are prioritized above non-time-dependent notifications because of the possibility that the condition can degrade further if the repairs are deferred;

- Time-dependent notifications in high fire spread areas are prioritized ahead of notifications in lower spread areas; and

- These considerations result in the following prioritization (highest to lowest):

  – Time-dependent ignition-related notifications in highest fire spread areas of HFTDs;

  – Time-dependent ignition-related notifications in lower fire spread areas of HFTDs;

  – Time-independent ignition-related notifications in HFTDs; and

  – Non-ignition-related notifications in HFTD areas or notifications outside of HFTDs.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, approximately 11,900 notifications within HFTD areas were completed (not including those for steel structures, further discussed in Section 7.3.3.15). In 2021, approximately 8,900 notifications within HFTD areas are expected to be completed, not including any urgent priority notifications that may be identified in 2021.

In 2021, PG&E is expecting to complete all ignition-related notifications in HFTD areas found before 2020 and all time-dependent ignition-related notifications found in 2020 on high fire spread areas, in addition to any new urgent priority notifications identified in 2021.

5) Future improvements to initiative:

As data is collected through enhanced inspections and maintenance, trending analysis will allow for understanding of deterioration rates of specific asset conditions and used to influence future inspection frequency and prioritization. Trending of notification find rates can also influence the maintenance strategy for specific lines or sections. This information will also be utilized in the programmatic approach for repair and replace decisions.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

Long term, it is expected that the volume of maintenance notifications generated through enhanced inspections will be executed in accordance with appropriate timelines associated with the damage found. Where notifications cannot be completed per the timeline, field safety reassessments (FSR) are conducted, and information will help to refine the understanding of the damage mode decay rates. This information will also be used to improve guidance to maintenance inspectors. Additionally, it is expected that effectiveness of maintenance will be trended and used to inform future maintenance mitigations, processes, and procedures.

7.3.3.12.4 Maintenance, Distribution

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

The distribution overhead enhanced inspection program is used to identify potential asset failures and gain a better understanding of asset condition for asset maintenance and replacement. EC notifications are a byproduct of the enhanced inspection process. These maintenance notifications are key to reducing asset risk by correcting identified asset hazards, poor conditions, and non-standard concerns.

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:

Detailed inspections are performed with enhanced inspection protocols. Enhanced inspection activities lead to corrective actions taken on the issues identified during the inspection. Since 2019, distribution assets have been inspected more rigorously than in previous years through PG&E's WSIP. These changes have resulted in a significant increase in the volume of EC notifications based on a FMEA approach. The maintenance (or replacement) work done as a result of the inspections is the final step in mitigating risk in the HFTD area.

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"):

Since 2019 the distribution enhanced overhead inspection process has been used on all distribution assets located in Tier 2 and Tier 3 HFTD areas. These enhanced inspections exceed GO 165 five-year cycle times as follows:

- Tier 3 – enhanced overhead inspection yearly; and
- Tier 2 – enhanced overhead inspection every three years.

The EC maintenance notifications generated through the enhanced inspection program are assigned a priority based on the potential safety impact. PG&E uses the following priorities:

- A: conditions that require immediate action;
- B: conditions that generally need to be addressed within three (3) months from the date a condition is identified;
- E: conditions that need to be addressed within twelve (12) months from the date the condition is identified or within six (6) months for conditions creating a fire risk located in Tier 3 HFTD areas; and
- F: conditions that need to be addressed within five (5) years from the date the

condition is identified.

Given the high volume of identified tags since 2019, PG&E utilized a risk-informed prioritization approach to address the highest risk issues on PG&E's facilities. The largest volume of identified corrective actions are the E and F tags, which includes findings such as chipped or broken insulators, pole repairs for woodpecker holes, loose cotter keys (E tags), missing markers, signage, or foundation mastic application (F tags). PG&E has prioritized execution of E and F tags based on ignition risk circuit prioritization and plans to continue to make repairs based on this prioritization.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

As of September 30, 2020 (the end of Q3 2020), the following HFTD tag progress has been made since 2019:

- WSIP-Generated Tags: 208,510 tags had been created, 73,359 had been closed (repairs have been completed) and 135,151 remain open; and

- Non-WSIP-Generated Tags: 84,949 tags had been created, 21,305 had been closed (repairs have been completed) and 63,644 remain open.

PG&E is continuing to verify the status of tags in Q4 2020, and thus is currently unable to provide the Q4 2020 information. Open tags will continue to be worked in a risk-based priority including new tags generated through the 2021 inspection program. Priority A and B tags are expected to be completed by the required due date. Due to the high volume of priority E and F tags, a risk ranking utilizing the FMEA severity score will be used. Any tag that contains a "time dependent" element and cannot be completed and beyond the due date will receive an FSR.

5) Future improvements to initiative:

PG&E is evaluating integrating the 2021 Wildfire Distribution Risk Model results into our maintenance program to allow prioritization of notifications by wildfire risk at the tag location level. This would pinpoint specific locations of ignition concern, allowing both the highest probable ignition potential issues as well as the highest consequence areas to be addressed first.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

At this time, there is no long-term plan beyond 2021. However, we will continue to evaluate the risk-based approach for enhanced inspections, including inspection frequency and methods. Additionally, the results of the integration between the Wildfire Distribution Risk Model and the maintenance program will allow for further analysis and planning.

7.3.3.13 Pole Loading Infrastructure Hardening and Replacement Program Based on Pole Loading Assessment Program

WSD Initiative Definition: *Actions taken to remediate, adjust, or install replacement equipment for poles that the utility has identified as failing to meet safety factor requirements in accordance with GO 95 or additional utility standards in the utility's pole loading assessment program.*

1) ***Risk to be mitigated/problem to be addressed:***

   PG&E started our pole loading program to reduce the risk of potential fire ignitions resulting from pole failures by evaluating poles so that each pole meets GO 95, Rule 44 strength requirements throughout its service life, both when initially installed and while in-service despite changing conditions, impacts from maintenance activities, attachment additions and potential wood strength degradation. Replacing overloaded poles eliminates the risks associated with pole failure, including potential ignition risk. This program also reduces risk by providing asset intelligence to identify locations that require corrective actions driven by pole safety factors or limitations for wind speeds.

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:***

   During a pole's service life, pole loading calculations are performed when load is added to a pole or if a suspected overload condition is observed during inspection. Pole loading calculations are performed in O-Calc software during the design phase to ensure poles are sized correctly to satisfy GO 95 requirements. When poles are analyzed and determined to be overloaded or the pole loading evaluation indicates that the pole does not satisfy GO 95 requirements, a pole replacement tag is initiated to correct the condition.

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"):***

   PG&E's pole loading program has focused on assessments of poles in the Tier 2 and 3 HFTD areas with the goal to be fully implemented (100 percent poles analyzed) in these areas by 2024. Poles located in non-HFTD areas will follow, with the goal to be fully implemented (100 percent poles analyzed) by 2030.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   PG&E is strengthening pole loading model parameters and variables considering historical data with various meteorological factors (e.g., wind speed). These enhancements include evaluation of advanced wire strength, clearance, and pole loading using acquired imagery and Light

Detection and Ranging (LiDAR) from Inspections, Drones and Helicopters. In addition, the program is using LiDAR to geo-correct pole locations.

In the 2020 WMP, PG&E forecast assessing approximately 230,000 poles in Tier 2 and Tier 3 HFTD areas. However, PG&E did not anticipate the huge volume of poles that our internal estimating teams would be analyzing every year. In addition, we switched vendors and refined quality standards, which slowed down the evaluation process in 2020. As of December 1, 2020, we have completed pole loading analysis of over 160,000 poles, all of which are considered the highest risk poles, either due to the pole characteristics or location (i.e., located in an HFTD area). In 2021, we will continue to focus on HFTD areas and plan to analyze approximately 160,000 poles. PG&E is on-track to finish poles in Tier 2 and Tier 3 HFTD areas by end of 2024 as originally forecast.

5) Future improvements to initiative:

PG&E is reviewing our pole loading calculation software to see if it can enable analysis of multiple pole models at once, enabling span linking to ensure structural connectivity.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E does not currently have specific long-term planning beyond 2030, since this effort extends until 2030. When poles are determined to be overloaded, their replacement is incorporated into our overall pole replacement program. Please refer to Section 7.3.3.6 for further discussion on pole replacements.

7.3.3.14 Transformers Maintenance and Replacement

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing transformer equipment.*

1) ***Risk to be mitigated/problem to be addressed:***

   PG&E's GO 165 Program, which covers distribution transformer maintenance, is primarily focused on the identification, assessment, prioritization, and documentation of abnormal conditions, regulatory conditions, and third party caused infractions that can negatively impact safety or reliability.

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:***

   Transformers may by maintained, repaired, or replaced based on their condition as assessed during the GO 165 process. The conditions identified during patrols and inspections of PG&E's distribution facilities may occur as a result of operational use, degradation, deterioration, environmental changes or third-party actions.

   Transformers that fail in connection with an outage may be replaced as part of PG&E's Routine Emergency or Major Emergency programs. PG&E is also replacing certain transformers on circuits that are included in the System Hardening Program discussed in Section 7.3.3.17.1

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"):***

   This work is covered under PG&E's GO 165 program covers Buffer Zones and all of our service area. GO 165 inspections for HFTD are the same for non-HFTD. However, while the scope of the inspection is the same, the frequency for HFTD and non-HFTD areas is different. The frequency of GO 165 program inspections is 1-3 three years in HFTD areas as opposed to 5 years in non-HFTD areas.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   PG&E will continue to maintain, repair, or replace transformers as warranted by their condition as part of our ongoing GO 165 maintenance program and Emergency programs. PG&E may also replace certain transformers as part of our System Hardening Program.

5) Future improvements to initiative:

PG&E has two Electric Program Investment Charge (EPIC) projects that are evaluating SmartMeters™ technology, data science, and remote monitoring to proactively identify and replace some overloaded transformers before they fail. These projects are covered in depth in Sections 7.1.D.3.12 – EPIC 3.20 and 7.1.D.3.11 – EPIC 3.13.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

Since this initiative is closely related to GO 165 requirements, the long-term vision will be guided by changes/updates to the GO 165 requirements. Please see references in the response to Question 5) above for more context.

7.3.3.15 Transmission Tower Maintenance and Replacement

WSD Initiative Definition: *Remediation, adjustments, or installations of new equipment to improve or replace existing transmission towers (e.g., structures such as lattice steel towers or tubular steel poles that support lines at or above 65 kV).*

1) ***Risk to be mitigated / problem to be addressed:***

   Maintenance, repair, and replacement of transmission towers, particularly those located in Buffer Zones and HFTD areas, are integral means of mitigating risk associated wildfire, public and employee safety, and customer reliability.

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:***

   PG&E's transmission tower maintenance, repair and replacement program focuses on high-risk steel structures. Many factors feed into determination of high-risk steel structures—including prior inspection conditions, environmental factors (such as location in an HFTD area or corrosion zone), age, structure design, prior outages, prior repairs, etc. Needs associated with Transmission tower maintenance are generally identified through system inspections and patrols.

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"):***

   Prioritization of maintenance, repair and replacement are based on severity of the issue found, fire ignition risk (i.e., risk associated with HFTD areas and HFRA), and time-dependency of the issue. As conditions are identified, they are given a time-based priority based on guidance in PG&E's Electric Transmission Preventative Maintenance Manual. For certain tags (E and F priority tags), additional prioritization occurs based on the damage found. If the repair needed is time-dependent (meaning that the damage can worsen with time), and in an HFTD area, it may be prioritized before other non-time-dependent, non-ignition potential tags.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   In 2020, approximately 5,100 tags associated with steel transmission tower repair were completed within HFTD areas. Of these, approximately 50 tags associated with steel structure painting were completed in 2020 in order to extend structure asset life. In 2021, approximately 4,000 tags associated with steel transmission tower repair have been prioritized for completion within HFTD areas, not including any urgent priority tags that may be identified in 2021. Approximately 500 tags associated with steel structure painting are prioritized for completion in 2021 within HFTD

areas. Overall, in 2021, it is expected to complete all ignition-related tags in HFTD areas found before 2020 and all time-dependent ignition-related tags found in 2020 on high potential wildfire spread lines, in addition to any new urgent priority tags identified in 2021.

5) Future improvements to initiative:

PG&E is piloting additional inspection and asset-life extension technology for steel structures, which is planned to feed into asset health modeling and repair-replace decision for these assets. For example, below-grade foundation inspections (see Section 7.3.4.10) will inform future repairs and replacements. These inspections aim to assess condition of steel structure foundations below the ground-line. Investigation will include a measure of soil resistivity, pH, Redox & Half Cell Measurement, as well as a visual assessment with photographic evidence of each excavated foundation leg. The results will validate data from models, inform (preventive) maintenance and repair decisions, and inform locations most requiring of cathodic protection.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

Long term, PG&E will evaluate potential steel structure failure modes through inspection, maintain structures with life-extension methods such as cathodic protection and tower coating, and replace steel structures at a sustainable rate. There are current pilots underway to expand some of the failure mode identification and life extension methods. Successful completion or additional research will be conducted until proven methods can be integrated into the lifecycle management of the assets, system-wide as needed based on risk priority.

7.3.3.16 Undergrounding of Electric Lines and/or Equipment

WSD Initiative Definition: *Actions taken to convert overhead electric lines and/or equipment to underground electric lines and/or equipment (i.e., located underground and in accordance with GO 128).*

1) Risk to be mitigated / problem to be addressed:

Undergrounding electric lines and facilities can significantly reduce wildfire risk by eliminating overhead lines which may be prone to wires down events or otherwise prone to potential wildfire ignitions. The installation of underground facilities is considered among a suite of alternatives to mitigate wildfire risk in areas prone to tree failures. PG&E also considers secondary risks such as PSPS impacts, egress/ingress routes to support fire department response times and public safety, past fire history and effects on available fuels, current system condition, environmental risks to reconstruction activities, and general accessibility considerations to enhance employee safety when determining whether specific facilities should be undergrounded.

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:

Undergrounding can be an effective means of addressing wildfire risk, but it is also time-consuming and costly. Thus, each location must be separately evaluated to determine if undergrounding is a prudent approach for mitigating wildfire risk. PG&E does not, for wildfire mitigation purposes, have a stand-alone targeted program to relocate overhead facilities to underground.[75] Instead, PG&E relocates existing high risk overhead medium voltage lines to underground as part of our System Hardening Program. When considering an underground alternative, it is essential to consider risk reduction from undergrounding as well as all execution risks and costs. Execution risks include accessibility, rights-of-way, public utility easements, private property crossings, the number of services, space for necessary subsurface and pad-mounted equipment, environmental restrictions such as naturally occurring asbestos or endangered species, Archeology and Historic Preservation, soil remediation, and soil conditions.

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75 PG&E has an undergrounding program under Rule 20A, but that program is not related to wildfire mitigation.

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"):***

The location and prioritization of undergrounding is addressed in the discussion of PG&E's System Hardening Program in Section 7.3.3.17.1

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

The progress on undergrounding and plans for 2021 is addressed in the discussion of PG&E's System Hardening Program in Section 7.3.3.17.1

5) ***Future improvements to initiative:***

Future improvements related to undergrounding are addressed in the discussion of PG&E's System Hardening Program in Section 7.3.3.17.1

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Section 7.3.3.17.1 for more information on future improvements for this initiative.

7.3.3.17 Updates to Grid Topology to Minimize Risk of Ignition in HFTDs

WSD Initiative Definition: *Changes in the plan, installation, construction, removal, and/or undergrounding to minimize the risk of ignition due to the design, location, or configuration of utility electric equipment in HFTDs.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.3.17.1: System Hardening – Distribution;
- 7.3.3.17.2: System Hardening – Transmission;
- 7.3.3.17.3: Non-Exempt Surge Arrestor Replacement Program;
- 7.3.3.17.4: Rapid Earth Fault Current Limiter;
- 7.3.3.17.5: Remote Grid; and
- 7.3.3.17.6: Butte County Rebuild Program.

7.3.3.17.1 System Hardening – Distribution

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative*

In addition to describing PG&E's sub-initiative for our System Hardening Program for electric distribution, this section also provides responses to the following Action Items: Action PGE-3 (Class B), PGE-9 (Class-B), PGE-10 (Class B), PGE-32 (Class B), PGE-35 (Class B), and PGE-36 (Class B).

1) Risk to be mitigated / problem to be addressed:

PG&E's System Hardening Program focuses on the mitigation of potential catastrophic wildfire risk caused by distribution overhead assets. This program targets the highest wildfire risk miles and applies various mitigations such as line removal, conversion from overhead to underground, application of remote grid alternatives, mitigation of exposure through relocation of overhead facilities, and in-place overhead system hardening. The highest wildfire risk miles are separated into three categories:

1. The top 20 percent of circuit segments as defined by PG&E's 2021 Wildfire Distribution Risk Model for System Hardening;

2. Fire rebuild areas; and

3. PSPS mitigation projects.

PG&E also considers secondary risks and benefits as part of the System Hardening Program effort such as PSPS impacts, egress/ingress routes to support fire department response times and public safety, past fire history and effects on available fuels, current system condition, environmental risks to reconstruction activities, and general accessibility considerations to enhance employee safety.

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:

Distribution overhead assets represent high ignition risk due to a combination of a high exposure area (overhead assets traversing HFTD areas) and proximity to risk factors such as vegetation. For utility equipment, estimated distribution-related ignitions per circuit mile are 1.6 times that of transmission-related ignitions. For vegetation drivers, estimated distribution ignitions per mile are up to 6x greater than for transmission circuits. Table PG&E-7.3.3-6 below illustrates the CPUC reportable ignitions from 2015 to September 2020 broken down into major contributing causes in Distribution and Transmission systems.

TABLE PG&E-7.3.3-6: CPUC REPORTABLE IGNITIONS AND ESTIMATED IGNITIONS PER 1,000 CIRCUIT MILES

	2015 - 2020 YTD[1] CPUC Reportable Ignitions in HFTD		Estimated Ignitions per 1,000 Circuit Miles in HFTD[2]	
Initiating Cause	Distribution	Transmission	Distribution	Transmission
Equipment – PG&E	217	30	8.5	5.4
Vegetation	305	11	11.9	2.0
All Other[3]	195	34	7.6	6.1

1. YTD represents data as of the end of September 2020.
2. Circuit mileage in HFTD areas source: 2020 Wildfire Safety Plan – 25,598 of distribution overhead mileage in HFTD areas, 5,542 of transmission overhead mileage.
3. Other includes ignitions primarily driven by Third Party and Animal.

PG&E's System Hardening Program is an important initiative that can reduce wildfire ignitions caused by distribution facilities. The System Hardening Program targets the highest wildfire risk miles as identified by PG&E's 2021 Wildfire Distribution Risk Model for system hardening (the 2021 Wildfire Distribution Risk Model is explained in further detail in Section 4.5.1), and also targets overhead structures impacted directly by wildfires, and those areas most impacted by PSPS. There are several ways that locations are identified for system hardening including:

- Identifying circuit segments with the highest wildfire risk using the 2021 Wildfire Distribution Risk Model;
- Locations where past events have identified deteriorated overhead conductor;
- Electric Corrective Optimization Program (ECOP), where a number of identified corrective repair tags on a single segment of line indicate that hardening the line may be more prudent than repairing each tag individually;
- Projects to mitigate the need for PSPS in a certain area;
- Fire damaged line sections requiring rebuild; and
- Idle facilities or other line removal opportunities.

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"):

As discussed above, the System Hardening Program identifies locations to perform this work based primarily on PG&E's 2021 Wildfire Distribution Risk Model for system hardening. Projects are prioritized at the circuit segments level, as opposed to regional or full circuit. In addition to the highest priority segments based on the risk model, projects are also included in the system hardening portfolio when needed to address overhead structures damaged directly by wildfires (described in subsection (e) below) and those areas most impacted by PSPS. The following mitigation options (subsections (a)-(c)) are considered for each circuit segment when developing a System Hardening Program project. Those options are evaluated through PG&E's process to consider system hardening alternatives (subsection (d)). Finally, this section also describes PG&E's consideration of Buffer Zones in system hardening (subsection (e)).

(a) Line Removal and Remote Grid

Complete removal of an existing overhead distribution line will also completely eliminate the fire risk associated with that line and is therefore explored for every identified system hardening project. A line removal mitigation can be applied in various ways. The simple application of this mitigation alternative is for known or suspected idle facilities, that are not currently, actively serving customer load. PG&E follows the procedures and requirements in Utility Procedure: TD-2459P-01 "Idle Facility Program" to investigate potential idle facilities and determine if they can be permanently removed. Another line removal alternative is the rearrangement or re-alignment of the existing circuit path. PG&E reviews the targeted circuit segment for redundant distribution ties through high risk areas. It may be possible that removal of certain circuit segments would have little impact on operational flexibility and provide the most cost-effective measure to reduce wildfire risk. Finally, a future removal opportunity lies with the application of the Remote Grid alternative discussed in Section 7.3.3.17.5 below.

(b) Relocation of Overhead to Underground

PG&E will relocate existing high-risk overhead distribution lines to underground as part of this mitigation. When considering an underground alternative, it is essential that all execution risks are considered to provide an accurate cost projection for the installation and lifetime of the asset. Among the cost risks to installing underground assets are: accessibility, rights-of-way, public utility easements, private property crossings, the number of services, space for necessary subsurface and pad-mounted equipment, environmental restrictions such as naturally occurring asbestos or endangered species, Archeology and Historic Preservation, soil remediation, and soil conditions to name a few.

PG&E has found that there are many impediments to underground construction that limit its viability to be a cost-effective mitigation alternative when compared directly to overhead system hardening. The teams responsible for scoping this work also take tree density and strike potential trees into consideration as well as ingress/egress risks as some of the primary drivers for choosing an underground alternative.

Another impediment to this alternative is its schedule risks. A typical overhead hardening project can advance from idea to execution, documentation, and close out in 13-16 months. Whereas an underground project can often take 18-45 months depending on the various risks presented. The most impactful driver in many cases is land rights. Most of our systems in the high-risk areas have existing overhead rights only and require the acquisition of new underground easements to complete the relocation. As PG&E is often unable to construct underground in the exact same path as the overhead, these easements are often required with customers and/or agencies without current agreements. This land rights acquisition process alone can take 6-18 months and requires the project to be at a fairly mature design stage prior to contacting property owners about the needed rights.

The final consideration, for PSPS mitigation, is that underground construction presents the most reliable method for mitigating the need for PSPS operations. There will be occasions that undergrounding is chosen even when it does not present the best Risk Spend Efficiency (RSE) of the hardening options because it is the most reasonable alternative to mitigate all risks considered.

(c) Overhead Hardening

The most frequently used method for system hardening is overhead hardening in place. Overhead system hardening can be done more quickly than that of many other alternatives through the use of existing rights and easements. After analyzing projected performance of overhead hardened facilities on more than 4,600 outage types, it is projected that overhead system hardening will reduce 62 percent of the distribution overhead asset ignitions from either equipment failures or due to external contact such as vegetation. This alternative has a higher RSE when compared to the undergrounding alternative in many scenarios. Overhead system hardening achieves risk reduction through these foundational elements:

- **Primary and secondary covered conductor replacement**

  Replacement of bare overhead primary (high voltage) conductor and associated framing with conductor insulated with abrasion-resistant polyethylene coatings (sometimes referred to as covered conductor or tree wire) can be an effective mitigation of wildfire ignitions on distribution lines. Installing covered conductor can help reduce the likelihood of faults due to line to line contacts, tree-branch contacts, and faults caused by animals. Installing covered conductor on secondary lines has similar benefits to installing it on primary lines.

- **Pole Replacements**

  All existing poles are evaluated for the strength requirements to withstand the new heavier covered conductor. Often the majority or all poles on a circuit segment will need to be replaced to support the new, heavier covered conductor and associated equipment. When poles need to be replaced, PG&E has tested and confirmed that composite poles and intumescent wrapped poles have increased fire damage resiliency to reduce the risk of a pole failure during a wildfire.

- **Replacement of Non-Exempt Equipment**

  Replacement of existing primary line equipment such as fuses/cutouts, and switches with equipment that has been certified by CAL FIRE as low fire risk is another component of our System Hardening Program. This replacement work eliminates overhead line equipment and devices that may generate exposed electrical arcs, sparks, or hot material during their operation.

- **Replacement of Overhead Distribution Line Transformers**

  Upgrading transformers to those that contain “FR3” dielectric fluid as part of PG&E’s current equipment standards (PG&E implemented the transition from mineral oil to FR3 in 2014) can also be an effective wildfire ignition mitigation. Newer transformers are filled with fire resistant “FR3” insulating fluid, a natural ester derived from renewable vegetable oils—providing improved fire safety, transformer life, increased load capability, and environmental benefits. In addition, new transformers are manufactured to achieve higher Department of Energy electrical efficiency standards.

- **Framing and Animal Protection Upgrades**

  Replacing crossarms with composite arms, wrapping jumpers, and installing animal protection upgrades to reduce contacts and pole related ignition risks.

- **Vegetation Clearing**

  Vegetation is a critical component of the System Hardening Program. In order to access our facilities to execute a project, it often requires significant undergrowth clearing which removes vegetation on the ground directly beneath the lines. In addition, some of the previously mentioned components of a system hardening project require additional clearance space to execute. Regulatory requirements mandate 4 feet of clearance all year long, so that if there is a change to a line’s profile, including using taller poles or wider cross-arms, the vegetation must be cleared to be consistent with any changes and provide the required clearing for new overhead lines.

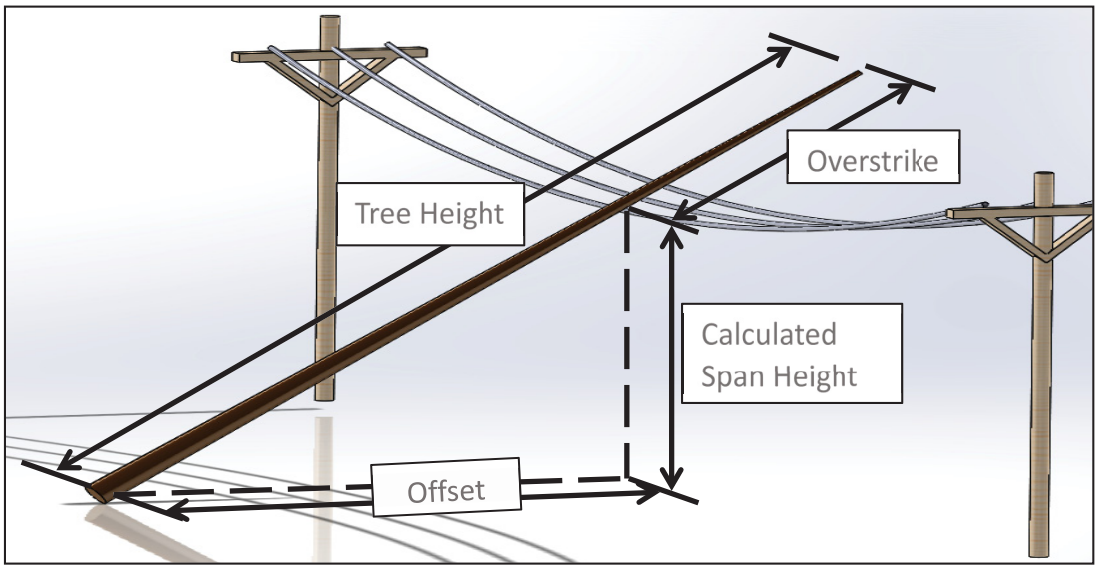
(d) System Hardening Process – Alternatives Consideration and Final Design

Once a circuit segment is targeted for system hardening, a project is launched for a segment that is no larger than 10-miles long. PG&E's Distribution Planning Engineers develop three primary alternatives for construction: (1) all overhead; (2) all underground; and (3) a hybrid alternative utilizing the specific hardening alternative thought to be the best fit for each section in the project. Line removal options are also considered during this scoping phase and, if feasible, thoroughly evaluated as generally the fastest and lowest-cost approach.

The system hardening project design options are brought to a scoping desktop review team made up of various experts to discuss and analyze additional risks such as tree strike potential, ingress and egress, localized fuel types and past fire history, land constraints, environmental risks, PSPS impacts, and general constructability concerns.

The tree strike potential factor is analyzed by PG&E's Applied Technical Services team. LiDAR data processing extracts pole, span, and fall-in tree geospatial information. This data is processed into an excel spreadsheet to determine Tree-span-pole associations. The tree strike threat is calculated as the number of fall-in trees in each span that can touch the line. A "fall-in tree" is simply a tree that is tall enough to potentially strike the span regardless of wind direction (i.e., when there is a non-zero overstrike, as shown in the figure below). Figure PG&E-7.3.3-3 shows an example of the overstrike assumptions used to calculate this risk.

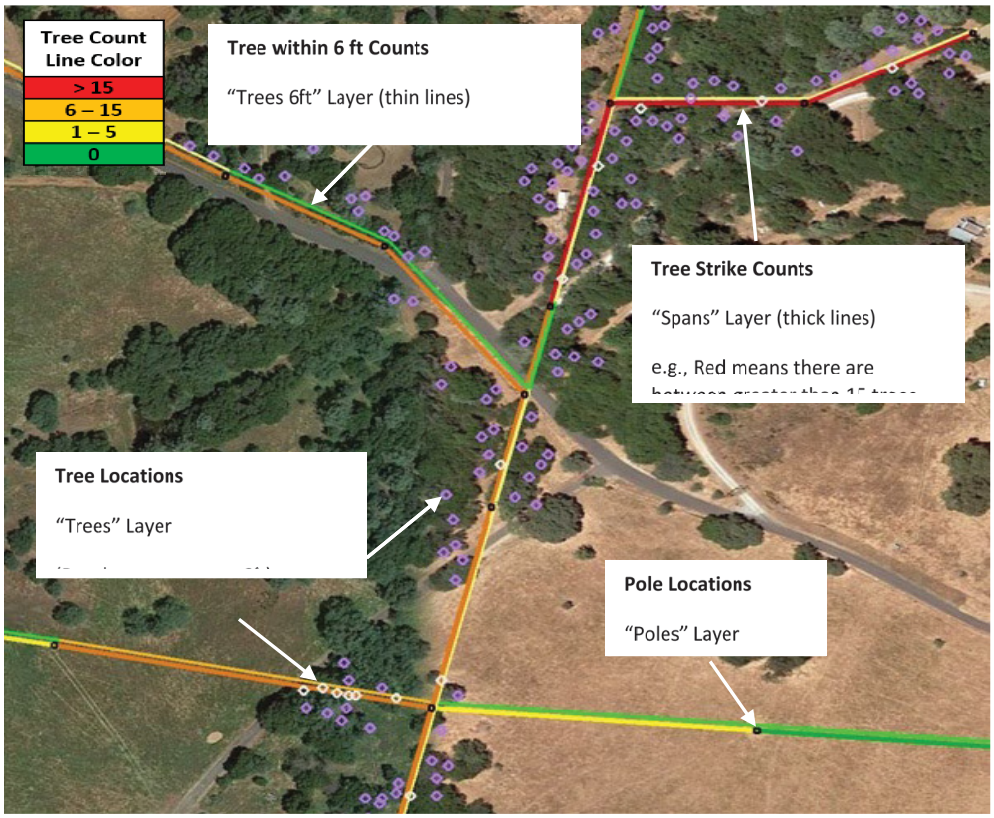
FIGURE PG&E-7.3.3-3: OVERSTRIKE ASSUMPTIONS USED TO CALCULATE RISK



Spans are then ranked based on the number of fall-in trees in each span. The results are outputted to Google Earth for visualization. The lines are color coded to represent the number of fall-in trees that can touch the line: Red for greater than 15, Orange for 6 to 15, Yellow for 1-5, and green for 0.

Figure PG&E-7.3.3-4 below is an example of the tree count and color coding for a potential system hardening project. Cost and constructability are key considerations in which the final mitigation alternative is chosen, but it is important to know and assess this tree fall-in potential risk as it is the largest single remaining risk to an overhead line that has been hardened.

FIGURE PG&E-7.3.3-4: TREE COUNT AND COLOR CODING FOR POTENTIAL SYSTEM HARDENING



Ingress, egress, fuel types and past fire history is also determined and provided by PG&E's Public Safety Specialist (PSS) to the field scoping desktop meeting. The PSS team are PG&E's field fire risk experts, many of them with significant first responder experience (often decades), that help inform PG&E's decision-making process. They analyze the area with a fire fighters' mindset to better understand the fuel types in the area, the historical fires, and the main egress and ingress routes. These experts are invaluable in providing analysis and first-hand experience in these areas, often working with local fire officials to understand the risks and available mitigations. Within the field scoping desktop meeting, it is often recommended to protect main egress routes through undergrounding, relocation, or fire resilient poles. Areas where an ignition may be hard to spot are often areas a relocation may be chosen to ensure response times for local first responders are minimized.

The execution of these projects is very challenging with the various environmental and other conditions found in high fire risk areas. Land and environmental specialists analyze the alternatives provided prior to the desktop meeting and Google Earth images are provided to aid in the analysis. Where significant environmental risks, water features, endangered species and habitats, known cultural areas, and local agencies required for the new rights are identified, appropriate scope, schedule, and cost impacts are discussed to aid in the decision making.

Projected PSPS impacts are also analyzed by meteorology team and provided to the project scoping team to aid in the understanding of past potential frequency and customer impact. In areas where greater than an average of one PSPS event per year has been modeled, or greater than 5,000 customer meters are projected to be impacted, the design alternative for undergrounding is strongly recommended due to the potential PSPS mitigation benefits. This benefit can still be difficult to capture in all cases due to the radial (i.e. “one-way”) nature of the majority of PG&E’s distribution system. If lines that are targeted for hardening are undergrounded, but the source of electricity is still coming from overhead lines that are likely to be de-energized, the PSPS savings may not be realized until significantly more work is done.

Utilizing all of this information, the field scoping team will review the design alternatives provided, make changes as necessary, and provide a final field scope document to the estimating team. An estimator then performs a field check to analyze the assumptions made during the field scoping desktop meeting to confirm viability of the constructability and execution risks associated with the mitigations chosen.

Once the design alternatives have been vetted to this level, a final economic analysis is performed creating net present values for the lifetime costs of each design approach, including long-term maintenance needs and costs including annual vegetation management, inspections, etc. A final recommendation and associated documentation is then submitted to PG&E’s Wildfire Risk Governance Steering Committee (WRGSC) to review the project scope, risk spend efficiency and related analysis. The WRGSC provides guidance and approval for the projects that the System Hardening Program should execute upon and the mitigation action to be taken on each project. Once approved, these projects are scheduled for final design, permitting, and execution.

(e) Urgent Fire Rebuild Targeted for System Hardening

During PG&E’s emergency response to a wildfire that has damaged our overhead or underground assets, several alternatives may be considered when restoring services to customers. The following guidance has been provided to the Grid Design Engineers, estimators, and assessment leads when choosing the best rebuild alternative tailored to the needs of the area. These alternatives are provided in the order of consideration for each segment and circuit for evaluation:

- **Removal** – Radial tap lines that are identified as Idle Facilities or circuit back-ties that are not required by our design standards for operational flexibility should not be rebuilt or be removed;

- **Remote Grid or Customer Self-Provided Standalone Power System (SPS)** – Isolated customer(s) in Tier 2/3 HFTD areas fed by >0.5 miles of distribution line that, if removed or not rebuilt, could be served remotely through temporary generation solutions until a permanent SPS is installed;

- **Underground** – Distribution primary conductor in an accessible area with adequate space and rights to facilitate underground infrastructure. Questions to evaluate this option include: Are gas facilities candidates to participate in the trench? Telecoms? Temporary generation may be required to support immediate customer restoration while the underground planning and construction project progresses;

- **Overhead Harden in a Different Location** – Distribution primary conductor through rural, heavily wooded, or inaccessible terrain should be evaluated for relocation to a road or more accessible location. Temporary generation would be required to support immediate customer restoration while the planning and construction project progresses;

- **Overhead Harden in Place** – This solution is appropriate for primary distribution overhead conductor in Tier 2/3 HFTD areas where >4 spans require full reconstruction or large sections of intermittent damage (generally greater than 50 percent of the segment) requires rebuild. These lines often represent mainline or major customer lines that cannot be effectively generated or switched to alternate sources of power and serve large sections of customers/critical facilities;

- **Restore in place** when intermittent damage is found without significant rebuild required; and

- **All of the Above** – some combination of all of the above depending on the circumstances for a given circuit.

Once an entire segment has been assessed, the Grid Design Engineer works closely with the Estimating team to document the damage notifications into a Google Earth image to clearly identify the damage found on the distribution assets. Then routes are determined, and initial recommendations are made for protection, switches, and wire size. These designs are sent to estimating to discuss with the incident commander at base camp, to distribution planning for fuse sizes and protection settings, and to land and environmental to begin the process of easement acquisitions and dependency clearing. In some cases, more time dependent alternatives must be rejected in favor of quicker mitigations to support customers by quickly restoring service to a community, for example when local, temporary generation until new assets can be constructed is not practical. The incident commander at the assigned base camps has final authority to ensure the customer needs are being met.

(f) Buffer Zones

In addition to work performed in HFTD areas, PG&E may also perform system hardening into "Buffer Zones." Buffer Zones are areas immediately adjacent to an HFTD area. Because a specific distribution line may continue from an HFTD area into a Buffer Zone, hardening the line may include both hardening the HFTD area portions of the line as well as portions of a line in the Buffer Zone.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2019, based on prioritization derived from the 2019-2029 Wildfire Risk Model, the System Hardening Program began with a target of completing 150 miles of hardened facilities. Much of this targeted work was overhead hardened facilities, though there was also undergrounding, and removal included in this target. In total, 171 miles were hardened by the end of 2019. This included targeted hardening work, idle facility removals, fire rebuild miles and hardened facilities associated with New Business and Capacity projects. As the first year of the program 2019 also featured the development of many key processes such as establishing a clearly defined field scoping document and process, the development of ECOP for evaluating sections with a number of identified corrective tags, the beginning stages of the finite element analysis for tree strikes, and building execution capacity to support annually increasing the target.

In 2020, the System Hardening Program established a 220-mile target to harden overhead facilities within the highest fire risk miles based on 2019-2029 Wildfire Risk Model. PG&E completed approximately 342 total miles, which includes approximately 194 miles hardened in HFTD areas during fire rebuild efforts and another 21 miles undergrounded through the Butte rebuild effort described in Section 7.3.3.17.6. The unprecedent wildfires in 2020 and the damage to PG&E led to the development of a more standardized fire rebuild process, which allowed PG&E to complete nearly 200 miles of hardened fire rebuild in the last four months of 2020.

In addition to the system hardening work completed, in 2020, PG&E further built on our 2019 execution progress by developing a standard tree strike analysis utilizing LiDAR data for facilities and tree locations. PG&E standardized the use of wood poles with an intumescent wrap to increase fire resiliency of hardened lines and supplement the supply limitations and design challenges associated with composite poles. Project strategies were refined to better coordinate permitting, easements, vegetation clearing, and other dependencies in advance of construction.

For 2021, PG&E has switched over from REAX to Technosylva as our Wildfire Consequence Modelling tool. The Wildfire Consequence Model was incorporated into PG&E's 2021 Wildfire Distribution Risk Model. This change and other associated improvements in our modeling, data, and understanding of fire risk, has led to a shift in thinking about where to target system hardening resources. PG&E's 2021 Wildfire Distribution Risk Model resulted in a significant change for PG&E in the targeting of where work would be directed to continue to harden the highest wildfire risk miles.

As mentioned earlier in this section, highest wildfire risk miles are separated into three categories:

1. The top 20 percent of circuit segments as defined by PG&E's 2021 Wildfire Distribution Risk Model for System Hardening;

2. Fire rebuild miles; and

3. PSPS mitigation miles.

PG&E is targeting 180 miles in 2021. In particular, PG&E is targeting that 80 percent of these miles be highest risk miles (one of those three categories above) and 10 percent must be performed through undergrounding or asset removal over the 3-year period from 2021-2023.

While this 2021 target of 180 miles does represent a drop from the 2020 mileage target, this is as a result of the previously referenced improvement in modeling and significant pivot in targeting. PG&E needed to change course, stop previously selected projects, and start different projects that are in alignment with our updated risk model. More importantly, the 180 miles targeted in 2021 represent a greater risk reduction value than if we had continued on the previously planned work plan and executed approximately 300 miles in 2021. Under the new risk model the 301 miles of potential system hardening work originally planned for 2021 equated to 118 risk units in PG&E's multi-attribute value function (MAVF) calculation. The 180 miles now targeted for completion in 2021 are worth 198 risk units, a 68% increase in quantifiable risk reduction even though the mileage number is reduced. With the significant pivot in the program this target for 2021 is still aggressive because the cycle time for a system hardening project generally exceeds 12 months, as of late January PG&E is moving aggressively to design and execute the 2021 plan as 60 percent of the planned work is still in first project phase (scoping).

5) Future improvements to initiative:

Although we will be hardening fewer miles in 2021 than previously targeted, PG&E will use this year to rebuild our pipeline of projects in alignment with the new risk model that are identified, vetted, designed, and permitted for future construction. In doing so, the pace of system hardening will increase substantially in 2022 and going forward to

between 450 to 500 miles per year. Even with the shift in the risk model PG&E anticipates generally aligning with previously outlined system hardening goals for the three-year WMP timeframe (2020-2022). In the 2020 General Rate Case (GRC), PG&E targeted 1,021 miles of system hardening for this period and our updated WMP plan forecasts completing 992 miles,[76] within 3% of the original, GRC plan.

In addition to increasing the pace of system hardening work in upcoming years, as PG&E continues to develop our risk models (as described in more detail in Section 4.5.1), we will be able to incorporate more data sets, make further programmatic refinements and better scope and target our System Hardening Program. We will be analyzing hardened facilities performance with regard to actual outages, incidents, and ignitions so that we can continue to refine our strategy and improve the scope of the System Hardening Program. Performance of hardened facilities that experience a wildfire will also continue to validate assumptions on life expectancy and effectiveness of hardened facilities (like wrapped poles) in various conditions. In addition, improvements in protection schemes—such as Rapid Earth Fault Current Limiters (REFCL)—may allow for a reduced level of work required to make safe a line in a high-risk area. Finally, we will seek closer alignment of our system hardening efforts with PSPS mitigation opportunities.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long-term planning within the respective section of each individual initiative.*

Response:

As mentioned above, we will focus on enhancing our risk models and hardened facilities performance analysis to ensure that hardening for at-risk infrastructure is consistent with evolving risk prioritization and strategies. For 2024 and beyond, we are targeting to complete between 450 and 500 miles per year of system hardening. These efforts will also be aligned with PSPS mitigation strategies to maximize the total reduction in wildfire risk.

ACTION PGE-3 (Class B)

1) *Explain why only hardening efforts are identified within a higher risk tranche as a solution for the 7,100 miles scoped for system hardening, and no other initiatives are viable as a solution;*

2) *Define what hardening consists of in regard to the 7,100 miles identified to be hardened;*

3) *Provide the supporting materials and calculations showing that assets in the 7,100 is 2.75 more likely to fail, including all conclusions as to the reason why the*

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76 2020 actual: 342 miles, 2021 target: 180 miles, 2022 target:470 miles = 992 from 2020-2022.

failure rate is higher;

4) *The location of the 7,100 miles; and*

5) *The explanation of the overlap and increase for these 7,100 and the 5,500 discussed in PGE-5 identified for hardening.*

Response:

PG&E is no longer targeting a specific set of miles such as the 7,100 miles or 5,500 miles referenced in the previous WMP. This strategy relies on a stagnant or non-changing risk model and assumes a specific risk reduction from that base value. As PG&E continues to study and enhance the risk model, this value will shift and change. PG&E will continue to harden at-risk infrastructure consistent with the evolving risk prioritization and strategies. For 2021-2023, the target is to harden 1,120 of the highest risk miles as described in Section 7.3.3.17.1. For 2024 and beyond, PG&E is targeting between 450 and 500 miles per year.

1) PG&E is not restricting other mitigation measures from being applied as a short-term wildfire risk mitigation to the highest risk miles. System hardening is a more complete measure as well as a long-term improvement initiative that will take some time to complete. Therefore, it is necessary to consider many other initiatives as part of our risk mitigation efforts both prior to and as part of a system hardening project.

2) A system hardening project can consist of multiple initiatives including but not limited to covered conductor installation, undergrounding, remote grid, PSPS mitigation through undergrounding, non-exempt fuse and surge arrestor replacement and line removal.

3) The calculations that show that the 7,100 miles are approximately 2.75 times more likely to fail are attached (see Attachment 2021WMP_ClassB_Action-PGE-3_Atch01). To get to that result, all probabilities of failure were added for the two groups: (1) targeted miles (i.e., 7,100), and (2) the rest of miles (18,300). Subsequently the sum of these probabilities was normalized per mile which resulted in two numbers that represent the expected failure probability per mile of Distribution lines in HFTD for each group. Lastly, to compare these two numbers, they were divided and the result shows that failure rate per mile of Distribution line in HFTD is approximately 2.75 times higher for the system hardening target miles than for those outside the scope of system hardening at the time. See cell U6:W8 for actual calculations in the attached workbook.

   Regarding the reasons why, the failure rate was higher for certain portions of the distribution system. As previously described in Condition PGE-7, the sub-model #1 for likelihood of failure processed 20 different input variables using a logistic regression algorithm. The results of this sub-model generate a likelihood of failure for a specific circuit segment. The results were later validated with the proper SMEs to corroborate that the areas showing higher failure rates match their knowledge of the system. While the reasons might vary depending on each individual segment of the distribution system being evaluated, typical conclusions that can be deducted from the model were that sections in certain

environments, with higher vegetation density, higher frequency of outages, certain materials of construction, higher number of overhead miles in HFTD areas, or a combination of the aforementioned, were more significant in predicting a higher failure rate.

It is worth noting that the results and calculations were objectively reasonable based on the 2018-19 Wildfire Risk Model results, however, PG&E anticipates a change if a similar calculation was to be conducted today given the improvements reflected in the 2021 Wildfire Distribution Risk Model described in Section 4.5.1.

4) Through the improvement of PG&E's risk model as described in Section 4.5.1, the location of the highest risk miles has shifted and the geographic representation of the 7,100 miles as requested is not representative of the current direction of the System Hardening Program.

5) There is not increase from 5,500 to 7,100 miles. As stated in Condition PGE-5, the 5,500 miles was just an observation from the model. The observation captured the fact that the results showed that 95 percent of the wildfire risk prioritization of system hardening was in 22 percent of the distribution line miles. The 5,500 miles was not meant to represent the scope of the System Hardening Program. It should be noted, however, that the 5,500 miles were part of the 7,100 miles identified for hardening at the time.

ACTION PGE-9 (Class B)

1) Provide details on the System Hardening Hybrid Program, particularly when comparing it to covered conductor and the standard system hardening projects discussed within the WMP;

2) When comparing the system hardening hybrid to standard hardening, provide the risk reduction per mile implemented;

3) Provide the locations in which the system hardening hybrid has been deployed and piloted, including an explanation of the rationale and any supporting calculations to determine the use of the hybrid over standard hardening approach in those areas; and

4) Provide the locations in which the system hardening hybrid is planned to be deployed, including an explanation of the rationale and any supporting calculations to determine the use of the hybrid over standard hardening approach in those areas.

Response:

The System Hardening Hybrid Program was being considered as an alternative program in 2020 to help target specific areas of risk for hardening while completing other low impact work to complete in lower risk sections. Specifically, PG&E would target installing covered conductor in areas where tree exposure exists in high risk zones identified by risk modeling and would leave bare conductor in areas with zero tree strike, branch fall, or branch/bark/frond blow in risk. This alternative has not

been deployed and we have no plans to implement the System Hardening Hybrid Program at this time. PG&E is focused on reducing risk more fully with an emphasis on alternatives such as undergrounding. It is not believed that the Hybrid alternative addresses enough risk to pursue at this time.

ACTION PGE-10 (Class B)

1) *Provide details on the Wildfire Targeted System Upgrades, particularly when comparing it to covered conductor and other system hardening projects discussed within the WMP*

2) *When comparing the Wildfire Targeted System Upgrades to covered conductor, provide the risk reduction per mile implemented*

3) *Provide the locations in which Wildfire Targeted System Upgrades have been deployed and piloted, including an explanation as to the reasoning and any supporting calculations to determine the use of upgrades in those areas*

4) *Provide the locations in which the upgrades are planned to be deployed, including an explanation as to the reasoning and any supporting calculations to determine the use of upgrades in those areas.*

Response:

The Wildfire Targeted System Upgrades Program was being considered as an alternative program in 2020 to target low-impact risk reduction alternatives in areas with zero tree strike, branch fall, or branch/bark/frond blow in risk. This would include animal protection, re-framing, pole loading calculations, and potentially spreader brackets to ensure mechanical separation between phase conductors. This would provide potentially a higher RSE mitigation in areas that are potentially high consequence risk yet low probability of failure. This alternative has not been deployed and we currently do not plan to implement the Wildfire Targeted System Upgrades Program. PG&E is focused on reducing risk more fully with an emphasis on alternatives such as undergrounding. It is not believed that the Wildfire Targeted System Upgrades alternative addresses enough risk to pursue at this time.

ACTION PGE-32 (Class B)

1) *Explain how the system hardening initiatives provided in this response are prioritized in comparison to one another.*

Response:

PG&E's process for comparing alternatives within the System Hardening Program is described in Section 7.3.3.17.1(d) above.

ACTION PGE-35 (Class B)

1) *Describe the reason behind the increase in RSE for system hardening between 2020-2022 and 2023-2026, and*

2) *Provide the calculations used to determine the RSEs for both date ranges.*

Response:

The RSE for System Hardening increases between 2023-2026 versus 2020-2022 for a number of reasons, most significantly:

Climate change increases the frequency of ignition and therefore the overall risk, hence the outer years (2023-2026) have higher risk reduction[77] by the deployment of this mitigation program.

In the 2020 RAMP Report, PG&E adjusted risk reduction and RSEs for a mitigation program considering a portfolio of mitigations.[78]

- Increased miles of investment in system hardening means a larger contribution to the overall portfolio risk reduction benefits, leading to higher allocation of portfolio risk reduction; and

- Other cross cutting programs have mitigation benefits that expire in the outer years.

For the details of the risk reduction contribution and allocation, please see Attachment 2021WMP_ClassB_Action-PGE-35_Atch01.

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77 Please refer PG&E's 2020 RAMP Report, pp. 10-17.

78 As discussed in PG&E's post-RAMP filing workshop held on July 14, 2020. See Attachment "2021WMP_ClassB_Action-PGE-35_Atch02."

7.3.3.17.2 System Hardening – Transmission

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative*

1) Risk to be mitigated/problem to be addressed:

The failure of overhead transmission assets can cause an ignition and create wildfire risk. To address this risk, PG&E has a number of programs designed to address the safety and health of our transmission system. In addition, aspects of the transmission system are upgraded or improved to reduce the impact of PSPS events from transmission facilities. PG&E's programs related to the hardening of the transmission system are described in more detail below.

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:

PG&E does not have a single, specific System Hardening Program for our transmission assets. Rather, transmission related programs target the highest wildfire risk areas as identified primarily by PG&E's Operability Assessment (OA) Model, in conjunction with wildfire consequence and/or weather data. These programs have the effect of hardening PG&E's transmission system and mitigating ignition and wildfire risk.

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"):

Transmission line related programs are focused in HFTDs but some are also extended into non-HFTD areas. Efforts associated with these programs are prioritized based on review of OA Model results for asset health, historical performance, wildfire consequence, and PSPS likelihood.

PG&E's programs that are related to hardening the transmission system, including impact reduction of PSPS events, are described below.

(a) Line De-energization, Grounding and Removal

The target of this mitigation program is known or suspected idle facilities. PG&E follows the procedures and requirements in Utility Procedure: TD-1003P "Management of Idle Electric Transmission Line Facilities Procedure" to investigate potential idle facilities. When these facilities are identified and confirmed to be within an HFTD area with no operational needs, they are prioritized for de-energization, grounding, and/or removal. Grounding of an already de-energized line addresses residual wildfire risk of induction from nearby energized line(s), until conductor removal or repurposing of the facilities can occur.

(b) Transmission System Islanding and Temporary Substation Microgrid

In some high wildfire risk scenarios, such as PSPS events, transmission islanding schemes and temporary substation microgrid may be the used to mitigate wildfire risk and reduce customer impact. The islanding schemes (such as the Caribou Power House or Humboldt Bay Power Plant Islands) allow a local area of transmission lines and substations to stay energized via local generation, as the system's primary transmission line sources are de-energized for wildfire safety purposes. The temporary substation microgrid focuses on serving substations that have safe-to-energize load. Both of these mitigations allow for those at-risk lines to be de-energized for wildfire risk mitigation, while keeping customers energized.

c) Overhead Hardening, Inspections, and Maintenance

- **Pole Replacements:** PG&E implemented enhanced design criteria for replacing wood pole structures. Most transmission wood poles are replaced with steel (most commonly light duty steel poles (LDSP)) when warranted based on condition or system capacity needs. LDSP have greater phase-to-phase conductor separation and are designed to accommodate peak wind speeds. Steel structures are also less likely to ignite compared to wood poles and crossarms. LDSP also are designed to reduce bird contact incidents by eliminating the exposure between energized conductors and grounded down guys;

- **Animal Protection Upgrades:** Installation of animal protection upgrades such as bird diverters, crossarm shields, and insulated fiberglass link to reduce contacts and pole related ignition risks is another element of transmission line centric system hardening efforts;

- **Enhanced Inspections and Prioritized Maintenance:** Enhanced inspections are designed to capture condition information aligned with components that can pose an ignition risk. These inspections are performed more frequently in HFTD areas. In addition, inspection methods such as below-grade foundation inspection are being piloted to provide further information on ignition risk failure modes that may not be easily detectable through existing methods. Maintenance work identified through inspections are prioritized (see Section 7.3.3.12.3) based on wildfire risk, wildfire spread consequence and the deterioration mode of the condition found;

- **Sectionalizing Devices:** The addition of transmission line SCADA switches (*see* Section 7.3.3.8.2) provides operating flexibility for lines that traverse HFTD areas. These switches, typically installed at junctions and near substations, can help isolate customers and reduce PSPS impact. During other planned or unplanned line outages, the switches can also be used to reduce outages and shorten restoration time;

- **Asset Replacement:** Though not the sole project driver, asset replacements in HFTD areas help reduce wildfire risk by introducing new assets in place of degraded, out-of-standard, or aged equipment. For major transmission line components—structures, conductor, insulators, and switches—there are corresponding targeted replacement programs to address asset lifecycle and extent of condition concerns. For example, there are several conductor replacement projects for addressing obsolete or failure-prone conductor. In addition, assets may be replaced for compliance or system capacity requirements; and

- **Asset Life Extension:** For some assets not in the highest priority for asset replacements, maintenance programs such as tower coating (see Section 7.3.3.15) and cathodic protection are used to extend useful life of the asset. These programs reduce exposure of steel structures to corrosion, thus maintaining its strength and integrity. Another example of life extension pilot program is installation of buddy bushings in hanger plates, to provide additional support to cold-end hardware such as C-hooks. This fail-safe design is being evaluated for more extensive application.

d) Urgent Fire Rebuild Targeted for System Hardening

During PG&E's emergency response to damaged transmission facilities during the 2020 Lightning Complex wildfire, more robust designs were incorporated into the rebuilt efforts. In addition to hardening the lines upon rebuilding (e.g., replacing prior wood poles with steel), conductor was also replaced to ensure future needs of the circuit or assets are met.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, approximately 2,700 wood pole structures within HFTD areas were replaced with steel. Avian protection retrofits were installed on 78 structures, mostly on the Drum-Rio Oso 115 kV Lines, which had a high likelihood of bird incidents. Approximately 216 miles of transmission rights-of-way (ROW) were cleared within HFTD areas. Approximately 103 miles of conductor replacement was completed on lines traversing HFTD areas.

In 2021, approximately 1,500 wood pole structures within HFTD areas are expected to be replaced with steel. Avian protection retrofits are identified and addressed through maintenance notifications based on activities. The level of retrofit is expected to decrease as more wood poles are replaced with steel and insulated fiberglass links are installed on poles in HFTD areas. Approximately 200 miles of Transmission ROW expansion are planned within HFTD areas. Replacement or removal of approximately 92 miles of conductor on lines traversing HFTD, including associated asset hardware, is planned to be in-service in 2021.

Other maintenance tags, sectionalizing devices, and tower coating progress is described in their respective sections.

In addition, asset health and risk models informing future planning of system hardening work will be updated. It is anticipated that enhancements such as digitized design data and refinements to the corrosion model will be integrated into the OA Model (see Section 4.5.1(h)) in 2021. The vegetation LiDAR Risk Score Model (see Section 7.3.5.8) will also continue to be validated and improved in 2021. Finally, in 2020, PG&E switched over from REAX to Technosylva, which PG&E has adopted for wildfire spread and consequence information. This data was incorporated with the OA Model in 2021 to provide another layer of risk information to existing workstreams.

5) Future improvements to initiative:

Continued development/maturity of asset risk models will help focus mitigations and key issues, leading to a better understanding of most effective inspection, repair, and replace decision making timelines based on asset design, environment, age, and performance and maintenance history. A new initiative is developing machine learning/artificial intelligence models to predict the presence of various asset threats, such as mechanical wear and corrosion.

The Transmission Overhead Asset Information Collection will search historic asset records, engineering drawings and other information to provide new, quality data fields into the system of record. This will provide better data to the various asset health and risk models, improving granularity and reducing the number of assumptions needed to be made around fields such as asset age.

Continued exploration of new technology for inspections and repair will close the gap on non-visual failure modes, as well as provide additional life extension techniques for medium-risk assets.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E is working towards a more granular and centrally accessible asset data in better inform various risk models. These predictive, probability and consequence, models will drive more refined risk-informed maintenance plans, repair prioritization and proactive replacements for all transmission line assets to minimize failure and ignition risk.

Based on maintenance condition assessment and wood pole testing, PG&E projects to replace approximately 56 percent (15,000 of the remaining 26,700) wood poles in the HFTD area with steel poles in the next ten years.

Additionally, PG&E is working towards a steady, sustainable level of replacement for key assets such as structures, conductor, insulators, and switches.

7.3.3.17.3 Non-Exempt Surge Arrester Replacement Program

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative*

1) Risk to be mitigated / problem to be addressed:

The surge arrester sub-initiative is a program that replaces existing non-exempt surge arresters with exempt surge arresters, which have less propensity to cause a fire ignition. In addition, while it is performing replacements, PG&E separates transformer and surge arrester grounds at designated locations.

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:

The purpose of the non-exempt surge arrester replacement program is to remove ignition risks in HFTD areas and an ancillary benefit of this is to modernize the connections and equipment on the pole at these locations which may improve reliability. The replacement of non-exempt surge arresters with exempt surge arresters will reduce wildfire fire risk since exempt surge arresters are considered "non-expulsion" and do not generate arcs/sparks during normal operation.

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"):

The surge arrester program is targeting replacement of non-exempt surge arresters in HFTD areas. PG&E will review lightning strike maps combined with the highest remaining work concentration areas to prioritize completion of surge arresters for 2021. Once HTFD areas are completed this program will be expanded to non-HFTD areas in throughout PG&E's service territory.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In the 2020 WMP, PG&E forecast replacing 8,850 surge arresters in Tier 2 and Tier 3 HFTD areas. The Surge Arrester Program replaced approximately 10,300 as of December 31, 2020. PG&E anticipates mitigating the remaining Tier 2 and Tier 3 non-exempt surge arresters by the end of 2021. Mitigating non-exempt surge arresters generally involves replacing non-exempt surge arrestors and installing grounds at subject locations. In some instances, surge arrestors have already been replaced under other projects, such as new business or fire resiliency projects. In these instances, the surge arrestor program considers these a "mitigated" location as well.

The surge arrestor program not only replaces non-exempt surge arrestors at each location, but also addresses deficient grounding at each location. The initial reason for the surge arrestor program was to provide separate grounds on poles where surge arrestors and transformers were co-located and shared a single ground. By separating the grounds, lightning strikes and other surges can now safely dissipate to their dedicated surge arrestor ground, while not affecting the separately grounded transformer co-located on the same pole.

The installation of grounds at some locations poses unique challenges, especially in heavily granite and lava cap areas in the Sierra and Cascade foothills. Large HFTD portions of the service territory where these surge arrestor mitigations are needed are located in this rocky soil. Geotechnical studies have been conducted, PG&E grounding Standards have been adjusted, and innovative excavation techniques have been incorporated to safely install these grounds. Unfortunately, multiple attempts and techniques are required to complete some of these ground installations.

Every attempt will be made to complete all of the remaining surge arrestor locations in HFTD in 2021. Even with advance geotechnical surveys, the ability to install grounds at some sites may not be known until crews begin excavating. At these locations rock-drilling or blasting may be required which may extend completion of these sites into 2022. Based on prior years success with these rock locations and the variability of terrain we will likely complete a range of 15,000 to 22,000 locations in 2021.

5) Future improvements to initiative:

Once existing non-exempt surge arrestors in HFTD areas are replaced, PG&E will then shift our focus to the system overall.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

This initiative is expected to end by 2023 and thus long-term planning is not applicable.

7.3.3.17.4 Rapid Earth Fault Current Limiter

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) ***Risk to be mitigated / problem to be addressed:***

   A high impedance fault like a wire down or tree contact could remain undetected and become an ignition source. In addition, high impedance line to ground faults on distribution circuits are difficult to detect with traditional overcurrent protection. REFCLs are intended to address these risks.

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:***

   REFCL technology mitigates ignitions from line to ground faults such as wire down or tree contacts using technology called Ground Fault Neutralizer (GFN) that detects line to ground faults and limits the fault current below ignition thresholds.

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"):***

   PG&E initiated a pilot project for REFCL technology in Calistoga based on wildfire risk in that area and historical line-ground outage events. The Calistoga substation and associated circuits (1101 and 1102) met the design criteria for the REFCL system that include 3-wire 12 kV with transformers connected line to line and charging current less than 100 amps.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   The Calistoga REFCL pilot project finished construction in 2020. The field installation involved replacing 15 line reclosers with advanced controllers, replacing 14 sets of line fuses with Fuse Saver devices that trip all three phases, updating all the distribution line voltage regulating devices, and installing 12 capacitive balancing units to balance the circuit capacitance necessary to tune the REFCL system and maintain sensitivity. The substation work included installing the GFN and Arc Suppression Coil with associated controls (Figure PG&E-7.3.3-5) along with upgrading the feeder relays and voltage regulators.

FIGURE PG&E-7.3.3-5: ARC SUPPRESSION COIL / GFN

PG&E plans to have the final results from this pilot project by September 2021. The system testing will involve stress testing the new and existing distribution equipment by energizing the GFN and adjusting the voltage to simulate a line to ground fault condition. The stress test will be followed by a series of fault test where a specialized test trailer will connect to an energized conductor and create an actual line to ground fault condition. During the live test, the actual line to ground current will be measured to ensure currents are below 0.5 amps (below ignition levels) and the GFN activates within the specified times for the conditions. The result of the pilot project will drive the longer-term REFCL strategy.

5) Future improvements to initiative:

Assuming the result of the pilot supports additional deployment, a long-term strategy will be developed to install REFCL in HFTD areas. The project team will identify improvements to design and materials. Future deployments will utilize PG&E's risk model tools to help drive deployment.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

A long-term plan will be developed after successful completion of the pilot and identifications of lessons learned in 2021.

7.3.3.17.5 Remote Grid

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

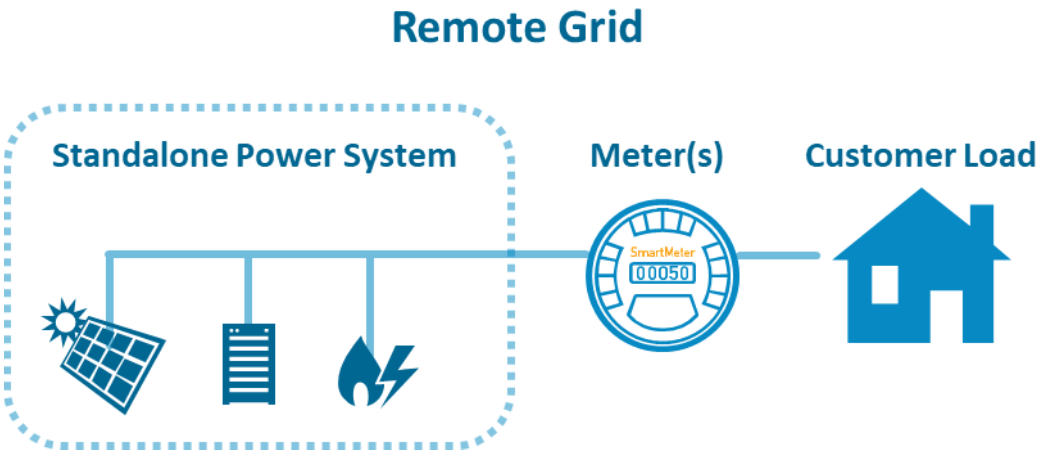
This section describes PG&E's Remote Grid initiative and provides a response to Action PGE-51 (Class B).

1) Risk to be mitigated / problem to be addressed:

Throughout PG&E's service territory, there are pockets of isolated small customer loads that are currently served via long electric distribution feeders. In certain circumstances, these feeders are overhead line construction that traverse HFTD areas and require significant annual maintenance and VM. If these long feeders were removed and the customers served from a local and decentralized energy source (i.e., a "Remote Grid"), the resulting reduction in overhead lines could reduce fire ignition risk as an alternative to or in conjunction with system hardening and other risk mitigations.

"Remote Grid" refers to relatively small, permanently islanded distribution facilities serving customers who are generally located on remote portions of PG&E's distribution system. The Remote Grid facilities include a SPS made up of local sources of electricity supply, such as solar PV generation, battery energy storage, and other distributed generation, as well as distribution and service facilities to connect customers to the SPS. Figure PG&E-7.3.3-6 below provides an example of the components of a Remote Grid.

FIGURE PG&E-7.3.3-6: DIAGRAM OF EXAMPLE COMPONENTS OF A REMOTE GRID



***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*:**

Remote Grid is a new concept for utility service using decentralized

energy sources for permanent energy supply to remote customers as an alternative to energy supply through hardened traditional utility infrastructure. The program leverages clean, emergent technologies such as solar-paired battery storage in a way that is intended to be cost-effective and/or more resilient relative to current distribution service delivery options. The objective of the Remote Grid sub-initiative is to develop and validate the Remote Grid concept as an alternative to other service arrangements and/or wildfire risk mitigation activities such as system hardening. Remote Grids that allow for the removal of lines in high wildfire risk areas could provide benefits to both the customers served by Remote Grids and to all distribution customers who will benefit from the cost-effective elimination of wildfire risks associated with distribution lines that run for significant distances through HFTD areas to serve a small number of remotely located customers. The elimination of these lines will serve two key objectives: (1) reducing the likelihood of fire ignition due to damage or failure of such lines; and (2) elimination or reduction of the cost to harden these lines and to conduct enhanced VM to mitigate the fire-related risks. In addition to acting as an alternative to conventional system hardening approaches for the hardest to reach customers at the end of distribution lines, Remote Grid could help to reduce wildfire risk and be a cost-effective solution for the rebuild of fire-damaged or destroyed infrastructure.

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"):***

Initial Remote Grid project locations were selected in order to validate a range of Remote Grid configurations while simultaneously providing immediate risk mitigation value at a reduced cost when compared to alternative risk mitigations. In 2019 and 2020, PG&E undertook an extensive review of all distribution feeders in Tier 2 and Tier 3 HFTD areas and developed a preliminary screening protocol, to identify potential Remote Grid projects where this alternative distribution method could deliver superior risk-spend efficiency and overall distribution cost reduction (including reduced capital costs). PG&E prioritized sites for detailed evaluation based on a combination of factors including:

- Located at the end of a radial distribution line;
- Consist of a small number and size of customer loads;
- Historically served by a long section of line;
- Preliminary feasibility assessment based on initial customer outreach and desktop screening for technical viability and constructability of a SPS';
- Potential cost savings: Remote Grid vs preferred alternative risk mitigation strategy (e.g., hardened overhead distribution or

underground conversation); and

- Risk ranking of line segment(s) to be eliminated or hardened.

From this list of preliminary screening results, PG&E has applied criteria including customer response, solar access (shading), civil constructability, and site accessibility to identify initial Remote Grid projects which are likely feasible for this early stage of Remote Grid deployment. PG&E believes initial sites can prove successful, both in terms of operational feasibility and in terms of delivering wildfire ignition risk reduction in a more cost-effective manner. Through initial projects, PG&E aims to develop the actual data needed to validate costs, performance, and customer acceptance of the Supplemental Provisions. Further validation is needed to increase the certainty of this portfolio and to identify the "total addressable market" for Remote Grid.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

PG&E has three (3) Remote Grid projects in the advanced stages of development which when completed will eliminate a total of 25.2 miles of overhead line (1.4 miles in HFTD areas and 23.8 miles in non-HFTD areas) by deploying SPS' at 5 locations to serve 10 customer meters. These initial projects are located in San Luis Obispo and Mariposa Counties. Note that the projects in San Luis Obispo County have been delayed due to unforeseen permitting delays due to presence of threatened species. PG&E plans to begin operations of the first Remote Grid project to serve customer load by the end of 2021.

Key accomplishments in 2020 toward validation and standardization of Remote Grids include:

- A detailed protocol was developed to identify and evaluate potential remote grid projects;

- Technical specifications have been iteratively refined through detailed design of the in-flight projects;

- Commercial availability of specialist vendor equipment and services has been verified at the preliminary level through a successful competitive solicitation for design and construction of a SPS;

- Assumptions about upfront capital costs and ongoing maintenance and operations expenses have found initial validation and refinement through a successful negotiation of a turnkey Purchase and Sale Agreement and a 10-year full-wrap Maintenance Agreement, forming a reusable template for future SPS procurements;

- The majority of customers engaged to date have voiced positive initial interest in pursuit of service conversion from overhead line to a Remote Grid;

- Terms of service have been drafted into a form of Supplemental Provisions to the Electric Rules, as a tariffed form agreement;

- The proposed form of Supplemental Provisions Agreement was filed with the CPUC in Advice 6017-E[79] on December 15, 2020; and

- Benchmarking with other utilities shows a point of validation in the advanced program now operational under Horizon Power in Western Australia.[80] In California, Liberty Utilities has procured its first SPS for a similar application.

In addition to the current projects, PG&E has identified and begun development on a portfolio of potential additional Remote Grid deployments designed to validate the viability of this new class of distribution asset. These projects are currently undergoing detailed scoping and feasibility assessment to verify customer interest, environmental requirements, solar access, civil constructability, and site accessibility. After initial assessment of feasibility, projects will move to the design, permitting and build phase which can take 9-12 months or more depending on specific site conditions. 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 requirements and geological conditions, permitting challenges such as presence of threatened species, cultural heritage, or adjacency to scenic highway among others.

In 2021, PG&E will continue to mature the Remote Grid concept toward an eventual standard distribution grid configuration. Experience gained through the deployment and initial operation of the first Remote Grid projects will contribute to refinements in the deployment processes, design and performance standards, customer agreements and operational protocols for the end-to-end Remote Grid solution. PG&E expects to further validate the availability of viable commercial sourcing agreements via another round of competitive solicitations for SPS' and supporting services. In addition, PG&E is seeking CPUC approval of a Supplemental Provisions Agreement to extend and clarify how the existing rules and tariffs apply to a customer served by Remote Grid, and to make clear the roles, restrictions, and responsibilities of both PG&E and the customer.

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79 See AL 6017-E "Remote Grid SPS Supplemental Provisions Agreement": https://www.pge.com/tariffs/assets/pdf/adviceletter/ELEC_6017-E.pdf.

80 https://renewtheregions.com.au/projects/standalone-power-systems/.

5) Future improvements to initiative:

In addition to potential Remote Grid facilities, PG&E is pursuing additional alternative configurations to eliminate the need to harden or rebuild overhead distribution lines in fire-prone areas. The alternative models include the option for PG&E to provide an incentive payment, tied to discontinuance of utility service, that would be sufficient to enable a customer to purchase and maintain its own SPS. If this option for self-provision proves preferable to a PG&E Remote Grid solution for some customers, then it could improve the portfolio reach of the Remote Grid Initiative by enabling broader customer agreement.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

PG&E has not determined a long-term plan yet for this initiative. Pending the success of initial Remote Grid projects, we will be evaluating the reduction in wildfire ignition risk and costs, engineering and execution feasibility, and overall service quality in order to determine the long-term path and program scalability. The long-term goal of the Remote Grid Initiative is to productize Remote Grids as standard offerings such that they can be considered alongside of or in lieu of other conventional service arrangements (including rebuild), and/or wildfire risk mitigation activities such as system hardening, particularly where such alternatives would represent significant costs and/or wildfire risk. Scaling up deployment of Remote Grids will involve creating design standards, developing new planning and decision-making evaluation tools, and establishing operational agreements and commercial arrangements with vendors.

Another long-term goal is to continue to identify other generation and storage technologies that can be effectively utilized in a Remote Grid configuration. Should alternative generation and storage technologies provide similar capabilities while being more favorable to environmental constraints (land availability, solar availability, etc.) and still prove cost-effective, PG&E will continue to incorporate such technologies into the Remote Grid configuration.

ACTION PGE-51 (Class B)

1) Expand on the remote grid initiative in detail and explain the feasibility of it.

Response:

Information requested is incorporated within the narrative provided in Section 7.3.3.17.5 above.

7.3.3.17.6 Butte County Rebuild Program

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

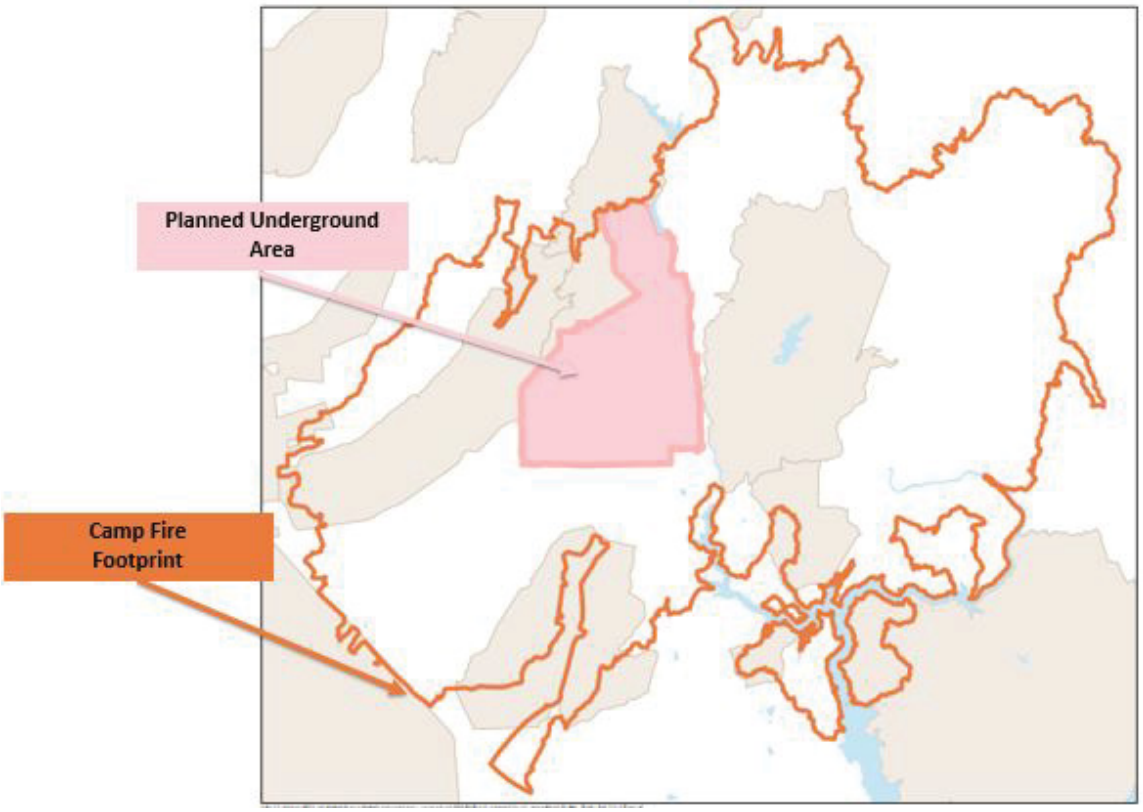
1) Risk to be mitigated / problem to be addressed:

The 2018 Camp Fire devastated the Town of Paradise (Paradise) and surrounding areas in Butte County. The Butte County Rebuild Program is focused on rebuilding the utility infrastructure to serve Paradise and the surrounding County assets destroyed during the Camp Fire in the safest and most cost-effective manner.

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:

In the 2018 Camp Fire, over 18,000 structures were destroyed, including 13,400 premises. The impacted area is primarily in Tier 2 and Tier 3 HFTD areas. Approximately 207 miles of electric distribution lines and 34 miles of gas pipeline were destroyed. Some electric distribution lines, such as the Bucks Creek 1101 circuit, have been burned multiple times in the last decade. Paradise and Butte County have expressed a strong desire for underground utilities, which would reduce fire risk and have the added benefit of reducing routine Vegetation Management costs. PG&E plans to underground all 207 miles of the destroyed distribution assets within a 5-10 year period. Figure PG&E-7.3.3-7 below shows the Butte County Rebuild Program area.

FIGURE PG&E-7.3.3-7: BUTTE COUNTY REBUILD PROGRAM AREA

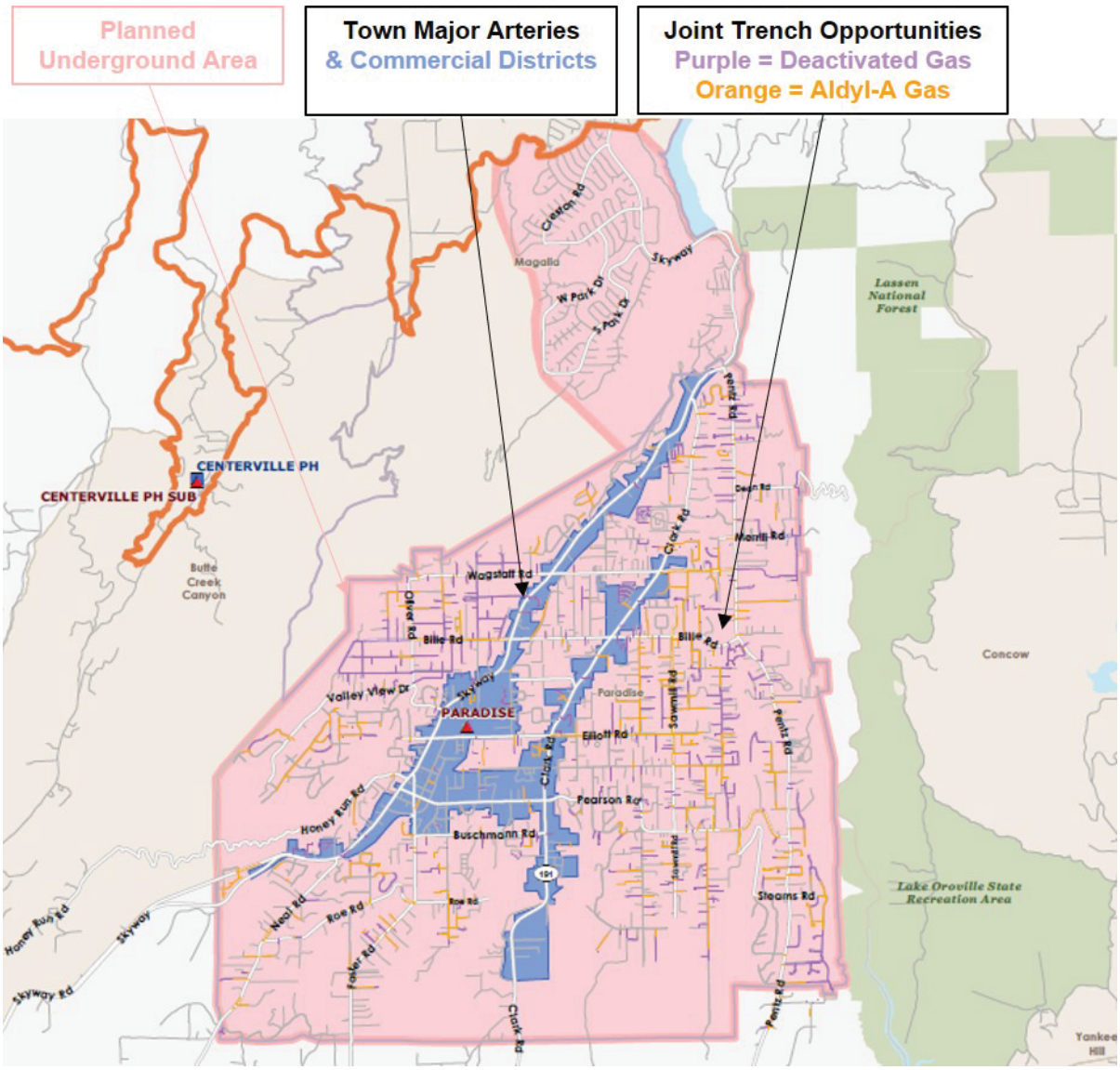


In addition to the electric distribution assets that were destroyed, 34 miles of gas distribution were destroyed by the Camp Fire and must be replaced. PG&E also had plans before the Camp Fire to replace an additional 248 miles of gas distribution pipeline under the Aldyl-A gas pipeline replacement program. For the Butte Rebuild, there is a unique opportunity to cost-effectively underground electric distribution assets by sharing the costs to underground assets in a joint-trench for 58 out of the 207 miles of electric distribution undergrounding.

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"):

The Butte County Rebuild Program is coordinating the project plans closely to align with Paradise's and Butte County's re-development plans with the goal of completing construction in specific areas before Paradise repaves the roads of their main arteries and restores the commercial district. In addition, PG&E also prioritizes restoring areas with deactivated gas destroyed by the fire to prevent customers from needing temporary propane if they are ready to rebuild in those areas. Figure PG&E-7.3.3-8 below provides more detail regarding the Butte County Rebuild Program, including commercial areas and joint trenches.

FIGURE PG&E-7.3.3-8: BUTTE COUNTY REBUILD PROGRAM DETAIL



Finally, Paradise has one of the highest rates of PSPS incidents in the PG&E service territory due to the high fire risk. As the Butte County Rebuild Program is executed over the next several years, it will further enable undergrounded areas of Paradise to remain energized during PSPS events. Scoping for the Butte County Rebuild Program is prioritizing PSPS mitigation while working with the community to align with their rebuild plans

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In our 2020 WMP, PG&E articulated a 2020 goal of completing 20 miles for the Butte County Rebuild Program, counting only those miles in HFTD areas, and completed just over 21 miles in HFTD areas. For the 2021 WMP, PG&E has identified that all work on this project, including those segments that are in non-HFTD areas (the center of Paradise is non-HFTD on the 2018 CPUC HFTD map) are relevant to track and report on as they are all fire rebuild areas, where a prior fire has indicated an elevated wildfire risk. Therefore, for 2021, the Butte County Rebuild Program target is 23 miles (including both HFTD and non-HFTD areas).

5) Future improvements to initiative:

PG&E is developing the base maps for the future electric distribution system in Paradise before estimating all underground infrastructure. The base maps help speed up the design process, which has been a current bottleneck for initiating project construction. PG&E aims to have all base maps complete for all currently scheduled rebuild areas through 2023 by the end of 2021.

ACTION PGE-25 (Class B)

1) Integrate discussion on long-term planning within the respective section of each individual initiative.

Response:

Once the base maps are done, the goal for PG&E is to bundle the underground projects in multi-year contracts with construction firms. This will help drive down construction costs and provide for stable project schedules. PG&E recognizes that there may be a greater need to underground utilities in the future. In coordination with our construction standards team, PG&E is exploring ways to improve underground construction. Two ideas to bring efficiencies to underground construction include:

- Looking into innovative methods to backfill trenches that will reduce trucking emissions, reduce cost, and reduce schedule time; and

- Piloting an underground project in the North Complex Fire rebuild to install a single-phase cable-in-duct to help drive down the cost of underground construction while maintaining quality, improving reliability, and reducing system risk.

Finally, PG&E is working with the Edison Electric Institute and recently launched a disaster rebuild benchmarking survey to share best practices with other utilities on how to strategically rebuild after a major disaster. Once PG&E has evaluated the results of the survey, we may incorporate other new items into our long-term planning.

7.3.4 Asset Management and Inspections

Overview:

This section provides an overview to Pacific Gas and Electric Company's (PG&E) asset management and inspection programs and provides information in response to Action PGE-26 (Class A) identified by the Wildfire Safety Division (WSD) in the evaluation of PG&E's Remedial Compliance Plan.

Preventive maintenance tasks such as enhanced inspections of overhead assets are a key means for PG&E to proactively identify potential failure modes that could lead to ignition if not resolved timely. Through a combination of ground inspection, intrusive wood pole testing, aerial inspections, infrared assessments, and patrols, PG&E seeks to identify conditions that require repair or replacement of assets prior to failing. Previously, PG&E utilized a time-driven cycle to prescribe patrol and inspection activities to transmission circuits or distribution plat maps. Since 2019, PG&E has undertaken efforts to develop risk-informed models that prioritize preventive asset patrol and inspection activity cycles aligned with the risk of wildfire ignition, including increasing the frequency of such preventive tasks in High Fire Threat District (HFTD) Tiers 2 and 3. Similarly, the evaluation and finalization of corrective findings by a Centralized Inspection Review Team (CIRT) was established for distribution, transmission, and substation inspection programs in 2019 and continues as a core component of the patrol and inspection program.

For 2020 through 2022, PG&E considers enhanced detailed inspections of overhead assets, which exceed the minimum requirements of General Order (GO) 165 to include the following tasks:

- Distribution: digitized capture of detailed visual inspection via checklists and photographic documentation from a ground vantage point; and

- Transmission: digitized capture of detailed visual inspection via checklists and photographic documentation, both from ground position and by aerial vantage, are coupled to complete an enhanced inspection cycle; and

- Transmission (500 kilovolt (kV)): this examination also includes structural integrity assessment of tower structures via climbing inspection.

The supplemental (enhanced) substation inspections carried on in addition to the baseline GO 174 inspections include digitized capture of detailed visual inspection via checklists and photographic documentation, both from ground vantage and by aerial means, coupled to complete an enhanced inspection. Supplemental enhanced substation inspections also include an infrared (IR) assessment of the station equipment in addition to the visual inspection.

Action PGE-26 (Class A)

In its 2021 Wildfire Mitigation Plan (WMP) update, PG&E shall explain whether and where enhanced inspections have replaced or been merged with routine inspections. PG&E shall also describe the areas outside of the HFTD that have had routine inspections replaced by enhanced inspections.

Response:

Enhanced inspections, meaning the use of digital checklists, documentation of asset features, capture of standard imagery, and centralized inspection review of findings, as well as work quality monitoring, have been applied systemwide for overhead transmission and distribution assets as of 2020 detailed inspection cycles. This includes ground, climbing, and aerial inspection collection methods in transmission and distribution, whether in HFTD or otherwise. Corrective findings from patrol inspections, IR inspections, and other emergent inspection methods are also subjected to centralized inspection review, but those patrol and inspection methods have not yet shifted to use the electronic documentation approach and remain largely paper based in their documentation.

Although the approach to digital data capture for enhanced inspections in HFTD and non-HFTD areas is the same, the frequency of inspections and specific checklist content may be different. For 2020 through 2022, PG&E intends to complete enhanced detailed inspections of overhead electric assets in HFTD areas at the following recurrence interval:

- HFTD Tier 3 annually; and
- HFTD Tier 2 every three years.

Aerial inspections of overhead transmission assets in the following recurrence interval:

- HFTD Tier 3 annually; and
- HFTD Tier 2 every three years.

Climbing inspections of 500kV transmission tower structures in the following recurrence interval:

- HFTD Tier 3 annually; and
- HFTD Tier 2 every three years.

Patrol inspections (patrols) of overhead assets of transmission and distribution in the following recurrence interval:

- HFTD Tier 2 on years when enhanced detailed inspections are not scheduled (e.g., two of every three years).

Infrared patrols of overhead assets of transmission, and substation in the following recurrence interval:

- HFTD Tier 3 annually; and
- HFTD Tier 2 every three years.

Infrared patrols of overhead assets of distribution in the following recurrence interval:

- HFTD Tier 3 1/3 annually for three years; and
- HFTD Tier 2 1/3 annually three years.

Supplemental Ground and Aerial Inspections of Substation assets in the following recurrence interval:

- HFTD Tier 3 annually; and
- HFTD Tier 2 every three years.

Intrusive wood pole inspections of overhead wood poles in the following recurrence interval:

- Within 15 years of wood pole installation date, and every ten years thereafter.

Aside from locations with access constraints, PG&E plans to complete these enhanced inspections in HFTD Tiers 2 and 3 locations before July 31, 2021.

7.3.4.1 Detailed Inspections of Distribution Electric Lines and Equipment

Wildfire Safety Division (WSD) Initiative Definition: *In accordance with GO 165, careful visual inspections of overhead electric distribution lines and equipment where individual pieces of equipment and structures are carefully examined, visually and through use of routine diagnostic test, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each rated and recorded.*

1) Risk to be mitigated/problem to be addressed:

Enhanced detailed inspections of overhead distribution assets seek to proactively identify and treat pending failures of asset components which could create fire ignition if left unresolved or allowed to "run to failure." Proactive identification of Level 2 and Level 3 GO 165 concerns also permits PG&E to evaluate potential investments in risk mitigation activities such as system hardening, enhanced vegetation management, reconductoring, among other programmatic tools.

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.

PG&E's prior practice of completing inspections and patrols on a time-driven cadence has been enhanced to address the increased risk from overhead asset or component failure in HFTD areas. Moreover, the scope of inspections has expanded to identify potential equipment issues that could cause a wildfire ignition. PG&E's prior inspection practice resulted in a corrective notification creation rate of 11 percent for distribution facilities. Our current enhanced inspection protocols yielded corrective notification creation rates of 23 percent in 2020 for distribution facilities. In addition to identifying potential equipment issues which may result in an ignition, the enhanced inspections also improve our visibility to field conditions which may inform new programmatic asset risk management responses or guidance clarifications.

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.")

Selection criteria of assets for each inspection cycle is driven by factors such as location, system operating criticality, public safety concerns, and overall risk modeling. Assets that continually show signs of concern can be inspected more frequently. The resulting "1-to-n" prioritization of assets by circuit ranking is then coupled with operational field knowledge and constraints, including restricted physical access periods, to develop an annual schedule for completion. In general, PG&E schedules patrol and inspection activities in Tier 2, Tier 3, and Zone 1 HFTD areas earlier in the year to provide time for necessary repairs prior to peak fire season.

4) Progress on initiative (amount spent, regions covered) and plans for next year.

For 2020 through 2021, enhanced inspections of overhead distribution assets, which exceed the minimum requirements of GO 165, included the following: (1) digitized capture of detailed visual inspection via checklists and photographic documentation from a ground vantage point; and (2) digital checklists that align to the Failure Modes and Effects Analysis (FMEA) for the structure, associated equipment and components. Both objective and subjective criteria are used to evaluate the condition of the asset and identify corrective actions. Examples of components evaluated during enhanced overhead inspections include anchors and guys, conductor, equipment, hardware and framing, structure. For the 2021 enhanced inspection cycle, the checklist for distribution inspections includes 14 unique components across 55 questions/246 possible answers.

In 2020, PG&E completed approximately 98 percent of distribution poles in Tier 3 and 33 percent of the distribution poles in Tier 2 of overhead distribution enhanced inspections and projects.[81] Additionally, PG&E also completed 45 percent of the distribution poles in non-HFTD areas.

For 2021 through 2022, PG&E plans to complete enhanced detailed inspections of overhead distribution assets in the following recurrence intervals: (1) Tier 3 and Zone 1 – annually; and (2) Tier 2 and High Fire Risk Areas (HFRA) within the non-HFTD – 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.

5) Future improvements to initiative

For 2021 and beyond PG&E will be leveraging the latest risk model, currently the 2021 Wildfire Distribution Risk Model, to drive the selection of assets to be inspected and work planning. Based on PG&E's experience in 2019 and 2020, future improvements to this initiative may include: reviewing or revising inspection cycles in alignment with the latest wildfire consequence modelling, updating inspection criteria and wording to increase objectivity and deliver more consistency between evaluators, and evaluating our corrective work prioritization thresholds to more directly mirror General Order 95 Rule 18 (levels 1, 2, 3 versus PG&E's historic A, B, E, F prioritization). During the enhanced inspections, PG&E has collected a substantial amount of digital records and photo documentation regarding the condition of distribution facilities. In 2021, the continuation of the digital records collection and photo documentation will enable ongoing asset registry improvements.

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81 Please see Voluntary Self-Identified Notification: GO 165 and WMP Enhanced Inspections, dated May 7, 2021, for further information.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

Future improvements to detailed inspections of overhead distribution electric lines and equipment will focus on broader incorporation of enterprise information, evolution of questionnaires and technology, and continued insourcing of inspection resources. Specifically, future improvements may include further integration of data sets and systems to expedite data corrections identified during the inspection task. This could include further integration with customer billing data, GIS (Geographic Information System) and asset risk models that either provide or utilize data collected during inspections. Similarly, the questionnaires which guide inspection reports may also evolve to incorporate more or fewer questions in response to the differing risk profiles of the specific assets. In addition, PG&E may make investments in emerging technologies such as Machine Learning and Artificial Intelligence for visual data recognition and analysis. Long-term recurrence intervals for HFTD Tiers 3 and 2 assets may be tailored based upon more comprehensive asset health and risk models, such that the inspections are deployed on an as-needed basis, rather than the current annual and triennial cycles, respectively. Concurrently, PG&E plans to continue development of long-term internal staffing models that limit reliance upon external vendor personnel and provide more consistency in workforce cycle over cycle. This includes reintroduction of Knowledge Assessments for measuring the skill and competence of the Qualified Company Representative (QCR) hired or contracted to perform asset inspections.

7.3.4.2 Detailed Inspections of Transmission Electric Lines and Equipment

WSD Initiative Definition: *Careful visual inspections of overhead electric transmission lines and equipment where individual pieces of equipment and structures are carefully examined, visually and through use of routine diagnostic test, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each rated and recorded.*

In this section, PG&E provides information regarding transmission line inspections and provides a response to Action PGE-17 (Class B).

1) Risk to be mitigated/problem to be addressed:

Enhanced detailed inspections of overhead transmission assets seek to proactively identify and treat pending failures of asset components which could create fire ignition if left unresolved or allowed to "run to failure." Proactive identification of Level 2 and Level 3 GO 165 concerns also permits PG&E to evaluate potential investments in risk mitigation activities such as system hardening, enhanced vegetation management, reconductoring, among other programmatic tools.

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.

PG&E's expanded inspections are expected to identify precursors of overhead asset or component failure in HFTD areas, which can cause a wildfire ignition. PG&E's previous inspection program generated 10,137 corrective notifications for transmission facilities in 2018. Our current checklist-guided inspection protocols yielded 52,399 corrective notifications from 26,282 enhanced transmission inspections in 2020 (both ground and aerial evaluation). In addition to identifying potential equipment issues which may result in an ignition, the enhanced inspections also improve our visibility to field conditions which inform new programmatic asset risk management responses or drive guidance clarifications.

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.")

Selection criteria of assets for each inspection cycle is driven by factors such as location, system operating criticality, public safety concerns, and general risk modeling. For example, a 500 kV tower providing bulk power transport within HFTD Tier 3 will be inspected more frequently than a 60 kV structure in a non-HFTD area, with low public safety threat. In regard to asset health, the Transmission Operability Assessment Model is directly informed by enhanced inspection results from 2019 or 2020. Assets that continually show signs of concern can be inspected more frequently. The "1-to-n" prioritization of assets by circuit ranking is then coupled with operational field knowledge and constraints, including restricted physical access periods, to develop an annual schedule for completion. In general, PG&E schedules patrol and

inspection activities in Tier 2, Tier 3, and Zone 1 HFTD areas earlier in the year to provide time for necessary repairs prior to peak fire season.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

For 2020 through 2022, PG&E considers enhanced inspections of overhead transmission assets to include the following: (1) digitized capture of detailed visual inspection via checklists and photographic documentation from a ground and aerial vantage point; and (2) digital checklists that align to the FMEA for the structure, associated equipment and components. For 500 kV transmission facilities, this examination also includes structural integrity assessment of tower structures via climbing inspection.

Enhanced detailed inspections are guided by digital checklists that align to FMEA for the structure, associated equipment and components. Both objective and subjective criteria are used to evaluate the condition of the asset and identify corrective actions. Examples of components evaluated during enhanced overhead inspections include anchors and guys, conductor, insulators, equipment, hardware and framing, structure. For the 2021 enhanced inspection cycle, the transmission ground checklist includes 26 unique components across 97/359 possible answers questions. Aerial transmission inspections encompass 14 components and 95/322 possible answers to questions.

PG&E intends to complete enhanced detailed inspections and aerial inspections of overhead transmission assets in the following recurrence interval: (1) Tier 3 and zone 1 – annually; and (2) Tier 2 and HFRA within the non-HFTD every three years. In addition, PG&E intends to complete aerial inspections of 500kV tower structures irrespective of the HFTD location every three years.

In 2020, PG&E completed 26,282 units of overhead transmission enhanced inspections and projects. This represents 100 percent of HFTD Tier 3 transmission structures and 33 percent HFTD Tier 2 structures as defined in the 2020 WMP. Similarly, PG&E planned to complete aerial inspections (drone, helicopter, aerial lift-vehicle) for 25,412 assets.

In 2021, for HFTD and HFRA transmission assets, PG&E plans to continue these protocols and re-inspection intervals consistent with 2020. In 2021, 100 percent of overhead transmission poles in HFTD Tier 3 and Zone 1, roughly one third of poles in HFTD Tier 2 and HFRA 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.

5) Future improvements to initiative:

For 2021 and beyond PG&E will be leveraging the latest risk model to drive the selection of assets to be inspected and work planning. Based on PG&E's experience in 2019 and 2020, future improvements to this initiative may include: reviewing or revising inspection cycles in alignment with the latest wildfire consequence modelling, updating inspection criteria and wording to increase objectivity and deliver more consistency between evaluators, piloting and adoption of new inspection technology to target difficult to detect failure modes. During the enhanced inspections, PG&E has collected a substantial amount of digital records and photo documentation regarding the condition of distribution facilities. In 2021, the continuation of the digital records collection and photo documentation will enable ongoing asset registry improvements. In addition, PG&E will explore investments in emerging technologies such as Machine Learning and Artificial Intelligence that may eventually expedite visual data recognition and analysis.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Going forward, detailed transmission inspection data will be trended and measured to ensure that proactive identification of asset threats is effective. In-service failure data will also be analyzed to identify any gaps in methodology. As discussed in Section 7.3.4.10, additional methods of inspection, if proven effective, may become part of the system inspection cadence. Furthermore, asset inspection cycles, with the benefit of robust data and asset health modeling (e.g., the OA Model) will be further risk-informed (e.g., more targeted application of annual inspections based on probability and consequence rather than all HFTD Tier 3 areas as is the current practice). This risk-informed inspection frequency may also vary by component, as certain components (e.g., structure, switch, insulator, etc.) may warrant more frequent, targeted inspection than other components.

ACTION PGE-17 (Class B)

1) Define "asset investment opportunities" and, 2) explain how these opportunities benefit from enhanced inspections.

Response:

1) Asset investment opportunities are defined by work that supports the asset management plan, meaning optimized management of the transmission line asset inventory, assessment of asset conditions, performance and performance measures, risks and efforts to mitigate those risks, as well as associated life cycle management costs. For example, rotten wood poles identified through enhanced inspections may become an asset investment opportunity by converting the wood pole to steel upon replacement to address risk, or by bundling the pole replacement with other work needed from an asset

management perspective—such as insulator replacement, conductor replacement, etc.

2) These opportunities benefit from enhanced inspection in several ways. First, timely identification of issues through enhanced inspections allows for bundling opportunities and potential to “build for the future,” choosing appropriate structure class or circuit size to meet existing and future environmental and electrical capacity needs. Second, identification of issues through enhanced inspections allows for system trending. These trends and extent of condition analysis can inform proactive programs for targeted replacement.

7.3.4.3 Improvement of Inspections

WSD Initiative Definition: *Identifying and addressing deficiencies in inspections protocols and implementation by improving training and the evaluation of inspectors.*

1) ***Risk to be mitigated/problem to be addressed:***

   Effective inspections are critical to identify equipment conditions and issues that may result in equipment failure creating a potential wildfire ignition risk. In addition, inspection information provides critical supports for the refinement of our asset investment and operational risk models.

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.***

   To drive repeatability in results and reduce costs over time, inspection tools, methods, and guidance are evaluated for improvement opportunities at least annually.

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.")***

   Inspection processes generally cover PG&E's entire service area. In addition, PG&E has implemented protocols and processes for enhanced inspections in Tier 2 and Tier 3 HFTD areas because of the greater wildfire risk associated with these areas. The selection of assets is driven by a risk ranking performed by Asset Management to prioritize enhanced inspection activities to assets with higher relative risk scores.

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

   Inspection programs are evaluated at the close of each annual cycle by a cross-functional team from the inspection execution team as well as asset strategy and standards to identify opportunities to improve efficiency and effectiveness of the programs. Such changes to improve inspection effectiveness may include expanded visual references, further refinements of definitions and terms, or the inclusion of secondary or nested questions to provide further detail. For example, in 2020 the programs reviewed and updated 2019 Wildfire Safety Inspection Program (WSIP) checklist software tool, checklist wording, question formatting, software tool performance, and reference materials to guide more consistent and repeatable results. For 2021, a similar retrospective assessment was performed. Revisions in all overhead inspection checklists to refine the flow and wording, as well as to address gaps in content from prior cycles, such as presence of non-exempt equipment, and new criteria for cold end hardware degradation (C-hooks) were completed as a result. Annual refresher trainings were delivered in 2020. Revised orientation trainings are prepared for both incumbent and new inspection personnel in 2021 as well.

5) Future improvements to initiative.

For 2021, results of inspections in 2020 cycle were used to identify areas of further refinement in 2021 training materials and job aids, to improve repeatability of results. The continued build out of internal quality management staffing and protocols for sampling and process quality monitoring seeks to create a rapid feedback loop to frontline personnel and leaders. This feedback identifies inspectors, programs, and questions that are problematic in some manner and may require corrective intervention. For example, inspectors who have abnormally low or high corrective finding rates relative to peers in similar areas, or questions which result in a large number of CIRT adjustments (escalating or de-escalating priorities) may need to be clarified or retrained to inspectors. Additional technology tool investments are also in progress to improve field performance of hardware (connectivity, battery life) and usability of the mobile application (integration of additional GIS and SAP data sets, work flow enhancements) as well as back office support tools that visualize the annual work plan and progress against execution of inspection. Finally, analytics and trending of conditions found through enhanced inspection will continue to inform future condition-based inspection cycles.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Long-term, PG&E's inspections programs will continue to refine asset data and condition collection needs, modify approaches to support varying risk profiles of assets, and pursue execution efficiencies. PG&E anticipates that asset detail inspection questionnaires will be refined cycle over cycle to focus on collection of data that changes over time and is utilized in various asset health and risk models across the enterprise. The strategy to applying inspection treatment types may also evolve to seek more or less overlap of inspection programs (patrol, detail, IR, LiDAR, PT&T, etc.), depending on the specific risk profile of the target assets. PG&E will also work to build more cross-program execution alignment via process and technology changes to reduce duplicate "touches" of the same asset in a given inspection cycle.

7.3.4.4 Infrared Inspections of Distribution Electric Lines and Equipment

WSD Initiative Definition: *Inspections of overhead electric distribution lines, equipment, and right-of-way using infrared (heat-sensing) technology and cameras that can identify "hot spots", or conditions that indicate deterioration or potential equipment failures, of electrical equipment.*

In this section, PG&E addresses Infrared Inspections for electric distribution lines and provides the responses to Actions PGE-54 (Class B), PGE-55 (Class B), and PGE-56 (Class B).

1) Risk to be mitigated/problem to be addressed:

Although the majority of failure modes can be detected via visual inspections required by existing rules and regulations, there are some that may not be easily detectable (e.g., components experiencing excessive heat condition). Lack of detection can lead to asset failure and associated consequences. For that reason, PG&E has adopted an infrared inspection program that go beyond mandated inspections in order to identify these potential risks and address them before a failure occurs.

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.

Excessive heat can contribute to component failure. Abnormal conditions attributed to excessive heat in distribution components (e.g., connectors, splices, transformers) are difficult to find during an enhanced ground inspection. Infrared inspections help identify potentially damaged and/or faulty components that are not detectable by visual inspection methods alone. In addition, infrared assessments can potentially prevent wire down equipment failures and help pinpoint areas for maintenance and conductor replacement. Infrared technology provides the opportunity to identify “hot spots” utilizing infrared imaging and temperature measuring systems to detect and record heat radiation from a target relative to its surrounding measurements. The Distribution Infrared program utilizes trained contractors to identify hot spots (abnormal temperature) for corrective action.

PG&E uses infrared inspections on distribution circuits in the HFTD to help detect and correct abnormal conditions. Overhead infrared inspection is not a mandated inspection requirement. Infrared technology provides the opportunity to identify abnormal conditions “hot spots” by utilizing infrared imaging and temperature measuring systems to detect and record heat radiation from a target relative to its surrounding measurements. Based on historical infrared results we expect IR to effectively detect abnormal heat in the following assets: Conductors, Jumpers, Splices, Connectors, Transformers, Fuses, Cutouts, Arresters, Switches.

In 2021, infrared inspections will be performed in conjunction with enhanced ground and aerial inspections, but will not be considered as, or substituted for, a detailed inspection. Any findings are coupled with the infrared image to

initiate SAP corrective maintenance tags, prioritized in accordance with TD-2022P-01 (IR Inspections of Electric Distribution Facilities).

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.")***

The 2020 HFTD infrared distribution circuit plan utilized the 2019 REAX scoring component to rank each circuit and was used to select the 2020 HFTD infrared circuit list.

For 2021, PG&E's HFTD infrared plan will evaluate using the new distribution risk model for primary overhead conductor which uses Technosylva instead of REAX modeling. Unlike the 2019 circuit scoring model, the new overhead conductor model includes a probability and consequence component to derive the actual risk score at the protection zone level.

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

PG&E generally schedules patrol and inspection activities in Tier 2, Tier 3, and Zone 1 HFTD areas earlier in the year to provide time for necessary repairs prior to peak fire season. However, infrared inspections are deployed in a targeted manner as the effectiveness of the technology is heavily influenced by the level of electric load in the lines being inspected. If the electric load is low, it can be challenging to capture meaningful data through Infrared inspections.

PG&E relies on contract resources to perform infrared patrols. Our prime contractor was unable to hire enough qualified electrical worker infrared inspectors to complete the required infrared patrols in 2020. The 2020 HFTD infrared plan target for distribution included 151 circuits and approximately 8,300 circuit miles. As of December 29, 2020, 120 circuits and 5,450 circuit miles were completed in HFTD areas.

To help address potential resource limitations in the future, PG&E contracted with a second firm in 2020 on a pilot basis, as an alternative resource for performing infrared patrols. After the successful pilot of this second vendor, PG&E will continue to work with at least two vendors, while evaluating others as well, to complete PG&E infrared patrols in future years.

The current 2021 distribution infrared plan is to complete approximately one-third of the HFTD area circuits based on funding levels and similar to the Tier 2 enhanced inspection cycle.

5) Future improvements to initiative.

PG&E is continuing to evaluate what technical improvements can be made when utilizing infrared technologies for increased effectiveness. Additionally, PG&E is evaluating what technologies can be paired with Infrared inspections to improve operations efficiency, such as better mapping, upgraded equipment and computing power.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E has not determined a long-term plan yet for this initiative. We will be evaluating the use of alternate technologies such as drones versus current handheld and vehicle mounted cameras. The evaluation would review whether access is better suited for drone use from time to result efficiency. It would also include a review of the technology itself (valid IR image extracted)

Long-term plan milestones are still under development with Electric Operations and Asset Management. In order to facilitate that review, an analysis of inspection findings will be done. This will allow PG&E to better understand effectiveness at reducing asset failures. Finally, in the longer term, PG&E will be able to analyze data to determine if a greater reduction in asset failure could be attained by increasing the annual scope mileage of the program.

ACTION PGE-54 (Class B)

1) Provide the source that states 70 percent of IR findings are not identified visually, and

2) Provide the percentage of PG&E findings via IR that were not identified during prior visual inspections.

Response:

1) The 70 percent statistic was an approximation based on internal employee knowledge when reviewing the IR findings known as hot spots relative to a visual inspection without an IR tool. The fact that IR inspections can identify findings that would not be identified in a visual inspection is also supported by industry literature. In the Electric Power Research Institute's (EPRI) Distribution Infrared Inspection Guidebook #3002007982 dated December 2016, EPRI concluded that "Infrared inspection identifies heating equipment needing maintenance or replacement that visual inspection usually cannot." (Page 1-1). The EPRI guidebook also notes that "excessive equipment heating cannot normally be visually distinguished, but it can be observed using an infrared camera (IR) camera." (Page 2-3).

2) PG&E's IR inspections are separate from the other inspection programs and they are not on the same schedule. In some instances, the two separate inspection programs could be a year apart and thus it would not be applicable to compare them because an incident or issue may have occurred after one inspection but before the other inspection. The review of IR findings that were not identified in prior visual inspections is something that PG&E could consider for our long-term analysis of the program, although, as explained, it may be difficult to draw conclusions from such a review given the differing timing of inspections.

ACTION PGE-55 (Class B)

1) Provide the expected risk reduction for using IR inspections, as well as all inputs and algorithms used for the calculation, and

2) Provide the estimated cost savings, both overall and per Overhead circuit mile, that IR inspections provide.

Response:

1) The Expected Risk Reduction and Risk Spend Efficiencies for IR inspections are provided in Table 12 in Attachment 1 – All Data Tables Required by 2021 WMP Guidelines.xlsx and the associated workpapers.

2) PG&E estimates the cost savings based on the comparison between the cost of IR inspection versus the cost of an outage and the cost of an outage that could lead to an ignition. The cost of the program is approximately $2.2M, or $155 per mile. In 2020, there were 67 B tags identified by infrared inspection. With an estimation of 50% of the B tags leading to a failure within 1 year, the anticipated number of failures prevented from IR inspections is 33.5 potential failures. Based on the financial cost of an outage and the financial cost of an ignition (including the likelihood of an ignition), the estimated cost of an outage is approximately $96,000. Multiplying this by 33.5 potential failures means the IR inspections provided a cost savings of approximately $3.2M.

   Financial cost estimations were derived by the following:

   Based on the 2020 RAMP Report, PG&E gathered the associated financial cost of an outage and an ignition, used to support the Failure of Distribution Overhead Failure and Wildfire risk assessment.

   The financial cost of an outage was based on 2017-2019 outages associated with distribution, details seen in Attachment 2021WMP_ClassB_Action-PGE-55_Atch04.xlsx. These costs were used as inputs for the Financial consequence in the assessment of Distribution Risk. By dividing the annual financial consequence by the annualized number of outages for distribution, shown in Attachment 2021WMP_ClassB_Action-PGE-55_Atch02.xlsx, PG&E calculates an average cost of an outage to be ~$5,000.

   The financial cost of an ignition was based on a combination of 2015-2019 PG&E data, shown in 2021WMP_ClassB_Action-PGE-55_Atch05.xlsx for smaller ignitions and CALFIRE data, shown in 2021WMP_ClassB_Action-PGE-

55_Atch06.xlsx for larger ignitions. These costs were used as inputs for the Financial consequence in the assessment of the Wildfire Risk. By dividing the annual financial consequence by the annualized number of ignitions, shown in 2021WMP_ClassB_Action-PGE-55_Atch03.xlsx, PG&E calculates an average cost of an ignition to be $5.2 million. However, given that not every outage results in an ignition, PG&E adjusted the dollars of an outage that could lead to an ignition by dividing the annual number of ignitions / annual number of outages, which is approximately 1.76%. By multiplying the financial cost of an ignition of $5.2 million x 1.76%, the financial cost of an outage that could lead to an ignition is an additional ~$91,000.

Between the cost of the program and the cost savings, it is anticipated that this activity saves approximately $1 million per year, or $75 per mile. Details of the calculation can be seen in Attachments 2021WMP_ClassB_Action-PGE-55_Atch01.xlsx, 2021WMP_ClassB_Action-PGE-55_Atch02.xlsx, and 2021WMP_ClassB_Action-PGE-55_Atch03.xlsx.

ACTION PGE-56 (Class B)

1) *Explain why IR inspections are used to determine splice count, and why it does not currently retain that information otherwise.*

Response:

PG&E does not have a comprehensive primary splice database; however, as part of the IR program, we started collecting primary splices from 2013-2019. Since the purpose of this effort was to help identify the location of deteriorated conductor, only spans with more than three (3) splices in an individual phase were collected. These splices are currently in a map guide GIS system and displayed by span (max/phase and total/span).

The IR inspection was one of several ways that PG&E has collected primary splice counts. Primary splices are also collected during vegetation management patrols following vegetation cased outages and collected in the past if a distribution engineer went into the field to complete an equipment failure wire down review.

PG&E intends to leverage the INSPECT app to collect splice counts in the future. Retention of this information will be migrated from map guide to ED GIS (PG&E's current Electric Distribution GIS platform).

The primary splice database is currently used to determine conductor health and scope limits of projects.

7.3.4.5 Infrared Inspections of Transmission Electric Lines and Equipment

WSD Initiative Definition: *Inspections of overhead electric transmission lines, equipment, and right-of-way using infrared (heat-sensing) technology and cameras that can identify "hot spots", or conditions that indicate deterioration or potential equipment failures, of electrical equipment.*

1) ***Risk to be mitigated/problem to be addressed:***

   Infrared inspections help identify potentially damaged and/or faulty components that are not detectable by visual inspection methods alone. In addition, infrared assessments can potentially prevent wire down equipment failures and help pinpoint areas for maintenance and equipment replacement.

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.***

   Infrared technology provides the opportunity to identify “hot spots” by utilizing infrared imaging and temperature measuring systems to detect and record heat radiation from a target relative to its surrounding measurements. Based on our FMEA, we expect IR to effectively detect:

   - Hot/Heating Conductors, Jumpers, Splices, Contacts/Live Parts, Quick Break Attachments;
   - Loose Splices, Clamps; and
   - Contaminated Insulators.

   Infrared inspections will be performed in conjunction with enhanced ground and aerial inspections, but will not be considered as, or substituted for, a detailed inspection.

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.")***

   PG&E prioritizes infrared inspections in Tier 2 HFTD areas every three years and in Tier 3 HFTD areas every year. Infrared inspections are deployed in a targeted manner as the effectiveness of the technology is heavily influenced by the level of electric load in the lines being inspected. It is generally necessary for lines, or segments of lines, to be loaded to 40 percent or greater of the operating ratings in order to perform a meaningful infrared inspection. Lines operating at significantly lower or no load will therefore not be able to be inspected using infrared technology.

4) Progress on initiative (amount spent, regions covered) and plans for next year.

In 2020, infrared inspections were performed on all summer-peaking transmission lines with structures in Tier 2 or Tier 3 HFTD areas. Winter peaking transmission lines with structures in Tier 2 or Tier 3 will have Infrared inspections performed in January/February 2021. In total, the 2020 transmission Infrared program covered 5,313 miles.

For 2021, we plan to conduct Infrared inspections on 100 percent of transmission circuits in Tier 3 HFTD areas, 33 percent of transmission circuits in Tier 2 HFTD areas, and 20 percent 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.

5) Future improvements to initiative.

We currently intend to utilize the 2020 data to trend and analyze the effectiveness of this technology compared to the other inspection methodologies currently employed. In addition, PG&E will evaluate opportunities to combine the infrared sensor technology with other aerial visual data capture on the same flight to drive improved cost efficiencies where possible.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

For infrared inspection, PG&E will continue to evaluate the effectiveness of infrared through benchmarking and calibration of the methodology. If deemed effective, PG&E will continue to use infrared inspections in the transmission line inspection cycle. If deemed ineffective, alternate methods of failure mode identification must be identified, piloted, proven effective and deployed. Effectiveness measures will be established to ensure long term goals of the program (proactive identification of asset threats) are met.

7.3.4.6 Intrusive Pole Inspections

WSD Initiative Definition: *In accordance with GO 165, intrusive inspections involve movement of soil, taking samples for analysis, and/or using more sophisticated diagnostic tools beyond visual inspections or instrument reading.*

1) ***Risk to be mitigated/problem to be addressed:***

   Intrusive pole inspections, also called Pole Test and Treat (PT&T), are a way to evaluate in-service wood poles and are conducted on an approximate 10-year cycle for early detection of deterioration. These inspections can be effective in identifying wood poles that need to be replaced before a pole failure, which may result in an ignition event.

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.***

   PT&T prolongs the service life of wood poles through reapplication of preservative and/or restoration of structural strength through reinforcement. PT&T identifies poles that are nearing the end of their service life and recommends these poles for replacement prior to failure. PG&E's PT&T program has existed since 1994 and is fully implemented across transmission and distribution wood pole structures.

   Intrusive wood pole testing involves the direct measurement of shell thickness, examination of below grade degradation, and application of preservatives. Intrusive wood pole testing is a control against premature or unintended failure of wood pole structure due to shell degradation.

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.")***

   Selection criteria of assets for each inspection cycle is driven by the date of wood pole installation into service. GO 165 requires a maximum 20-year cycle through the life of the wood pole, and PG&E prescribe an initial interval of 15 years, with a recurrence of 10 years thereafter. In 2021, the HFTD location is not a factor in the selection of wood poles for intrusive testing, however enhanced inspections may trigger the need for off cycle intrusive testing based upon initial visual examination.

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

   PT&T annually examines approximately 10 percent of PG&E's wood poles, or roughly 240,000 poles, and historically identifies approximately 8,000 units which require remediation, up to and including replacement.

   In 2020, PG&E completed approximately 238,000 units of intrusive wood pole testing including: (1) 10,491 poles in HFTD Tier 3; (2) 28,346 poles in

HFTD Tier 2; and (3) the remainder in non-HFTD areas. In addition, upon completion of approximately 40,000 incremental field assessments that were reported to the CPUC in 2020, 5,363 poles were included in the 2020 testing to ensure compliance with the 20 year GO 165 cycle.

PG&E contracts out the execution of PT&T to a specialized contractor who performs this work for other utilities as well. QA is provided through sampling and reinspection by internal PG&E personnel, as well as the vendor performance reports. PT&T has its own QA program of the inspections. PG&E's Internal Audit department performs audits as requested or recommended, in accordance with their requirements

***5) Future* improvements to initiative.**

In 2021, PG&E intends to upgrade the PT&T program's existing field hardware and software tools to enhance recordkeeping and data system integration. This transition will also enhance the capability of PT&T to report asset registry discrepancies, and to collect photographic data to supplement test report results, and aid in the asset registry enhancement efforts.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Future improvements to intrusive wood pole inspections (PT&T) will be informed by the increased data gathered during the 2022 cycle utilizing the refreshed technology solution. Based upon the asset risk models and results of PT&T, long-term recurrence intervals may be tailored, such that the inspections are deployed on an as-needed basis, rather than the current ten-year cadence.

7.3.4.7 LiDAR Inspections of Distribution Electric Lines and Equipment

WSD Initiative Definition: *Inspections of overhead electric distribution lines, equipment, and right-of-way using LiDAR (Light Detection and Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*

1) ***Risk to be mitigated / problem to be addressed:***

   Inspections, including inspections using LiDAR, can help identify and treat pending failures of asset components which could create fire ignition if left unresolved or allowed to "run to failure." LiDAR and imagery can improve PG&E's effort to digitize our inventory and update our data sets for our mobile equipped workforce and improve our knowledge about distribution asset condition.

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.***

   LiDAR technology can provide information for work planning and operational workflows. Aerial LiDAR collection includes use of helicopters with mounted LiDAR sensors and photogrammetry equipment operated by an onboard technician. Large three-dimensional point clouds and hi-resolution imagery datasets collected during the flight missions are then processed to register data to real world coordinates. The data is used to measure relative distances between classified objects (for example the height of a pole). The LiDAR collection using vehicles includes a 360-degree area collection system mounted on top of the car that can create point cloud data and imagery to be used to identify specific features. LiDAR can: (1) provide accurate measurements to improve pole loading; (2) provide an accurate location for distribution inspection and (3) improve mapping. LiDAR allows for operational decision making from a desktop and minimizes field visits which improves efficiency and safety.

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.")***

   This initiative was first targeted at HFTD areas. However, the data and operational knowledge gained from its inception has the potential to be leveraged and utilized for additional portions of PG&E's service area.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year:***

   LiDAR Collection Work and Data Leveraged:

   - In 2019, LiDAR collection (i.e., the acquisition of LiDAR and imagery) was completed in HFTD areas via various LiDAR platforms. Aerial LiDAR and imagery were collected in the HFTD areas and where distribution assets were

near public roads within the HFTD, LiDAR imagery was also collected via mobile vehicles;

- In 2020, approximately 3,000 miles of LiDAR imagery was collected in the Northern regions primarily in Tehama, Shasta, Trinity, and Humboldt Counties. This northern area was targeted for circuits related to the HFTD area boundaries and areas with dense vegetation; and

- In 2020, PG&E was able to operationalize LiDAR for updating positional accuracy of electrical distribution GIS (EDGIS) mapping and Pole Loading.

LiDAR Data and Operation Refinement:

- In 2020, PG&E also worked to validate the collection and data received, working on Quality Assurance, Quality Control, and optimization of the LiDAR data to understand relative and absolute positional accuracy, and false negatives and positives from automated vegetation identification;

- Backpack mounted LiDAR was also tested in 2020 and showed some initial promising results.

- Operational progress for both the geospatial asset data improvement project to improve EDGIS and Pole Loading are underway;

- As part of Wildfire Order Instituting Investigation, PG&E is executing a conductor line slap analysis pilot leveraging LiDAR data collected through the Vegetation management process to assess the risk of conductor line slap on circuits in the PG&E service area and will be looking to understand how this analysis can inform operations and procedures in the field; and

- For 2021, the focus is on incorporating the existing information in order to leverage broader adoption across PG&E for existing digital tools, plans to analyze aerial data and mobile data to be used together for use cases with operations such as streetlights, third party attachments, mapping conflation and other areas.

5) Future improvements to initiative.

While no specific improvements for this initiative are currently planned, PG&E intends to continue to use both aerial and mobile LiDAR (collection platforms) datasets and high-resolution imagery to improve our recording of asset locations and is looking for ways to utilize LiDAR data to improve, safety, efficiency, and accuracy. In 2021, evaluation of how to effectively integrate the data into existing operational tools will be conducted. Based on the effectiveness of operationalizing the derivative LiDAR products, additional LiDAR collection may be planned and considered for non HFTD areas. Evaluation of the quality of LiDAR to provide detailed measurements for engineering purposes is being conducted that will support how viability this tool is for additional use cases. The investment to collect additional LiDAR is also dependent on prioritized areas defined by the risk model.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

PG&E will be evaluating LiDAR accuracy from the available modes of collection and sensors including but not limited to dual sensors on fixed wing planes and 360 degree vehicle mounted sensors to reliably identify equipment type attached to poles and conductor types. A combination of these collection modes is also being evaluated to determine the best collection platform combination to address the most operational use cases variables to determine what the long-term path is. Several operational groups are leveraging these datasets including Pole Loading, GIS Mapping, Estimating, and Third Party Attachments. Long-term plan milestones are still under development with Electric Operations and Asset Management. We forecast this program to remain stable at its current stage until operational integration is developed for production deployment at which point the further deployment could be expected.

These steps seek to drive toward decision-making based increasingly on integrated datasets that can leverage more informed inputs for its operations. Potential outcomes include developing new applications to leverage the LiDAR data, increasing our gathering of LiDAR data, and optimizing our LiDAR deployment strategy based on lessons learned. PG&E intends to use both aerial and mobile LiDAR (collection platforms) datasets to improve our recording of asset locations and is looking for ways to utilize LiDAR data to improve safety, efficiency, and accuracy, based on effective integration with operational tools scheduled for 2021. Evaluation of the measurement quality for engineering purposes is being conducted to confirm viability to additional use cases.

7.3.4.8 LiDAR Inspections of Transmission Electric Lines and Equipment

WSD Initiative Definition: *Inspections of overhead electric transmission lines, equipment, and right-of- way using LiDAR (Light Detection and Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*

PG&E does not currently have a program to leverage LiDAR for the inspection of Electric Transmission Assets. While we use LiDAR for the evaluation of vegetation in proximity to Electric Transmission lines, as discussed in Section 7.3.5.8, we are still evaluating alternatives and value propositions for using LiDAR to supplement our transmission asset inspection programs.

1) ***Risk to be mitigated/problem to be addressed:***

   Inspections can help identify and treat pending failures of asset components which could create fire ignition if left unresolved, the use of LiDAR as part of the Asset Inspection effort is being explored.

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.***

   PG&E does not have a formal initiative for the use of LiDAR for Transmission assets. LiDAR data collected on Transmission assets is collected through our Vegetation Management program (as detailed in Section 7.3.5.8) and that data is then used to aid in:

   - Tree strike potential analysis by the PG&E Applied Technical Services (ATS) team. LiDAR data processing extracts pole, span, and fall-in tree geospatial information. Tree strike threat is calculated as the number of fall-in trees in each span that can touch the line.

   - Ad-hoc assessment of the current position of conductor as it relates to required clearance from other conductors, physical features as well as the ground.

   - Modeling of conductor position, sag and sway, calibrated to the ambient temperature and loading at the time that the LiDAR data was captured.

   - PLS-CADD (Power Line Systems - Computer Aided Drafting & Design) model development. PLS-CADD is the industry standard overhead power line design software. The modeling includes terrain, structures, and wires and uses the Finite Element Analysis feature to combine a system of structures as a single model, which accounts for load between adjacent structures. Our PLS-CADD software automatically assess the conductor for a range of temperatures and creates a NERC alert file for any situations that might be out of compliance.

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.")***

LiDAR data is collected as a part of PG&E's Vegetation Management program that includes our entire service area.

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

PG&E does not have a formal LiDAR initiative for transmission facilities. Rather, LiDAR information is gathered as a part of PG&E's Vegetation Management programs.

5) ***Future improvements to initiative.***

PG&E will evaluate the further and/or programmatic use of LiDAR data, or additional LiDAR data collection, to supplement existing Transmission asset inspection programs and make any changes or adjustments required going forward.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

PG&E does not have a long-term plan established for LiDAR inspections of electric transmission assets. As noted above, PG&E is exploring the use of this technology which may, or may not, result in the development of a program to leverage this technology for asset inspections in the future.

7.3.4.9 Other Discretionary Inspection of Distribution Electric Lines and Equipment, Beyond Inspections Mandated by Rules and Regulations

WSD Initiative Definition: *Inspections of overhead electric distribution lines, equipment, and right-of-way that exceed or otherwise go beyond those mandated by rules and regulations, including GO 165, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*

1) ***Risk to be mitigated/problem to be addressed:***

   No incremental discretionary inspection activities beyond those described in Sections 7.3.4.1 and 7.3.4.4 are planned for electric distribution facilities in 2021.

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.***

   See the response to Question 1 above.

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.")***

   See the response to Question 1 above.

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

   See the response to Question 1 above.

5) ***Future improvements to initiative.***

   See the response to Question 1 above.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

See the response to Question 1 above.

7.3.4.10 Other Discretionary Inspection of Transmission Electric Lines and Equipment, Beyond Inspections Mandated by Rules and Regulations

WSD Initiative Definition: *Inspections of overhead transmission lines, equipment, and right-of-way that exceed or otherwise go beyond those mandated by rules and regulations, including GO165, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*

1) Risk to be mitigated/problem to be addressed:

Although the majority of failure modes can be detected via visual inspections required by existing rules and regulations, there are some conditions that may not be easily detectable (e.g., conductor core condition or below-grade foundation condition). Lack of detection can lead to asset failure and associated consequences. For that reason, PG&E has initiated several pilot inspection programs to consider technology and methodology to further improve the inspection program.

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.

The following transmission line inspection programs are currently under pilot to address situations which may be difficult to identify in routine regulatory inspections, or to augment the enhance inspection programs:

- Below-Grade Foundation Inspections: This pilot program aims to assess the condition of steel structure foundations below the ground-line. The investigation includes a measure of soil resistivity, pH, Redox and Half Cell Measurement, as well as a visual assessment with photographic evidence of each excavated foundation leg. The results will validate data from models, inform (preventive) maintenance and repair decisions and also inform locations most requiring of cathodic protection.

- Corona Inspections: This pilot program aims to assess non-visible conditions, particularly of insulator and insulator hardware, via the detection of corona (free electrons that fragment stable oxygen molecules (O_2) combining with others to create ozone (O_3) gases.) concentration. The results will inform preventive maintenance and provide additional data for asset management.

- Conductor Measurement/Inspections: This pilot program aims to assess the condition of steel-core conductors via the measurement of remaining cross-sectional area of steel core wires and detection of local flaws such as deep pits or broken strands (by measurement of magnetic flux leakage). The results will inform conductor replacement programs and provide additional data for asset health modeling.

- Drone-Span Inspections: This pilot program aims to assess the condition of conductors through mid-span high-resolution imagery and inspector review. The results will provide additional visual assessment of the mid-span assets (i.e., conductors, splices, flying bells, marker balls, etc.), which may not be visible during routine aerial or ground-based structure inspections. The drone-span inspections provide an understanding and safety assessment of conductor condition severity during the interim period between project kick-off and project completion (which could be several years depending on permitting, clearances, etc.).

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.")

- The Below-Grade Foundation Inspections pilot covers approximately 1,000 steel structure locations, chosen to provide a statistical representation of various foundation types and environments throughout PG&E service territory;

- Corona Inspections were and will be included on all lines planned for infrared inspection in 2020 and 2021; and

- The Conductor Measurement/Inspections pilot will be field-tested on a 115 kV line in the East Bay in 2021.

- The Drone-Span Inspections pilot was tested on a 115 kV line in the East Bay in 2020 based on locally identified conductor condition concerns.

4) Progress on initiative (amount spent, regions covered) and plans for next year.

- Below-Grade Foundation Inspection: Pilot began December 2020 and is expected to continue until Q2 2021. Pilot results will be evaluated, and a recommendation made whether to continue funding additional inspections in the future. The cost for 1,000 structures is approximately $1.1 million.

- Corona Inspections: In 2020, Corona Inspections were performed during infrared inspections. In 2021, Corona Inspections will also be performed during infrared inspections.

- Conductor Measurement/Inspections: In 2021, an initial field pilot will be conducted. Cost is still under evaluation but will likely be less than $100,000.

- Drone-Span Inspections: In 2020 and 2021, costs have been included as part of targeted projects for conductor replacement. Drone-Span Inspections may continue to be tested on select, targeted circuits in 2021 as triggered by condition.

5) Future improvements to initiative.

For all of these pilots, success of the methodology must be determined, based on cost to benefit (number of quality findings), usability/calibration of the data (is the data provided from the inspections useful for asset health modeling) and benchmarking with others in the industry. For remaining failure modes that are not easily detectable with current pilot or enhanced inspection methods, additional research into potential design or inspection method changes will be considered based on consequence of failure.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

The goal for discretionary inspections going forward is to identify effective means of inspecting assets for potential failure modes, test and prove the methodology and incorporate effective inspection methods into the standard maintenance cycles for assets. A good example of this is the piloting of drone inspections in 2019, and the full incorporation into the enhanced detailed inspection maintenance cycle in 2020.

Additionally, effectiveness of existing inspection methods can be reviewed and compared against potential new methodologies for informing amendments to existing methods or frequencies. For example, the use of artificial intelligence/computer vision to supplement existing inspection methods.

7.3.4.11 Patrol Inspections of Distribution Electric Lines and Equipment

WSD Initiative Definition: *In accordance with GO 165, simple visual inspections of overhead electric distribution lines and equipment that is designed to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business.*

1) Risk to be mitigated/problem to be addressed:

Patrol inspections of distribution electric lines and equipment are routinely undertaken for assets not scheduled for a detailed or climbing inspection within the calendar year. Patrol inspections are defined within the EDPM (TD-2301M) as maintenance activities that include a simple, visual examination of applicable overhead and underground facilities to identify obvious structural problems and hazards. Patrol inspections are visual reviews of the asset condition to proactively detect imminent or existing safety or reliability hazards in alignment with GO 165. Distribution overhead patrols may be executed on foot or by vehicle as appropriate to the terrain. Patrol inspections reduce the risk of unforeseen equipment failure that could result in a wildfire ignition by ensuring that assets not scheduled for a detailed inspection are patrolled within the calendar year.

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.

Overhead asset patrols seek to proactively identify and treat actual or pending failures of asset components which could create fire ignition if left unresolved or allowed to "run to failure."

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.")

Prior practice of completing inspections and patrols solely on a time-driven cadence did not adequately address the increased risk from overhead asset or component failure in HFTD areas. As such, the HFTD assets not selected for enhanced detailed inspection are normally scheduled for patrol. For 2021 through 2022, PG&E intends to complete patrol inspections of overhead assets in the following recurrence interval: Tier 2 HFTD areas on years when enhanced detailed inspections are not scheduled (e.g., two of every three years). For example, the subset of Tier 2 HFTD area assets not slated for detailed inspections in 2021 is instead scheduled for patrol inspections in cycle 2021. In general, PG&E schedules HFTD patrol and inspection activities earlier in the year to provide time for necessary repairs prior to peak fire season.

Because all Tier 3 HFTD area assets are scheduled for detailed overhead inspections annually, they are not subjected to patrol inspections on a routine basis.

4) Progress on initiative (amount spent, regions covered) and plans for next year.

In 2020, PG&E planned to complete 1.638 million units of overhead distribution patrols and projects. This represents approximately 445,000 HFTD Tier 2 poles and 1.193 million poles non-HFTD areas. In 2021, PG&E anticipates completing a total of 1.181 million units of inspection patrol in HFTD Tier 2 and other areas not subject to detailed inspection.

5) Future improvements to initiative.

Improvements in the Patrol Inspections of Distribution Electric Lines and Equipment anticipated in future include adjustments based upon the results of 2019 and 2020 cycles. Such refinements may include asset selection and work planning to align with revised risk models, clarification and evaluation of corrective work prioritization thresholds to more directly mirror GO 95 Rule 18 (levels 1, 2, 3 versus historic A, B, E, F).

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Long-term improvements to Patrol Inspections of Distribution Electric Lines and Equipment are expected to evolve in recurrence interval to align with detailed inspections of the same assets, informed by expanded asset risk and health models. In addition, the patrol inspections are anticipated to adopt digitized recordkeeping similar to the enterprise solutions already deployed for Detailed Overhead Inspections documentation. While such technology will not alter the intent or scope of the patrol inspections, it will more rapidly integrate patrol inspection results into the system of record.

7.3.4.12 Patrol Inspections of Transmission Electric Lines and Equipment

WSD Initiative Definition: *Simple visual inspections of overhead electric transmission lines and equipment that is designed to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business.*

***1) Risk* to be mitigated/problem to be addressed:**

Patrol inspections of transmission electric lines and equipment are routinely undertaken for assets not scheduled for a detailed or climbing inspection within the calendar year. Patrol inspections are defined within the EDPM (TD-2301M) as maintenance activities that include a simple, visual examination of applicable overhead and underground facilities to identify obvious structural problems and hazards. Patrol inspections are visual reviews of the asset condition to proactively detect imminent or existing safety or reliability hazards in alignment with GO 165. Transmission overhead patrols may be executed on foot or by vehicle as appropriate to the terrain. Patrol inspections reduce the risk of unforeseen equipment failure that could result in a wildfire ignition by ensuring that assets not scheduled for a detailed inspection are patrolled within the calendar year.

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.

Overhead asset patrols seek to proactively identify and treat actual or pending failures of asset components which could create fire ignition if left unresolved or allowed to “run to failure.”

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.")

For 2021 through 2022, PG&E intends to complete patrol inspections of overhead transmission assets in the following recurrence interval: Tier 2 HFTD areas on years when enhanced detailed inspections are not scheduled (e.g., two of every three years). For example, the subset of Tier 2 HFTD area assets not slated for detailed inspections in 2021 is instead scheduled for patrol inspections in cycle 2021.

Because all Tier 3 HFTD area assets are scheduled for detailed overhead inspections annually, they are not subjected to patrol inspections on a routine basis. In general, PG&E schedules HFTD patrol and inspection activities earlier in the year to provide time for necessary repairs prior to peak fire season.

4) Progress on initiative (amount spent, regions covered) and plans for next year.

In 2020, PG&E completed 150,725 units of overhead transmission patrols. This represents 33 percent of all HFTD Tier 2 poles and 20 percent of all non-HFTD poles. For 2021, PG&E forecasts to complete a total of 191,000 units of patrol inspection in HFTD Tier 2 and other areas not subject to detailed inspections.

5) Future improvements to initiative.

Improvements in the Patrol Inspections of Transmission Electric Lines and Equipment anticipated in future include adjustments based upon the results of 2019 and 2020 cycles. Such refinements may include asset selection and work planning to align with revised risk models, clarification and evaluation of corrective work prioritization thresholds to more directly mirror GO 95 Rule 18 (levels 1, 2, 3 versus historic A, B, E, F).

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Long-term improvements to Patrol Inspections of Distribution Electric Lines and Equipment are expected to evolve in recurrence interval to align with detailed inspections of the same assets, informed by expanded asset risk and health models. In addition, the patrol inspections are anticipated to adopt digitized recordkeeping similar to the enterprise solutions already deployed for Detailed Overhead Inspections documentation. While such technology will not alter the intent or scope of the patrol inspections, it will more rapidly integrate patrol inspection results into the system of record.

7.3.4.13 Pole Loading Assessment Program to Determine Safety Factor

WSD Initiative Definition: Calculations to determine whether a pole meets pole loading safety factor requirements of GO 95, including planning and information collection needed to support said calculations. Calculations shall consider many factors including the size, location, and type of pole; types of attachments; length of conductors attached; and number and design of supporting guys, per D.15-11-021.

1) ***Risk to be mitigated/problem to be addressed:***

   Determining whether an electric pole is overloaded is an important element of preventing pole failure and the associated potential wildfire ignition risk. PG&E started our pole loading program to reduce the risk of potential fire ignitions resulting from pole failures by evaluating whether a pole meets GO 95 Rule 44 strength requirements throughout its service life, both when initially installed and while in-service despite changing conditions, impacts from maintenance activities, attachment additions, and potential wood strength degradation.

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.***

   During a pole's service life, pole loading calculations are performed when load is added to a pole, or if a suspected overload condition is observed during inspection. Pole loading calculations are performed in O-Calc software during design phase to ensure poles are sized correctly to satisfy GO 95 requirements. PG&E created a centralized database to retain pole loading calculation record information, in accordance with D.09-08-029.

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.")***

   The program has focused on assessments of poles in the Tier 2 and 3 HFTD areas with the goal to be fully implemented (100 percent poles analyzed) in these areas by 2024. Poles located in non-HFTD areas will follow, with the goal to be fully implemented (100 percent poles analyzed) by 2030.

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

   As of December 1, 2020, this program has completed pole loading analysis of over 160,000 poles, all of which are considered the highest risk poles, either due to the pole characteristics or location, being in an HFTD area. The program continues to focus on the HFTD areas, planning to analyze approximately 160,000 poles in 2021.

5) Future improvements to initiative.

PG&E is using enhanced field collected images, obtained during recent inspections, for the pole loading evaluations, as well as LiDAR data to geo-correct pole locations. PG&E is also strengthening the pole loading model parameters by considering historical meteorological data (e.g., wind speed) to ensure poles are strong enough before field installation. In addition, PG&E is working with the pole loading calculation software vendor to enable analysis of multiple pole models together, enabling span linking to structural connectivity.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

This is a 10-year program continuing the work started in 2020 that focuses on structural desk top review assessments of all poles. Due to the higher risk of potential fire ignition exposure in the HFTD Tier 2 and 3 areas, PG&E's goal for these poles is full implementation of assessments (100 percent poles analyzed) in these areas by 2024. Poles located in PG&E's non-HFTD areas will follow with the goal to be fully implemented (100 percent poles analyzed) by 2030.

Throughout this period, PG&E is continually evaluating risk associated with the completion of this work and will adjust course as necessary to meet the objective. At this time, we have gone through a request for proposal process and selected a vendor, but during the course of this ten-year project, contracts will be signed in two-year intervals to provide PG&E flexibility to course correct as necessary.

Response to Critical Issue No. PGE-04:

Critical Issue Title:

Equivocating Language in Asset Inspection QA/QC Process Descriptions

1) *PG&E shall revise Section 7.3.4.14 of its 2021 WMP to describe its QA/QC processes for its transmission and distribution asset inspections using measurable, quantifiable, and verifiable language.*

PG&E has revised Section 7.3.4.14 below to include a more detailed description of its Inspection Quality Programs and has included measurable, quantifiable, and verifiable language regarding these programs and processes.

2) *In section 7.3.4.14, PG&E shall describe its internal plans to address QA/QC issues related to asset inspections, including any changes to organization structure.*

In Section 7.3.4.14, subparts (2) and (5) below, we describe the processes we have and are undertaking to improve our Inspection Quality programs and to address the specific gaps and issues that have been identified either by third parties, such as the Federal Monitor, or by our internal teams.

7.3.4.14 Quality Assurance / Quality Control of Inspections

WSD Initiative Definition: *Establishment and function of audit process to manage and confirm work completed by employees or subcontractors, including packaging QA/QC information for input to decision making and related integrated workforce management processes.*

1) Risk to be mitigated/problem to be addressed:

Quality assurance and quality control are important tools for providing consistent and reliable inspection results for PG&E's equipment and facilities, which ultimately can reduce wildfire risk.

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.

PG&E has implemented a number of programs, processes, tools, and other control points to review and manage the quality and accuracy of inspection work performed by our employees and contractors. These programs identify anomalies in inspection and patrol results, address any gaps, determine the root cause of any gaps, and implement improvements. Our programs areas are managed by three internal organizations, with several processes and programs implemented by each organization. In addition, we have developed internal plans to address asset inspection issues. Below, we describe our:

(a) System Inspections Organization;

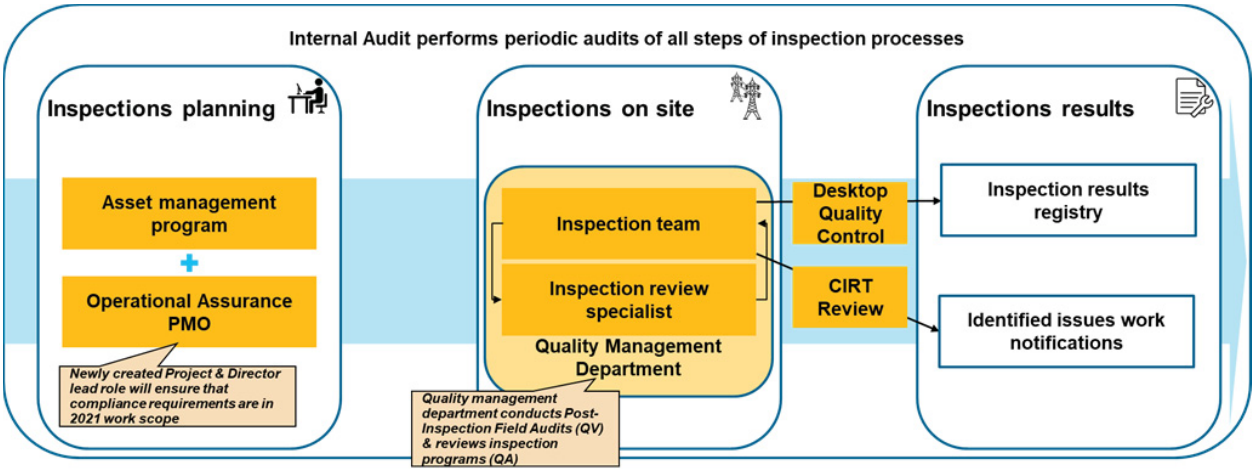
(b) Quality Management Organization;

(c) Internal Audit Organization; and,

(d) Internal Plans to Address QA / QC Asset Inspection Issues.

Because our processes and programs include more than just the quality assurance and quality control, we will refer to these programs collectively in the remainder of this section as our "Inspection Quality Programs." An overview of the points during the inspection cycle impacted by the Inspection Quality Programs is provided in Figure PG&E-Revision Notice-7.3.4-1 below.

FIGURE PG&E-REVISION NOTICE-7.3.4-1: OVERVIEW OF INSPECTION CYCLE AND INSPECTION QUALITY PROGRAMS



a. System Inspection Organization

The System Inspection organization is focused on work performed in the field or that is coming from the field and consists of three groups: (1) Inspection Review Specialists; (2) Quality Control; and (3) the Centralized Inspection Review Team (CIRT).

1. Inspection Review Specialists (Inspections on Site)

While an inspection is occurring, we have Inspection Review Specialists who participate in inspections to provide feedback on the quality of the inspection being performed. These specialists are not the inspector, but instead have significant field experience and will attend the inspection to provide real-time feedback while an inspection is occurring. This is helpful both to ensure that the quality of an actual inspection and as an opportunity for feedback for inspectors to further refine and improve their skills.[82]

2. Quality Control (Inspection Results)

Immediately after an inspection has been completed, our Quality Control or QC team reviews the inspection results using a desktop approach. Specifically, QC focuses on desktop activities for the detailed overhead inspections conducted by our System Inspections (SI) organization under the GO 165 Compliance program for Electric Transmission and Distribution assets.[83] The QC process checks for adherence of inspections to the guidance provided in the Electric Distribution Maintenance Manual

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82 Inspection Review Specialists also review and give feedback to CIRT personnel. The CIRT program is described in more detail below.

83 The QC Program will be expanded to include detailed Substation inspections and Aerial inspections in the 4th Quarter of 2021.

(TD-2305M) and the Electric Transmission Maintenance Manual (TD-1001M).

Desktop QC activities are conducted as part of routine inspection quality verification and are also initiated for any ad-hoc quality performance issues observed in the SI environment. The following table lists the three selection methods:

TABLE PG&E-REVISION NOTICE-7.3.4-1: SELECTION METHODS

Selection Method	Description
Random selection	Determine the inspectors to evaluate using a simple random process methodology.
Targeted	Picking confirmed "Outlier" inspectors for review based on Quality KPI tracking data.
Probable cause	If a vendor or inspector's performance is deemed "suspect" or unsatisfactory through other SI processes or channels, additional desktop QC inspection will be conducted to verify work quality.

Due to the large volume of detailed inspections conducted, the Desktop QC process only reviews a sample from the overall completed inspection population. Statistically valid sampling plans are established which utilize key system risk information available during the inspection period to select appropriate confidence level and compliance error rates. Below, we described our process for routine desktop QC sampling and non-routine sampling.

Routine Desktop QC Sampling:

(1) The QC sampling plans are derived from completed inspections.

(2) To create the total sample population for statistical sampling, QC divides the inspection records by Division for Distribution inspection methods and by Main Work Center (MWC) for Transmission inspection methods. The total sample population is currently contractor only.

(3) Outlier Sampling – Segregate all Outlier inspector records in each sample population and randomly select 5% of each inspector's records for QC.

(4) Statistical Sampling – For the remaining non-outlier inspection population, QC determines the sample size using the sample size calculator. For general random QC sampling a 95% confidence level and 10% margin of error is used. These parameters can be adjusted to accommodate varying resource levels or other system risks with documented justification.

(5) Statistical Sampling – Once the total sample size is generated for the Division or MWC, QC calculates the number of records for each inspector

proportionate to the total volume of inspections conducted by the inspector. Once the counts are generated for each inspector, records are randomly picked. For example, if a non-outlier inspector performed 100/1000 (10%) inspections in that Division for the month, and the sample size for the Division was 100, then QC will look at 10 randomly assigned records for that inspector.

(6) QC assesses every inspector that was actively performing inspections for the time period being assessed.

Non-Routine/Ad-hoc Desktop QC Sampling:

(7) For all non-routine Desktop QC Assessment requests, a statistically valid sampling plan is developed with critical to quality data input from the requesting group.

(8) The sampling parameters vary depending on the impacted inspection population size and the associated risk factors.

In terms of the scope of each review, the QC Specialist reviews the entire Inspection for overall accuracy and completeness, verifying the following:

- Use of the correct inspection form for the asset structure type (Transmission and Sub Station).
- Photos captured per requirements as documented in ELEC-0341 and PSOS-0451 and PSOS-0452 (Inspector Training).
- Review and confirm, in each section, if abnormal conditions have been correctly identified.
- All required Record Keeping and Declaration items have been identified and noted.
- All existing notifications at location have been reviewed and records updated in SAP.
- All new compelling abnormal field conditions identified have been logged into an existing notification or a new notification with correct FDA and priority assignment.
- That the inspector did not fail to identify or miss reporting on a compelling abnormal field condition present during the initial inspection.
- All discrepancies found during the QC review are recorded in detail under the specific Inspection checklist section. Specialist provide detailed objective evidence supporting their finding(s) and list procedural or guidance documentation references where applicable.
- QC Specialists suggest recommended corrections/corrective actions as “Follow Up” items in the QC form when applicable. Impacted reference documentation is noted.

Discrepancies found during a QC review are divided into three different classifications:

- Observation – Minor documentation error or a low risk requirement discrepancy.

- Non-Conformance – Major documentation error or failure of inspector to properly assess and/or document an abnormal field condition, as per the documented requirements in Electric Distribution Preventative Maintenance (EDPM) manual (TD-2305M) and the Electric Transmission Preventative Maintenance (ETPM) manual (TD-1001M).

- Failed Non-Conformance – An inspection record review conducted by the QC specialist via photographic/other evidence that determines the inspection was not performed, resulting in a recommendation to re-inspect, and/or an inspection record review that indicates a compelling abnormal condition was miss-identified by the inspector, resulting in an incorrectly updated EC/LC notification, or failure to create an EC/LC notification.

Each QC review completed generates a record containing all the pertinent assessment information. In Q3 2021, the QC team will be implementing a process for all Failed Non-Conformance records to be sent to the inspector's immediate PG&E supervisor. This will be done in real time as records are reviewed and completed in QC. All Records will be archived. QC is reporting weekly and provides a link to these records for reference to the respective PG&E supervision teams. Reports identify records by Inspection method/Division or MWC/Inspector/Equipment ID.

QC data collected is used to generate an SI Weekly QC Dashboard. This dashboard provides data by Inspection method/DIV/MWC/Vendor on:

- # of QC assessments completed, dispatch – in queue, pending

- # of Observation & Non-conformances – by Inspection sections

- # of Missed Compelling abnormal conditions

- # of Notifications recommended for change (Upgrade, Downgrade, Invalid – Cancel, Update/Add FDA)

- Top 5 Non-conformances in the System by issue type

- Top 5 Observations in the System by issue type

- Top 5 Recommended Follow Up activities

In addition to conducting QC Assessments, an integral piece of the Quality Control program is the on-going tracking and trending of system outliers for inspector work quality. These key metrics are a combination of inspector Productivity, Notification find rate, and accuracy. The Outlier Tracker is used as a guide by the Execution team/Vendors to easily identify which inspectors may be high risk so they can appropriately target and conduct their internal quality verification checks. These Key Performance Indicators (KPI) have appropriate upper/lower control limits generated using the Interquartile range method and outliers are flagged based on inspector performance versus the overall system. The tracker has the capability to filter data for Inspectors by Division/MWC, Vendor for a specific date range.

The QC team is developing two additional methods, to be completed in 2021, to further explore continuous improvement of QC in SI. These two additional methods are:

1. Desktop Blind Audit – This will be a version/modification of the existing post-inspection desktop audit that is already established. The Blind Audit will utilize the same systems, resources, and processes as the previously outlined desk-top audit with one modification. The Blind Audit will not evaluate the completed inspection against the standards; instead, the blind audit will be a duplicate inspection completed by a desktop auditor using the photos contained in the completed inspection, which is the subject of the audit. This method will allow for additional analysis regarding the quality of the inspection auditor and give the QC team a measurable method for understanding the accuracy of Desktop audit results. This additional analysis will allow the SI organization to better differentiate root cause drivers of inspection discrepancies that are attributable to the inspector versus the auditor.

2. QC Team Field Audit – This will be a modified version of the existing post-inspection desktop audit that is already established. The Field Audit will utilize the same systems, resources, and processes as the previously outlined desk-top audit with three modifications. The first modification is that the audit is performed in the field, at the location of the asset. The second modification is that the Field Audit will not use the photos from the completed inspection, which is the subject of the audit. The Field Audit will produce new photos, in adherence to the inspection process as documented in ELEC-0341, PSOS-0451, and PSOS-0452 (Inspector Training). The third modification will be the timing of the audit. The timing of the field audit will be within one week of the date of the original inspection, which is the subject of the audit. This is to ensure the field condition of the asset is the same between the original inspection and the audit. This method will allow for additional analysis regarding the repeatability of the inspection process and the reproducibility of the inspection, which is commonly known as a Gage R&R study. This additional analysis will allow the SI organization to better differentiate root cause drivers of adverse performance that are attributable to process complexity versus human performance and will better inform/validate corrective actions and continuous improvements.

3. CIRT Review (Inspection Results)

We established the Centralized Inspection Review Team or "CIRT" in 2019 to provide centralized and consistent review for notifications resulting from distribution, transmission, and substation inspections. In 2020, we consolidated the CIRT team under the System Inspections department. CIRT includes supervisors and dedicated staff who are responsible for reviewing the results from transmission, distribution, and substation facility inspections.

CIRT was formed to improve the effectiveness and consistency of the prioritization of work notifications (i.e., tags) resulting from inspections by reviewing the results of field inspections performed by Qualified Company Representatives (QCR) or Qualified Electrical Workers (QEW). CIRT also provides a centralized and consistent approach to process work notifications using photos, maps, and other information provided by field employees.

To perform this function, CIRT: (1) reviews inspection information regarding the current condition of an asset and enters the proper information into SAP as it relates to the condition and the priority of any needed work; (2) verifies that the information in SAP is accurate; (3) verifies that the required end date for the notification corresponds to the priority determination per transmission, distribution and substation standards and job aids; and (4) ensures all information received from the inspection is accurately reviewed to capture all potential nonconformances.

The CIRT reviews of corrective findings operate as first in-first out, with priority given to reviewing Level 1 or 2 findings (PG&E priority A or B) which have shorter resolution durations. The initial CIRT review of corrective notifications targets a turnaround time from the date the condition was observed in the field: 5-day for Priority B, or 30-day for Priorities E and F notifications.

b. Quality Management Organization

During 2019, our Electric Operations organization established a new Quality Management (QM) department responsible for the portfolio of audits performed by its employees and contractors. The QM group creates audit plans which contain detailed information on audits planned to verify compliance. Two groups in Quality Management relevant here are: (1) Quality Verification; and (2) Quality Assurance.

1. Quality Verification (Inspections on Site)

After an inspection is completed, our Quality Verification or "QV" program performs field audits on internal and contract inspection resources. Audits are performed to determine the completeness and accuracy of inspections and occur over a three-month timeframe in which a previous three-month time period is determined as a sampling source. Audits of Inspector Supervisor work verifications are also performed. The sampling methodology is to review 25 completed inspections per division, which is a

95% confidence level per region. Maps are randomized. In divisions where both overhead and underground maps were inspected, audit locations are relative to the ratio of completed overhead and underground map locations. If the completed overhead to underground ratio is less than 5 underground locations, a minimum of 5 UG locations are audited. In divisions where a minimum of 25 sample inspections are not met, 100% of completed inspections are audited. The quality verification team are former lineman and some are former inspectors as well. The references for the audits are the Electric Distribution Preventative Maintenance Manual, revision update April 2016, Overhead Inspections job aid, revision 7, updated April 2020, underground inspections job aid, revision 3, updated January 2020 and the electric distribution quality verification audit process procedure updated December 2019.

2. Quality Assurance (Inspections on Site)

The Quality Assurance (QA) group is responsible for review of inspection programs at the program level. Specifically, QA reviews our inspection procedures and standards, reviews inspection-related training, reviews our standards to make sure that we are complying with applicable rules and regulations, reviews our documentation standards and system of record, and looks for gaps in the inspection program and processes. QA does not look at the results of specific inspections. Instead, QA conducts program-level reviews.

c. Internal Audit Organization

As part of performing audits across PG&E, IA also performs periodic audits over transmission and distribution asset inspection processes. During 2021, IA continues to monitor PG&E's progress to address multiple audit issues reported during 2020 that are related to transmission, distribution, and substation inspections. In addition, IA will be performing an audit over a new tool that was implemented over the processes to review data collected through aerial inspections.

d. Internal Plan to Address QA / QC Asset Inspection Issues

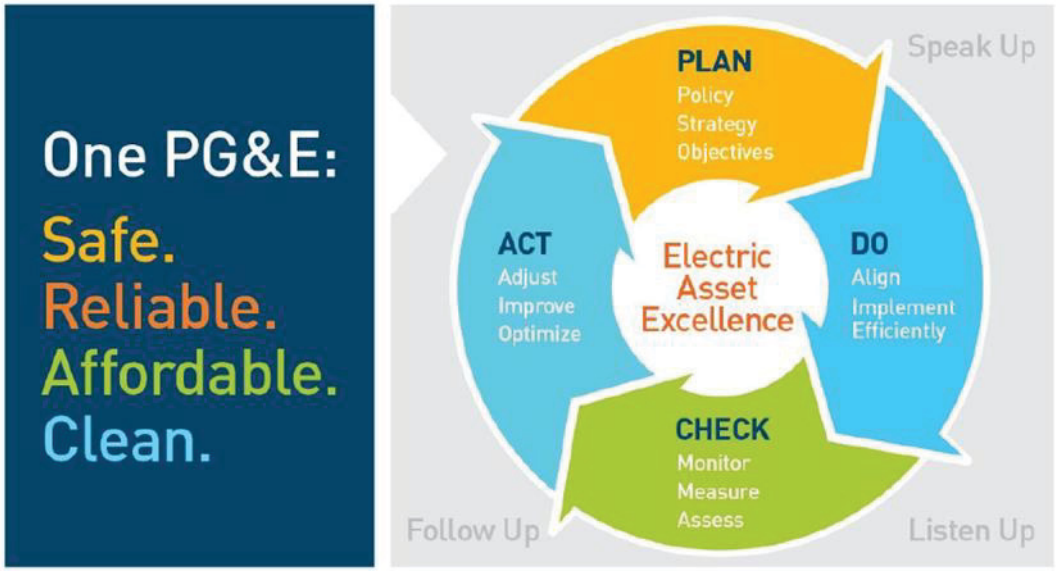
This section includes a specific discussion of our plan to address QA / QC Asset Inspection Issues as described in the WSD's Revision Notice. Please refer to subpart (5) below for additional future improvements planned for this initiative.

Plan, Do, Check, Act framework:

Asset Strategy continues to monitor feedback from the QA/QC inspections team to better inform how work is planned, guidance / internal documents are updated, and quality and consistency of inspections are improved. PG&E uses the ISO 55000 asset management framework of Plan, Do, Check, Act, a continuous cycle of incorporating feedback and learnings, to improve asset strategy including asset inspections. Asset Family Owners responsible for various asset family (Electric Transmission, Electric

Distribution, Power Generation, etc.) are aligned with this framework and meet periodically to ensure alignment of strategy and the work plan. The workplan is jointly developed to ensure it meets the intent of WMP initiatives and all relevant compliance requirements. This framework also provides a feedback loop for employees responsible for doing and checking the work (QA/QC) to employees responsible for the strategy and work plan to continuously adjust and improve.

FIGURE PG&E-REVISION NOTICE-7.3.4-2: ISO 55000 ASSET MANAGEMENT FRAMEWORK OF PLAN, DO, CHECK, ACT



PG&E typically updates our Electric Transmission Preventive Maintenance (ETPM) and Electric Distribution Preventive Maintenance (EDPM) annually which describe transmission and distribution line inspection requirements, procedures, checklists, and job aides. In this update process, all stakeholders including team members responsible for QA/QC are solicited for improvement suggestions. Examples of improvements to drive quality and consistency of inspections are:

- Streamline procedures for consistent understanding and adherence.
- Modify checklist to improve inspection results for asset management decisions.
- Improve electronic IT program (such as the Inspect APPS for transmission overhead line detailed ground inspection) for consistent and accurate results.
- Develop new electronic checklists to replace manual paper process for efficiency and accuracy.
- Refine job aides for guidance and training to inspectors.

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.")

As described above in subpart (2), our Inspection Quality Programs apply to inspections that occur throughout our service area.

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

For the 2020 inspection and patrol cycle, CIRT reviewed more than 84,000 transmission and 170,000 distribution corrective notifications generated by one or more asset inspection programs. During these reviews, CIRT referenced internal and external guidance, utilized subject matter experts, and reviewed prior inspection reports to guide their final determinations. Of the total corrective notifications, approximately 7,000 transmission and 7,000 distribution findings were rated as “B” priority (GO 95 Rule 18 priority 1 or 2). CIRT made changes to the priority, scope, or other aspect of the initial inspection field finding in 12 percent of transmission cases and 7 percent of distribution cases.

In late 2020, PG&E published initial process quality control metrics for field data collectors, inspectors, and Inspection Review Specialists. Work verification of inspector results by supervisory personnel, or through a representative re-inspection sampling scheme, has historically been used for inspection quality management. In 2021, PG&E has shifted to trend data collected during digital paperless inspections to lessen the need for this type of after-the-fact sampling approach.

5) ***Future improvements to initiative.***

Improvements to the inspection quality management for 2021 are focused on timeliness of reporting process quality results to support remedial actions while inspectors are still in-area. This supports lower overall costs by reducing re-mobilization of personnel back into a geography previously considered complete. Other improvements to internal quality oversight include ensuring data analysis of processes, such as inspector productivity rates, notification creation rates, notification rejection/duplication rates are actionable for inspection supervisory personnel. In 2021, we also hired internal and contract staff into Inspection Review Specialist roles. As described above, the Inspection Review Specialists are primarily tasked to provide technical guidance and quality oversight to field inspection personnel and CIRT personnel (PG&E and contractor), including work performance coaching and work quality sampling.

In addition to these program and process improvements, we have also made changes to address specific issues and gaps that have been identified. For example, we have addressed the transmission tower inspection issue identified in the Revision Notice[84] by establishing a firm schedule for inspections and having

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84 Revision Notice, p. 13.

our WRGSC establish a system inspection workplan.[85]

For the intrusive pole inspection issue identified in the Revision Notice,[86] we are upgrading our pole test and treat hardware and software tools to enhance recordkeeping and data system integration.[87]

For the substation inspections identified in the Revision Notice,[88] as we explained in our May 20, 2021 letter, we have completed inspections of the hydroelectric substations and have performed a root cause evaluation to determine process changes needed to prevent any similar situations.[89]

For the missed distribution pole inspections described in the Revision Notice,[90] we submitted a self-identification notice to the Commission on May 7, 2021 and in that notice described the gaps that we identified and a corrective action plan to address those gaps.[91]

To further enhance our internal communication, coordination, and execution of inspections process, we have created a new position, Director of Compliance and Operational Assurance, which reports directly to our Chief Operating Officer. That Director will lead the Operational Assurance Project Management Office (PMO). A tactical branch of the PMO will validate in the near term that our 2021 compliance requirements are accurately captured in the asset registry and included within scope of the 2021 work plan. A strategic branch of the PMO will focus on building the new asset registry and developing the roadmap that creates sustainability and an increased level of operational discipline.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

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85 2021 WMP, Section 4.1(b).

86 Revision Notice, p. 13.

87 2021 WMP, Section 7.3.4.6.

88 Revision Notice, p. 14.

89 See May 20, 2021 letter from Debbie Powell to Caroline Thomas Jacobs and Leslie Palmer, pp. 1-3.

90 Revision Notice, p. 14.

91 May 7, 2021 letter from Debbie Powell to Caroline Thomas Jacobs and Leslie Palmer, p. 4.

Response:

Long-term, the Inspection Quality Programs will continue to mature in process documentation, rigor, and timeliness. PG&E will build out capabilities for process quality monitoring and control, with a focus on near-real-time data trending and feedback. This will include increased data analytics capabilities to monitor control limits for key performance indicators, via technology investments and staffing.

7.3.4.15 Substation Inspections

WSD Initiative Definition: *In accordance with GO 174, inspection of substations performed by qualified persons and according to the frequency established by the utility, including record-keeping.*

The below narrative for Section 7.3.4.15 covers Substation Inspections, including distribution and transmission. However, in Table 12, in Attachment 1 – All Data Tables Required by 2021 WMP Guidelines.xlsx we have separated the financials and Risk Spend Efficiency calculations for distribution and transmission.

1) Risk to be mitigated/problem to be addressed:

PG&E's routine substation preventive maintenance practices, including inspections, were developed to comply with requirements of various regulatory agencies such as the CAISO, NERC, WECC, CPUC. In 2019, routine substation inspections in Tier 2 and Tier 3 HFTD areas were supplemented as part of WSIP. Supplemental ground and aerial substation inspections seek to proactively identify and treat pending failures of substation components which could create fire ignition if left unresolved or allowed to run to failure. In addition, the proactive identification of less urgent concerns permits PG&E to evaluate potential investments in risk mitigation activities such as system hardening, enhanced vegetation management, reconductoring, among other programmatic tools.

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.

The supplemental inspection program includes three methods: Drone-based aerial inspection, Ground-based visual inspection, and Infrared inspection. These supplemental inspections are performed in addition to the routine inspections that are part of the maintenance practices described in Utility Standards TD-3322S and TD- 3323S. To develop this supplemental inspection program, FMEA was performed on all substation equipment. Enhanced detailed inspections are guided by digital checklists that align to the FMEA for the structure, associated equipment and components. Both objective and subjective criteria are used to evaluate the condition of the asset and identify corrective actions. The improved visibility from enhanced inspections may inform new programmatic responses including equipment replacements, improvements to maintenance tasks, changes in frequency of maintenance or guidance clarifications.

Supplemental inspections will be performed in PG&E-owned substations based on the following risk factors: location in an HFTD area, Transmission Substation criticality, and Distribution Substation customer count.

For the 2021 supplemental inspection cycle, the substation enhanced ground will evaluate 17 unique components with 252 questions, and the substation aerial evaluation assesses 16 components with 606 questions. Examples of components evaluated during enhanced inspections include the items such

as: batteries, breakers, bus, load tap changer, shunt capacitors, synchronous condensers, transformers, among other equipment.

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.")***

For 2021-2022, supplemental inspections are planned annually for all Tier 3 HFTD area substations and on a three-year cycle for substations in Tier 2 HFTD areas. Additional non-HFTD sites may also be assessed using these supplemental inspection methods. For 2020-2022, the baseline GO 174 monthly (or bi-monthly) station inspections are anticipated to proceed consistent with existing procedures. In general, PG&E schedules patrol and inspection activities in HFTD areas earlier in the year to provide time for necessary repairs prior to peak fire season.

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

For 2020, the inspections are summarized in the table below, which is an excerpt from our PG&E 2019 and 2020 Wildfire Mitigation Plan Update – Report submitted on May 20, 2021.

TABLE REVISION NOTICE-PG&E-7.3.4-2: 2020 WMP SUBSTATION INSPECTIONS

ATTACHMENT A

2020 WMP SUBSTATION INSPECTIONS
(clean)

PG&E Assets	HFTD Tier	PG&E Substations/ Switchyards					WMP Inspection Requirements	Substations Inspected (% of requirements)
		Total	EO Substations (single + shared location)		PG Switchyards (shared + single location)			
Substations (# of substations/switchyards)	Tier 3	65	32	11	11	11	100%	43 (66%)
	Tier 2	178	118	21	21	18	Three-year cycle	33 (N/A)
	Tier 2/3 Adjacent	69	68	0	0	1	N/A	23 (N/A)
Total Substations (T2/T3 + Adjacent)		312	250		62		N/A	99 (N/A)

For 2021, PG&E intends to complete supplemental ground and aerial inspections on all transmission and distribution substations and power generation switchyards in Tier 3 HFTD areas annually and once every three years (~33%) for Tier 2 HFTD areas. PG&E will also inspect substations in areas adjacent to Tier 2 and Tier 3 HFTD areas (i.e., Buffer Zones) once every three years.

5) ***Future improvements to initiative.***

Future improvements may include asset selection and work planning to align with revised risk models and the consideration of 2019 and 2020 supplemental inspection findings, evolution of objective inspection criteria and wording to deliver more consistency between evaluators, and incorporation of aspects of the supplemental inspection into routine station checks.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

Going forward, supplemental inspections for substation in HFTD areas is expected to continue. However, PG&E will evaluate efficiency opportunities between supplemental and routine inspections.

7.3.5 Vegetation *Management and Inspections*

Overview of Pacific Gas and Electric Company's (PG&E or the Utility) Vegetation Management (VM) Program

Given the growing wildfire threat, PG&E has further expanded and enhanced our VM around assets in High Fire Threat Districts (HFTD). This includes addressing vegetation that poses a higher potential for wildfire risk in high fire-threat areas through PG&E's Enhanced Vegetation Management (EVM) program. The goal of this important wildfire safety effort is to reduce the risk of trees, limbs and branches contacting power lines and equipment to help keep our customers and communities safe.

This work is critical because PG&E operates in a heavily forested and vegetated area, particularly compared to the other large California utilities. Additionally, PG&E's service area includes approximately:

- 81,000 circuit miles of overhead distribution power lines with approximately 25,200 circuit miles in HFTD areas

- 18,000 circuit miles of overhead transmission power lines with approximately 5,520 miles in HFTD areas

The EVM program is being done in addition to other baseline and long-standing, multi-pronged PG&E VM programs with various elements all designed to:

- Proactively conduct tree work that reduces the likelihood of tree failure that could impact electric facilities and pose a public safety risk;

- Comply with State and Federal regulations regarding minimum vegetation clearances for the Electric Transmission (ET) and Distribution overhead systems;

- Perform recurring cycle inspections so required vegetation clearances are maintained, remain compliant year-round and hazardous trees are abated;

- Maintain vegetation-to-line clearances, and radial clearances around poles, pursuant to California Public Resource Code (PRC) Sections 4292 and 4293, General Order (GO) 95 Rule 35, and Federal Agency Code (FAC)-003-4 (Federal ET standard), to ensure year-round compliance and risk reduction; and

- Validate that work was done as planned and intended through Work Verification (WV) and Quality Assurance (QA) reviews, including maintaining auditable records of all work done.

PG&E's EVM program encompasses all overhead distribution lines in Tier 2 and Tier 3 HFTD areas and is designed to exceed its Routine VM work to comply with California Public Utilities Commission (CPUC) mandated clearances (GO 95, Rule 35). In HFTD areas, PG&E's Routine VM meets regulations requiring four feet (ft) radial clearance around overhead distribution lines. The EVM program is much more expansive and includes the following:

- Radial Clearances: Exceeding the 4-ft minimum clearance requirement by ensuring vegetation requiring work is trimmed to the CPUC recommended 12-ft clearance at time of trim and in some cases, trimming beyond 12 ft depending on tree growth rates, among other factors. Trimming to the CPUC recommended 12-ft clearance ensures compliance with GO 95 Rule 35.

- Overhang Trimming: Removing overhanging branches and limbs four ft out from the lines and up to the sky around electric power lines to further reduce the possibility of wildfire ignitions and/or downed wires and outages due to vegetation-conductor contact.

- Assessing Trees with the Potential to Strike: Evaluating all trees in HFTDs tall enough to strike electrical lines or equipment and, based on that assessment, trimming or removing trees that pose a potential safety risk, including dead and dying trees.

Objectives, Strategies, and Tactics for VM

1) Collaboration with Local Land Managers and Regulation Compliance

In order to facilitate timely completion of VM activities, PG&E collaborates with local landowners and communities, local governments, state agencies and federal agencies. This includes coordinating with cities, counties and other local authorities to obtain local encroachment permits. PG&E's VM activities comply with endangered species and fish and game restrictions, California Department of Forestry and Fire Protection (CAL FIRE) forest practices rules, and state permitting requirements that could trigger review under the California Environmental Quality Act (CEQA). PG&E's VM Program is focused to a large degree on compliance with GO 95, Rule 35, PRC 4292, and PRC 4293. Additionally, VM is focused on the commitments within PG&E's Wildfire Mitigation Plan (WMP).

While VM is focused on complying with regulatory requirements, PG&E's higher mission is to perform VM in ways that reduce wildfire threat as circumstances dictate. Because climate threat conditions today are more severe than those that existed when regulations were developed and adopted, PG&E views VM requirements as the minimum standards for reducing risk. The program includes inspection identification, clearing and removal of potentially problematic vegetation, as well as QA review of the work performed. PG&E's EVM Overhang Clearing supports compliance with GO 95 Rule 35 and PRC 4293, which require that no vegetation approach within 4 feet of electric distribution wires at any time.

2) Identification and Determination of Ignition Risk

PG&E complies with Decision 14-02-015 in which the CPUC adopted a Fire Incident Data Collection Plan that requires investor-owned utilities (IOU) to collect and annually report certain information related to fire-related events. PG&E's annual report includes: the number of fire incidents; number of incidents by fire size; suspected ignition cause (e.g., third-party contact, equipment/facility failure, wire/wire contact, objects); object type suspected of causing ignition; and equipment failure type suspected of causing ignition. In addition, PG&E provides additional information about the tree species suspected of causing ignition. The data contained in these reports is analyzed to identify and determine the causes of ignition risk which ultimately drives the development of the WMP.

3) Determination to Trim Beyond GO 95 Requirements

PG&E has determined that in certain circumstances it is prudent to exceed the GO 95 requirements for tree trimming. For example, instead of the required four ft radial clearance around conductors, PG&E is trimming trees from the conductor to sky for overhang clearing. Additionally, through our EVM program, PG&E abates or trims trees outside of the GO 95 prescribed 4-ft clearance where trees more than four ft away from a power line are determined to have a defect as identified through the tree assessment tool (TAT) and have a clear path to strike.

4) Mitigation of Strike Trees

As part of our EVM program, PG&E performs an inspection of all strike trees adjacent to our distribution lines in HFTDs and uses the TAT as a guide for addressing strike trees with defects. PG&E will conduct a study to assess the need for and scope of the targeted tree species program. Depending on the circumstances, trees that are dead, diseased, or dying or that are identified by the TAT as "abate" may be removed under either Enhanced VM or the Tree Mortality Program.

5) Overall VM Initiatives

PG&E's VM and EVM initiatives are designed to address the overall VM objectives including:

- Enhance community and public safety by further reducing the risk of power outages, wires down, and fires caused by trees growing or falling into high voltage distribution lines;

- Maintain the reliability of the electric distribution system and continue to comply with vegetation clearance regulations through the Routine Tree Work and Vegetation Control programs;

- Maintain program and work quality through Quality Verification (QV) and QA programs;

- Continue to educate the public about the hazards posed by high voltage lines and vegetation through Public Education efforts;

- Further improve field working conditions and safety practices for tree workers through the Contractor Safety Oversight Program; and

- Continue to comply with environmental regulations while performing VM work.

- The initiatives that PG&E introduced in 2018 and continues to develop include:

- Overhang Clearing: Removing branches overhanging electric power lines to further reduce the possibility of wildfire ignitions and/or downed wires due to vegetation- conductor contact;

- Fuel Reduction: Reducing vegetative fuels in the area under and adjacent to power lines with the intention of further reducing wildfire risk;

- Light Detection and Ranging (LiDAR): Using analytics from LiDAR and imagery (collectively referred to as remote sensing) data collection to augment the information gathered through manual patrols.

PG&E continues to refine our VM and EVM programs based on additional data and experience, feedback from stakeholders and the Commission, and developments within the VM industry.

Response to Critical Issue No. PGE-06, Remedy 1

Critical Issue Title:

Contradictory Reduction in Expenditure Allocation for Critical Vegetation Management Initiatives

1) *Explain in full and complete detail how PG&E is ensuring it is still meeting its risk reduction targets from vegetation contact (as quantified in Tables 7.1 and 7.2) considering PG&E's modified percentage allocation and expenditure reduction, as compared to the 2020 WMP, for the following WMP initiatives:*

   a) *7.3.5.6 Improvement of inspections (-$18,777,398/ -83.87%);*

   b) *7.3.5.13 Quality Assurance / Quality Control of vegetation inspections (-$9,073,416/ -21.82%);*

   c) *7.3.5.14 Recruiting and training of vegetation management personnel (-$17,953,379/ -99.78%).*

   PG&E's overall vegetation management spend forecast has remained relatively flat year over year, with an approximately 2% change from what was reported in the 2020 WMP ($4,113,370,693[92]) as compared to the 2021 WMP ($4,195,142,314[93]). From the 2020 WMP filing (as updated in the First Quarterly Report submitted on September 9, 2020 (First Quarterly Report)) to the February 5, 2021 WMP submission, there is no material change in how the budget is being utilized to support each activity described in the WSD defined initiatives for the Vegetation Management Program.

   The differences in expenditure data between the First Quarterly Report and 2021 WMP can be attributed to differences in the financial assumptions used to calculate the numbers. PG&E is including the list of assumptions used for both submissions in Attachment 2021 WMP_Revision_PGE-06_Atch01.

   To provide a normalized view of the data between the submissions, PG&E is using the 2021 WMP assumptions to disaggregate programmatic vegetation management (Routine Distribution, Routine Transmission, Enhanced, and Tree Mortality) forecasts into the WSD-defined initiatives in Attachment 2021 WMP_Revision_PGE-06_Atch01. These assumptions are applied to both the 2021 WMP and First Quarterly Report forecasts and show a relatively consistent spend profile across each filing for each WSD defined initiative, including the three initiatives identified by the WSD in this Critical Issue No. PGE-06 (see Table PG&E-Revision Notice-7.3.5-1 below).

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92 For further details on this number, see the response to Critical Issue No. PGE-05 in Section 7.3.a.

93 *Id.*

TABLE PG&E-REVISION NOTICE-7.3.5-1: COMPARISON OF 2020 AND 2021 EXPENDITURE DATA FOR 7.3.5.6, 7.3.5.13, AND 7.3.5.14 (USING 2021 WMP FINANCIAL ASSUMPTIONS)

Initiative	2020 WMP (2020 – 2022 total)	2021 WMP (2020 – 2022 total)	Variance	% change
7.3.5.6 Improvement of inspections	$3,302,131	$3,611,845	$309,714	+9%
7.3.5.13 Quality Assurance / Quality Control of vegetation inspections	$29,719,182	$32,506,607	$2,787,425	+9%
7.3.5.14 Recruiting and training of vegetation management personnel	$34,058	$39,372	$5,314	+16%

In addition, we are meeting our risk reduction estimates from vegetation contact through the following actions, as described in detail in the Executive Summary and Section 7.3.5 in the 2021 WMP:

a) Newly-formed Wildfire Risk Governance Steering Committee (WRGSC) which approved the implementation of the 2021 EVM Scope of Work to target and complete the highest risk circuit segments.
b) Plans to triple the work verification workforce by adding more than 200 quality inspectors to increase the ability to verify that vegetation management was completed to meet or exceed state and federal standards.
c) Performing work verification (post-tree work inspections) on work performed in HFTDs, ongoing for EVM and expanded into the routine vegetation management programs.
d) Deployment of ground-based LiDAR technology to capture objective snapshots of the condition of vegetation throughout the HFTDs to further validate work completion and time stamped conditions across the system.
e) Staffing a team of centralized arborists to investigate any concerns or findings raised by internal or external parties to ensure timely follow-up, appropriate resolution and adequate closure of any issues identified.

7.3.5.1 Additional *Efforts to Manage Community and Environmental Impacts*

Wildfire Safety Division (WSD) Initiative Definition: *Plan and execution of strategy to mitigate negative impacts from utility VM to local communities and the environment, such as coordination with communities to plan and execute VM work or promotion of fire-resistant planting practices.*

1) ***Risk to be mitigated/problem to be addressed:***

   Our VM activities face numerous legal challenges, such as land rights issues, local permit requirements, environmental requirements, and other state and federal requirements. These issues can involve concerned landowners and communities, local governments, state agencies, or federal agencies, and can cause significant delays in performing VM work.

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.***

   PG&E wants customers and communities to be completely informed about the VM work taking place and our role in increasing public safety and reducing fire risk. PG&E proactively communicates and partners with impacted customers, landowners, government agencies and community organizations regarding the planned work and long-term solutions in and around their neighborhood or community. Communication efforts focus on community and environmental impacts that provide program information, share plans and engage in partnerships where possible, including the promotion of utility compatible, fire resistant landscaping education.

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")***

   Communication efforts to mitigate community and environmental impacts are performed within all PG&E regions by various PG&E lines of business (LOB), such as VM, Governmental Relations, Division Leadership Teams, Call Center Operations, Customer Communications and Local Customer Experience. The various forms of communication used include letters, postcards, door hangers, fact sheets, brochures, presentation materials, Interactive Voice Response outbound calling, web site, social media, email letters, texting, and work plan portals.

   In some cases, through PG&E's outreach regarding this work, opportunities can arise for communities or agencies to support or leverage the work PG&E is performing along power lines to further enhance community safety. Since 2014, PG&E has provided grant and other funding to community organizations (Fire Safe Councils) and agencies to support local or jurisdictional efforts toward reducing community wildfire risk mitigation, like fire break clearing and fuel cleanup in areas that are not adjacent to PG&E powerlines and are outside of the scope of PG&E's VM programs.

4) Progress on initiative (amount spent, regions covered) and plans for next year

To address the requirements described above, PG&E's land and environmental management, customer care, and legal teams work closely with PG&E's VM team annually to overcome community and environmental challenges. They coordinate and plan the work in order to reach out to landowners, communities, and local governments to address concerns in advance of the proposed VM activities. PG&E tries to reach mutually agreeable results with concerned parties, but this regularly causes delays, that in certain situations prompt PG&E to seek court orders. PG&E routinely engages with the CPUC, state and local agencies, as well as legislature to address these constraints.

In 2020, PG&E started using a web-based file transfer program known as "ProjectWise" to share workplans and schedules associated with VM programs and activities. This is an elective enrollment-based process. Current scope includes monthly outlooks for Routine and EVM activities. The Local Government VM Data Sharing corrective actions #17 of twenty system enhancement corrective actions agreed upon in the Wildfire Order Instituting Investigation Settlement Agreement with the Commission. The platform is being extended to the Regional Water Quality Control Board Representatives in 2021.

PG&E continues discussion with the Board of Forestry and CAL FIRE regarding Forest Practice Rules and application of Utility Exemptions for VM and WMP Plan activities. Workshops are scheduled to begin in December 2020 and continue through 2021.

5) Future improvements to initiative

PG&E will continue to communicate and partner with stakeholders regarding this public safety vegetation work and promote fire resistant planting. PG&E informs cities and counties of VM work within their community and works with them to address any questions they may have.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Managing community and environmental impacts is one of PG&E's top priorities and will continue to be well beyond the next 10 years. Long-term, PG&E is planning on better partnerships and agreements with agencies to perform VM work on federal or state lands without additional permitting requirements that could slow the mitigation of crucial work activities. PG&E also wants to promote fire-resistant plantings on these agency lands to reduce the community and environmental impacts of continuing to perform VM activities on a regular basis.

7.3.5.2 Detailed Inspections of Vegetation Around Distribution Electric Lines and Equipment

***WSD Initiative Definition*:** *Careful visual inspections of vegetation around the right-of-way (ROW), where individual trees are carefully examined, visually, and the condition of each rated and recorded.*

This section also addresses Action PGE-78 (Class B).

1) Risk to be mitigated/problem to be addressed:

Vegetation located close to electrical equipment can cause a fire by contacting the equipment, either catching fire or dropping a spark that could cause other vegetation to ignite. Vegetation trimming and dead tree removal reduce the availability of fuel that could start or spread a fire, whatever the cause. PG&E's VM program inspects approximately 100,000 miles of overhead electric facilities on a recurring cycle.

PG&E's distribution VM program consists of several different inspections (Patrols) that help PG&E safely and reliably operate primary distribution circuits and secondary distribution lines, while complying with the state laws and regulations. These inspections identify the following:

- Dead, dying, and declining trees, or dead portions of trees including dead overhangs, that can contact PG&E facilities if they fail
- Green trees observed within the Minimum Distance Requirement (MDR) or with the potential to encroach within the MDR before the next patrol cycle
- Green hazard trees with the potential to impact the electric facilities
- Trees causing strain or abrasion on secondary lines
- Abnormal field conditions

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

PG&E's Distribution VM program has been designed and implemented to ensure safe and reliable operation of distribution facilities and to prevent foreseeable vegetation outages. In addition, the Distribution VM program is designed to monitor compliance with state and federal laws and regulations including GO 95 Rule 35, PRC 4292, PRC 4293 and PG&E's 2021 WMP.

Each state and federal law requires the following:

- GO 95 Rule 35 requires a year-round clearance below power lines of a minimum 18 inches. New fire safety regulations require a minimum clearance of four ft year-round for high-voltage power lines in the CPUC-designated HFTDs.

- PRC 4292 is administered by the CAL FIRE. It requires that PG&E maintain a firebreak of at least 10 feet in radius of a utility pole, with tree limbs within the 10-ft radius of the pole being removed up to eight ft above ground. From eight ft to conductor height requires removal of dead, diseased or dying limbs and foliage. This applies in the State Responsibility Area (SRA) during the designated fire season.

- PRC 4293 is also administered by CAL FIRE. It requires that PG&E maintain a 4-ft minimum clearance for power lines between 2,400 and 72,000 volts (V), and a 10-ft clearance for conductors 115,000 V and above. PRC 4293 also requires the removal of dead, diseased, defective, and dying trees that could fall into the lines. This applies to the SRA during the designated fire season.

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")

VM inspects all distribution circuit miles in PG&E's service territory on a recurring cycle using a combination of different Patrol methodologies and Patrol types, please see below.

Patrol Methodologies:

- Direct visual inspection from the ground;

- Direct visual inspection from the air;

- Ground-based LiDAR inspection; and

- Aerial LiDAR Inspections.

Patrol Types:

- Routine Patrol – The VM routine program performs scheduled inspections on all overhead primary and secondary distribution facilities to maintain radial clearance between vegetation and conductors by identifying trees that will encroach within the MDRs required by law or PG&E procedures, dead, dying and declining trees.

- Mid-cycle Patrol – The VM Second Patrol program, (also known as CEMA Patrol), performs scheduled mid-cycle patrols approximately six months before or after the routine patrol on all overhead primary and secondary distribution facilities to maintain radial clearance between vegetation and conductors by identifying trees that will encroach within the MDRs required by law or PG&E procedures and by identifying dead, dying and declining trees that have the potential to strike the conductors. Second patrols occur primarily within HFTDs.

- EVM Patrol – The EVM Program is a multi-year program that performs risk-based, scheduled patrols on overhead primary distribution facilities. EVM patrols occur on specific line sections, based on risk, within HFTD Tier 2 and

Tier 3. Additionally, EVM patrols include a tree assessment of all trees with the potential to strike the facilities. This aspect of the EVM program is specified in section 7.3.5.15.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, PG&E trimmed approximately 1.5 million trees (including 2019 carry-over) in Routine VM. PG&E identified approximately 68,000 CEMA trees and trimmed approximately 65,000 trees (including 2019 carry-over).

At this time, PG&E is forecasting to work on approximately 1,800 circuit miles for the EVM program.

5) Future improvements to the initiative

Future improvements include, but are not limited to, increasing staff for general oversight and WV, as well as improvements to the QV process described in Section 7.3.5.13 (QA/Quality Control (QC) of Inspections).

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Long-term, PG&E plans to improve patrol procedures for all programs to incorporate additional details and lessons learned to help employees and contract staff members perform better inspections that benefit all customers. This is an effort that will be continuous and carried out well beyond 2025. WV and QV processes are projected to continue to expand within the next five years. Expansions of these processes will allow PG&E to use internal audit results to improve inspections of vegetation around distribution electric lines and equipment.

ACTION PGE-78 (Class B)

1) Describe whether it has evaluated implementing Utility Defensible Space (UDS) for distribution ROW, and either

a) Provide locations where UDS for distribution ROW is being implemented or planned to be implemented, or

b) Explain why PG&E is not utilizing UDS for distribution ROW vegetation maintenance.

Response:

PG&E has evaluated implementing UDS within Distribution and is in the process of building the framework for the program. At this time, the program will not include fire retardant application because it is pending further environmental reviews as mentioned in the Transmission UDS pilot Class B-action 77. The goal for 2021

Distribution UDS is to leverage the Vegetation Risk Model developed by the Asset Strategy team to identify sections of high-risk circuit protection zones (CPZ) to identify projects for performing modification of vegetative fuels. No section locations have been identified at this time. Any projects identified outside the Vegetation Risk Model will be locations based on a combination of local knowledge and a cohesive strategy to work with CAL FIRE, US Forest Service (USFS), and municipalities on wildfire prevention initiatives.

7.3.5.3 Detailed *Inspections of Vegetation Around Transmission Electric Lines and Equipment*

WSD Initiative Definition: *Careful visual inspections of vegetation around the ROW, where individual trees are carefully examined, visually, and the condition of each rated and recorded.*

This section also addresses Actions PGE-70 (Class B) and PGE-77 (Class B).

1) Risk to be mitigated/problem to be addressed:

Trees or other vegetation that make contact or cross within flash-over distance of high voltage transmission lines can cause local, regional, or cascading, grid-level service interruption. Vegetation encroachment can cause phase to phase or phase to ground electrical arcing which can cause injury, death, or wildfire ignitions. Vegetation growing close to poles or towers with non-exempt equipment can act as a fuel bed for wildfire ignition. Vegetation growing close to any structure can impede inspection of the structure base and in some cases can damage to the structure.

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

PG&E's Transmission VM program has been designed and implemented to ensure safe and reliable operation of transmission facilities and to prevent foreseeable vegetation outages to reduce wildfire risk. PG&E manages approximately 18,200 miles of ET Lines across our service territory ranging from 60 kilovolt (kV) to 500 kV. This includes approximately 6,800 miles of "critical" lines as designated by the North American Electric Reliability Corporation (NERC) and subject to the Federal VM Standard FAC-003-4 and approximately 5,500 miles of line in Tier 2 & 3 of the HFTD. All lines are subject to additional state VM regulations including GO 95 Rule 35, PRC 4292, PRC 4293, and the California Independent System Operator Field Maintenance Agreement.

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")

PG&E operates our lines in ET corridors that are home to vast amounts of vegetation. This vegetation ranges from sparse to extremely dense. PG&E's transmission lines also pass through urban, agricultural, and forested settings. The corridor environment is dynamic and requires focused attention to ensure vegetation stays clear of energized conductors and other equipment.

Vegetation inspection is a required operational step in an overall VM Program. Accordingly, PG&E has developed a recurring cycle inspection program as part of our overall Transmission VM Program to respond to the diverse and dynamic environment of our service territory.

This initiative is executed systemwide consisting of the following elements:

- Routine NERC – LiDAR inspection, visual verification of findings, and mitigation of vegetation encroachments as well as other vegetation conditions on approximately 6800 miles of NERC Critical lines. 100 percent inspection and work plan completion required by Federal VM Standard FAC-003-4.

- Routine Non-NERC - LiDAR inspection, visual verification of findings, and mitigation of vegetation encroachments as well as other vegetation conditions on approximately 11,400 miles of transmission lines not designated as critical by NERC.

- ROW Expansion – A program that removes vegetation to widen existing 60 kV/70/kV115/kV ET corridors in Tier 2 and Tier 3 HFTD areas. The work scope seeks to address lines that have radial clearance of vegetation, but do not necessarily have clear corridors. At a minimum, ROW expansion establishes a 20' corridor (10' on either side of centerline). Greater ROW widths are obtained where land rights (easements) allow; or where property owners are willing to partner. In addition, trees outside of the ROW that could fall and touch a PG&E line are inspected after initial ROW expansion activities conclude to assess any potential risks that may have developed as a result of the ROW clearing activities.

  – The program addresses approximately 200-line miles each recurring patrol cycle targeting trees and other woody vegetation for removal.

  – Work is prioritized based on wildfire risk, PSPS frequency, historic outage performance and tree risk characteristics.

  – Slash and fuels from previous VM work is chipped onsite with an off-road-tracked chipper machine or masticated in place where it is reasonable to do so.

  – Areas inaccessible to machinery have fuel treatments of lop and scatter.

- Integrated Vegetation Management (IVM) – Ongoing maintenance program designed to maintain cleared rights-of-way in a sustainable and compatible condition by eliminating tall-growing and fire-prone vegetation and promoting low-growing, fire-resistant vegetation. Prioritization is based on aging of work cycles and evaluation of vegetation re-growth.

- LiDAR Mid-cycle inspection of 80 percent to 100 percent HFTD Tier 2 and Tier 3 Transmission Lines – Started in 2020 to provide a snapshot of vegetation growing conditions and conductor clearances at the height of the growing season and immediately prior to the height of the fire season.

4) Progress on initiative (amount spent, regions covered) and plans for next year

- 2020 Commitment Performance:

TABLE PG&E-7.3.5-1: 2020 TRANSMISSION INSPECTIONS

Work Category*	Unit Description	Plan Units	Areas inaccessible to machinery have fuel treatments of lop and scatter; Year End Actual Units	Region
Routine NERC	mile**	6,779	6,779	Systemwide
Routine Non-NERC	mile**	11,441	11,441	Systemwide
ROW Expansion	mile	207	207	HFTD
IVM	acre	7,895	8,587	Systemwide
LiDAR Mid-Cycle	mile	5,662	5,662	Tier2 and Tier3, HFTD

Note: Mileage is reconciled annually from ET GIS data

- 2021 Transmission Inspections

  In addition to compliance inspections, in 2021, approximately 200 miles of Transmission ROW expansion work are planned within HFTD areas. PG&E will also continue to perform IVM Maintenance based on aging of work cycles and evaluation of vegetation re-growth and will conduct LiDAR mid-cycle inspections on 80 percent-100 percent of HFTD Tier 2 and Tier 3 Transmission lines.

5) Future improvements to initiative

Future improvement opportunities include continued improvement of LiDAR Risk Score Model. This model is being reworked, validated, and vetted by a team of internal and consulting experts as well as an industry panel that was assembled by the North American Transmission Forum (see Section 7.3.5.8 concerning LiDAR Inspections of Vegetation Around Transmission Electric Lines and Equipment).

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

Work related to inspections around transmission electric lines and equipment is recurring work that will expand beyond 2030. Due to the higher risk of potential fire ignition exposure in the HFTD Tier 2 and 3 areas, PG&E's goal is to remove vegetation to widen existing 60kV/70/kV115/kV ET corridors in Tier 2 and Tier 3 HFTD areas. Throughout this period, PG&E will be evaluating risk associated with the completion of this work and will adjust course as necessary to meet the objective.

ACTION PGE-70 (Class B)

1) *Provide the resource allocation in terms of percentage between transmission ROW expansion and PSPS risk-tree work, and*

2) *Provide the number of circuit miles completed in 2020 for transmission ROW expansion and PSPS risk-tree work, respectively.*

Response:

1) ROW Expansion refers to work intended to clear a minimum 20' ROW on lines identified by a number of risk factors, primarily: fire risk, outage frequency and number of times the line was in scope for a PSPS event. "PSPS risk-tree work" targets trees outside the *ROW*, either before or after full scope ROW expansion, to address trees identified as having higher risk relative to other trees based primarily on geospatial characteristics identified by LiDAR inspection. Working from those two descriptions, resources were allocated as follows:

   - 98 percent ROW Expansion; and
   - 2 percent PSPS risk tree work.

   Resource allocation is extrapolated from the number of trees completed in each work group as well as taking into consideration the efficiencies associated with scale: PSPS 3592 trees, ROW Expansion 269,892 trees. It is important to note that the PSPS work is a necessary component of the ROW Expansion work. They are not separate programs. They complement each other and support the same goals.

2) ROW Expansion and PSPS risk-tree work are multi-year projects. Therefore, PG&E does not track circuit miles completed within a calendar year. However, VM completed 207 corridor *miles* of transmission ROW Expansion in 2020. PG&E VM completed 206 corridor miles of Transmission PSPS targeted risk-tree removal work in 2020. This represents mitigation of the highest risk trees as identified by LiDAR on a circuit. See Table PG&E-7.3.5-2 below for details

TABLE PG&E-7.3.5-2: COMPLETED CORRIDOR MILES OF TRANSMISSION ROW EXPANSION AND PSPS TARGETED RISK-TREE REMOVAL WORK

Miles completed in 2020: This represents the total corridor miles worked on the Transmission lines below

PSPS targeted Risk-tree 2020	Miles	ROW Expansion	Miles
Apple Hill #1	1.4	Colgate-Alleghany	2.9
Black Tap	0.5	Colgate-Grass Valley	0.2
Carberry Sw Sta RND MTN	12.6	Deer Creek-Drum	5.7
Eldorado Missouri Flat 1&2	13.4	DeSabla-Centerville	5.9
Forbestown Tap	0.2	Donnells-Curtis	12.1
Forks of the Butte	0.2	Drum-Higgins	7.5
Haas Woodchuck	3.8	Drum-Summit #1	2.5
Humboldt Bay 1	2.5	French Meadows-Middle Fork	5.2
Malin Round Mtn 2	48.3	Fulton-Calistoga	15.9
Pit 1 Cottonwood	50.4	Fulton-Pueblo	43.5
Pit 4	7	Gold Hill #1	9.9
Pit 6	3.4	Humboldt-Trinity	3.3
Pit 6 JCT RND Mtn	8.1	Keswick-Trinity	7.6
Pit 7	3.6	Kilarc-Deschutes	7.6
Round MTN Cottonwood 1&2	26.5	Laytonville-Willits	0.1
Tiger Creek Electra	13.9	Middle Fork #1	4.4
Briones Tap	5	Monta Vista-Burns	3.6
Delta- Mtn Gate Jct	0.1	Monte Rio-Fulton	4.4
Halsey- Placer	1.8	Philo Jct-Elk	19.4
Mountain Gate Tap	0.7	Pit #1-Cottonwood	10.8
Volta – South	1	Pit #5-Round Mtn #1	11.7
Windsor- Fitch Mountain	1.3	Trinity-Cottonwood	9.9
	205.7	Trinity-Maple Creek	3.1
		Weimar #1	3.0
		Green Valley-Paul Sweet Rel	5.0
		Moraga-Oakland	0.1
		Moraga-San Leandro	1.5
			206.6

ACTION PGE-77 (Class B)

1) *Provide the percentage and number of overhead circuit miles that underwent the Transmission UDS pilot program, including the Transmission UDS and ROW Expansion overlap, for both completed and scheduled work, and*

2) *Explain* how *it determines UDS is beneficial on top of TVM, and how the benefits between the two differ.*

Response:

1) Our Transmission UDS pilot was focused on application of fire retardant around selected poles and towers where fuel reduction had been completed by some of our TVM programs. However, this program was not implemented in 2020. It is pending additional environmental reviews including, but not limited to, product toxicological and environmental analysis, efficacy analysis, and environmental planning and permitting. No circuit miles underwent the UDS pilot in 2020, and

there was no overlap between the pilot and ROW expansion.

2) The Transmission UDS Program is intended to be an additional layer of protection against wildfire that uses the application of fire-retardant chemicals to prevent the start or slow the growth of an ignition. The application of fire retardant is not included in the scope of any other TVM programs. UDS is unlike other TVM programs because of its potential to address multiple modes of failure, whether it be vegetation or equipment failure. TVM programs only address vegetation failures.

7.3.5.4 Emergency *Response Vegetation Management Due to Red Flag Warning or Other Urgent Conditions*

WSD Initiative Definition: *Plan and execution of VM activities, such as trimming or removal, executed based upon and in advance of forecast weather conditions that indicate high fire threat in terms of ignition probability and wildfire consequence.*

1) ***Risk to be mitigated/problem to be addressed:***

   All trees identified for work by pre-inspectors are evaluated for the priority of the required tree work. If vegetation is determined to be an immediate risk to PG&E facilities, described as a Priority 1 Condition in the VM Priority Tag Procedure (TD-7102P-17), the condition will be mitigated within 24 hours of identification as long as conditions are safe for the tree crew to proceed with work. Vegetation identified as pending Priority 2 work within the Red Flag Warning (RFW) area will be reviewed and re-prioritized if determined necessary by the local PG&E VM Point of Contact. Vegetation identified for follow-up work that shows no near-term risk factors, as outlined in the VM Priority Tag Procedure, is scheduled following the standard mitigation process.

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***

   It is important to review areas with potentially increased risk during a RFW or other elevated fire weather events and mitigate any identified vegetation risk to PG&E facilities.

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")***

   This activity takes place in areas identified as RFW conditions by PG&E's Meteorology Department where Priority Trees (per procedure TD-7102P-17 stated above) are pending.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

   In 2020, PG&E used the VM Priority Tag Procedure (TD-7102P-17) to identify, and mitigate, trees that represented an immediate risk to PG&E facilities during RFWs or other elevated fire weather events. RFWs and other elevated fire weather events continue to be prioritized daily. Accordingly, PG&E will continue using this process to mitigate wildfire risk in 2021.

5) Future improvements to the initiative

PG&E has no current plans for improvements to this initiative. However, PG&E will continue to evaluate the process annually by reviewing the execution of the work.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As stated in the section above, there are no further improvements planned at this time.

7.3.5.5 Fuel Management *and Reduction of "Slash" From VM Activities*

WSD Initiative Definition: *Plan and execution of fuel management activities that reduce the availability of fuel in proximity to potential sources of ignition, including both reduction or adjustment of live fuel (in terms of species or otherwise) and of dead fuel, including "slash" from VM activities that produce vegetation material such as branch trimmings and felled trees.*

In addition to describing the Fuel Reduction Program this section also addresses Action PGE-8 (Class B).

1) ***Risk to be mitigated/problem to be addressed:***

   The Fuel Reduction or UDS Program is intended to reduce vegetation fuels close to potential sources of ignition. Through this program, PG&E aims to remove dead fuels and to reduce, or adjust, live fuels to reduce the spread and intensity of fires associated with PG&E assets.

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***

   The goal of the fuel reduction work is to create "fire defense zones" to mitigate the spread of an ignition if one were to occur under or adjacent to PG&E powerlines while enhancing defensible space for communities, properties, and buildings. Locations for fuel reduction work are identified during pre-inspections (PI), beginning with the 2021 EVM high-risk circuits. VM may also identify some locations not on the Vegetation Risk Model to successfully complete cohesive strategy projects.

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")***

   The program will leverage the Vegetation Risk Model developed by the Asset Strategy team to identify sections of high-risk CPZs to identify projects for performing modification of vegetative fuels. Any projects identified outside the Vegetation Risk Model will be locations based on a combination of local knowledge and a cohesive strategy to work with CAL FIRE, USFS, and Municipalities on wildfire prevention initiatives.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

   PG&E is still in the process of building a framework for fuel reduction work. In 2020, different strategies were discussed and benchmarking with other utility companies was completed. The future work will target high-risk areas in all six regions based on the Vegetation Risk Model. There is no specific mileage target or budget for this work in 2021, this work in 2021 will be included in the 2021 EVM program (Section 7.3.5.15).

5) Future improvements to the initiative

Incoming data will be used to determine effectiveness and risk spend efficiency of a fuel reduction program. In addition, PG&E will use incoming data to identify the most effective schedule and cycle time. As mentioned above, PG&E has completed benchmarking with other utility companies. PG&E will be one of the first utility companies developing an official fuel reduction program.

In addition, as part of our UDS Program, PG&E is evaluating the use of fire-retardant products to reduce risk of ignition from utility infrastructure.

Traditionally, the use of fire-retardant chemicals has been limited to firefighting operations during active wildfires. PG&E is interested in land application of fire-retardant chemicals as a preventative measure to reduce potential ignitions related to utility infrastructure during extreme weather events in HFTDs. In the U.S., there is currently no single regulatory framework for the production, authorization and use of fire retardants. PG&E intends to conduct a review of commercially available fire-retardant products. This review will consist of the following:

- Product toxicological and environmental analysis;
- Efficacy analysis;
- Environmental planning and permitting initial assessment; and
- Scope of use including asset protection and proactive application.

PG&E's review of fire-retardant chemicals will take place ahead of the 2021 wildfire season.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E has not determined a long-term plan yet for this initiative. Depending on the results of PG&E's fire-retardant review, PG&E will establish best management practices for future use of fire retardants. Additionally, PG&E will work with regulatory agencies to secure permits for future product use and application. Long-term plan milestones are still under development with VMs Leadership team.

ACTION PGE-2 (Class B)

1) Provide an RSE calculation for fuel and slash management

2) Provide a description of how this value was calculated.

Response:

1) PG&E is actively exploring fuel management in more detail to represent its risk reduction benefits and effectiveness. Much like other vegetation-related programs, the intent of fuel management is to prevent an ignition, however unlike other vegetation related programs fuel management addresses multiple modes of failure, whether it be vegetation or equipment failure. Since this is a new program, PG&E continues to explore ways to provide an estimation of RSE. As PG&E will be one of the first utility companies developing an official fuel reduction program, we believe incoming data will help in identify preliminary effectiveness and cost estimations. While PG&E does not have data to use, PG&E intends to provide rough estimations for RSEs for the February 26th submission to better represent this program.

2) The method of calculation will utilize the standard Enterprise Risk Model. Given that this is a new project scope, the effectiveness and cost estimations will be preliminary estimations until this activity is performed in practice.

ACTION PGE-8 (Class B):

1) Discuss how PG&E is piloting the use of fire retardant, including how PG&E is choosing areas to undergo the pilot,

2) Discuss how long it takes to deploy fire retardant, including when such a decision would be made,

3) Describe the environmental permitting process needed for deployment of fire retardant, and

4) Explain what continuing "to explore the potential of this 'fail safe' alternative" 14 consists of.

Response:

1) PG&E has re-evaluated the concept of using of long-term commercially-available fire retardants to pre-treat ROWs and around equipment in select locations to limit a spark from causing an ignition. Before this concept can be further explored, retardants must be evaluated for potential environmental impacts associated with preventative pre-treatments in the absence of wildfires.

2) See the response to subpart (1) above.

3) The environmental permitting process to apply fire retardant materials to PG&E facilities or ROWs will vary based on the type of fire retardant used and the application process. Other similar treatments that are applied to electric facilities include herbicides and tower treatment materials. If not a preapproved material, application of herbicides and treatments must be approved for use on state and federal lands. The USFS requires the issuance of a Pesticide Use Permit and both the National Parks Service (NPS) and Bureau of Land Management (BLM) require National Environmental Protection Act (NEPA) review. Non-wildfire related projects proposing use of herbicides not previously approved in the USFS

and BLM have been subject to review timelines upwards of a year.

PG&E has various Operations and Maintenance (O&M) agreements with state and federal land management agencies across our service territory (including USFS, NPS, and California State Parks) which establish timelines to review PG&E O&M work. However, application of fire retardant material is not a "covered activity" under the various O&M agreements. Since PG&E's existing O&M Plans do not cover these activities, it is expected that PG&E will need to pursue a Special Use Permit with the relevant agencies. It is likely that the process of obtaining a Special Use Permit from these agencies will require a NEPA/CEQA review, similar to the process of getting herbicides approved for use of state/federal property. The agencies will likely require documentation to support the choice of product use as a fire retardant and will want to better understand of potential impacts it may cause to the health of both humans and the environment.

If the method for applying fire retardant is limited to precise application to PG&E equipment by a crew person who accesses by ft (or via truck from an access road), then it will be significantly lower impact than application to the material to the entire ROW or beyond.

For work proposed on private property, a land rights assessment will be necessary. Depending on the rights granted to PG&E within the easement document, application of fire retardant materials may not be covered and will need property owner approval. Additionally, if the application of fire retardant is required outside of the ROW width that is granted by an easement, PG&E will need new rights or property owner approval.

4) PG&E's evaluation and "exploration" of this alternative is described in subparts (1) and (3) above. The findings described in subpart (3) will inform the feasibility of resuming an evaluation of using of long-term commercially available fire retardants to pre-treat ROWs and around equipment in select locations to limit a spark from causing an ignition.

7.3.5.6 Improvement *of Inspections*

***WSD Initiative Definition**: Identifying and addressing deficiencies in inspections protocols and implementation by improving training and the evaluation of inspectors.*

1) Risk to be mitigated/problem to be addressed:

Identifying and mitigating hazards related to vegetation is an effort that requires a series of different protocols to properly manage. Training courses and inspection protocols must be continuously monitored and revised to ensure proper management of potential and unforeseen risk in the field while conducting work.

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

Vegetation Management Inspectors provide real-time support to VM operations by ensuring safety and compliance with VM project scope, contract adherence and PG&E standards and specifications. Evaluating the work of PG&E inspectors is critical to the sustainability of our VM program. PG&E has implemented multiple work authentication processes that allow us to identify deficiencies and improve upon our protocols, please see below:

- WV – Validates that 100 percent of vegetation work in EVM was completed to scope through an audit of all work performed. This process provides confirmation that requirements have or have not been met.

- QV – Reviews a sample of inspections and recently completed tree work to validate that all work was performed in accordance with PG&E standards. This process provides confirmation that requirements have or have not been met. (See Section 7.3.5.13)

- QA – Uses a random sample of PG&E systems to estimate the work quality rate for the VM process from PI to completion of tree work. This process provides assurance that procedures are followed. (See Section 7.3.5.13)

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")

Vegetation inspection is a required operational step in an overall VM Program. Accordingly, PG&E has developed a recurring cycle inspection program as part of our overall Transmission VM Program to respond to the diverse and dynamic environment of our service territory. Through our WV process, 100 percent of vegetation work completed is cycled through our audit process for EVM. Please see Sections 7.3.5.2 (Detailed inspections of vegetation around distribution electric lines and equipment) and 7.3.5.3 (Detailed inspections of vegetation around transmission electric lines and equipment) for additional information regarding region prioritization.

Each of our work authentication processes allows us to identify deficiencies in our inspection processes and revise training as needed to improve the performance of inspectors.

4) Progress on initiative (amount spent, regions covered) and plans for next year

PG&E continues to develop new training to support changes, such as assessing burned redwoods in response to the 2020 fires and focused training on Priority Tags in response to procedure changes. In all cases, our training will be developed with and managed through the PG&E Academy to ensure proper development and learner completion tracking. Please refer to Section 7.3.5.14 (Recruiting and Training of VM Personnel) regarding additional progress on this initiative.

5) Future improvements to the initiative

Please refer to Sections 7.3.5.2 (Detailed inspections of vegetation around distribution electric lines and equipment), 7.3.5.3 (Detailed inspections of vegetation around transmission electric lines and equipment) and 7.3.5.13 (QA/ QC of Inspections) for future improvements regarding this initiative.

ACTION PGE-25 (Class B)

Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

As stated above, please reference Section 7.3.5.2, Section 7.3.5.3, and Section 7.3.5.13 for more information on future improvements for this initiative.

7.3.5.7 LiDAR Inspections *of Vegetation Around Distribution Electric Lines and Equipment*

WSD Initiative Definition: *Inspections of ROW using LiDAR, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*

1) ***Risk to be mitigated/problem to be addressed:***

   LiDAR is a remote sensing method that uses pulsed laser light, in all light ranges, to sense relative distance of objects in the environment and provide precise measurements. Due to its high level of accuracy, PG&E will pilot the use of LiDAR derived data as an additional layer of review for quality in Routine VM.

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.***

   LIDAR and remote sensing data can consistently take measurements and, depending on the time of acquisition, this can be leveraged to verify radial clearance and compliance on distribution lines. The resulting detections can be documented for later analysis and record keeping and can be used to provide positive confirmation of compliance.

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"):***

   LiDAR and Remote Sensing data is targeted toward distribution lines in HFTDs Tier 2 and Tier 3. Data will be collected on pilot circuits in Routine VM.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

   LiDAR and Remote Sensing data was collected for distribution lines in HFTD Tier 2 and Tier 3 in 2019 and reviewed in 2020. (See also Section 7.3.4.7, LiDAR Inspections of Distribution Electric Lines and Equipment.) In 2021, PG&E will expand the pilot use of ground-based LiDAR for QC of 4 ft. radial clearances in Routine VM for a portion of our Routine VM program dependent on time of roll-out and resource availability. LiDAR is not used to perform EVM inspections at this time.

5) ***Future improvements to initiative:***

   Future LiDAR and Remote Sensing initiatives will focus on the continued evaluation of the use of LiDAR in QC and WV for radial clearances in Routine VM.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

PG&E will pilot the use of ground-based LiDAR datasets for QC in Routine VM in HFTD areas. We will be evaluating future LiDAR and remote sensing initiatives and will utilize lessons learned from previous and upcoming pilots to determine what the long-term path is. Long-term plan milestones are still under development, with the VM Leadership team.

7.3.5.8 LiDAR Inspections *of Vegetation Around Transmission Electric Lines and Equipment*

WSD Initiative Definition: *Inspections of ROW using LiDAR, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*

1) Risk to be mitigated/problem to be addressed:

Vegetation encroachment upon high voltage Transmission Lines presents a serious risk to public safety due to the risk of wildfire, electrical injury, or electrocution. Vegetation encroachment can cause electric service interruptions capable of disrupting the electric grid. Vegetation encroachment can also result in violations of both State and Federal regulations. Encroachment can occur as a result of tree growth, movement of the conductors, or trees failing from within or outside of the ROW.

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.

The Transmission System traverses substantially more rugged and inaccessible terrain as a percentage of the system than does distribution. This presents numerous safety exposures to ground inspectors and significantly increases the time it takes to complete inspections. Aerial LiDAR is a safer, more efficient, more effective, and more accurate means of conducting transmission vegetation inspections.

LiDAR inspections produce vegetation to conductor measurements with five-centimeter accuracy and include movement of the conductor caused by conductor sag (due to ambient temperature and electrical loading) and conductor sway (due to wind). In addition to identifying vegetation in immediate proximity to the lines, LiDAR captures tree data for trees on and adjacent to the ROW that can strike the lines. LiDAR provides a high level of accuracy in these measurements and helps to minimize possible human error.

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")

The PG&E Transmission VM Program conducts LiDAR inspections on 100 percent of PG&E's Transmission System (lines carrying 60 kV and above) as an integral first step of our routine program.

PG&E conducts a second, "mid-cycle" LiDAR inspection in the HFTD areas of our system at the height of the vegetation growing season which coincides with the beginning of historically the most active part of the California fire season. 2020 marks the first year the mid-cycle LiDAR patrol was conducted. PG&E plans to continue this activity in 2021.

4) Progress on initiative (amount spent, regions covered) and plans for next year

TABLE PG&E-7.3.5-3: 2020 TRANSMISSION LIDAR INSPECTIONS

Work Category	Unit Description	Plan Units	Year End Target	Year End Actual Units	Region
LiDAR Routine	mile*	18,220	96% –100%	18,220	Systemwide
LiDAR Mid-Cycle	mile	5,662	100%	5,662	Tier2 and Tier3, HFTD

TABLE PG&E-7.3.5-4: 2021 TRANSMISSION LIDAR INSPECTIONS

Work Category	Unit Description	Year End Target	Region
LiDAR Routine	mile*	96% – 100%	Systemwide
LiDAR Mid-Cycle	mile	80% – 100%	Tier2 and Tier3, HFTD

5) Future improvements to initiative

The Transmission VM team in collaboration with the PSPS team has developed a tree risk model, referred to as the "LiDAR Risk Score Model." This model calculates the relative risk of individual trees within the HFTD that have strike potential to a transmission conductor. The LiDAR Risk Score Model is being reviewed and validated by a team of internal and consulting experts as well as an industry panel that was assembled by the North American Transmission Forum.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

100 percent LiDAR inspections of ET lines are ongoing and in 2020 PG&E began a mid-cycle LiDAR inspection process that coincides with fire season. In addition, long-term, PG&E plans to use the LiDAR Risk Score Model. This model calculates the relative risk of individual trees within the HFTD that have strike potential to a transmission conductor. That model is being reworked, validated and vetted by a team of internal and consulting experts as well as an industry panel that was assembled by the North American Transmission Forum. In addition to the LiDAR Risk Score Model, PG&E will review subject matter expert input to make determinations on scoping or descoping of transmission lines prior to PSPS events.

7.3.5.9 Other Discretionary Inspection of Vegetation Around Distribution Electric Lines and Equipment*, Beyond Inspections Mandated by Rules and Regulations*

WSD Initiative Definition: *Inspections of ROWs and adjacent vegetation that may be hazardous, which exceeds or otherwise go beyond those mandated by rules and regulations, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*

1) ***Risk to be mitigated/problem to be addressed:***

   Dead and dying trees, as well as portions of dead trees, present a risk to PG&E's facilities if they fall. In addition, trees causing strain or abrasion on secondary lines, and other abnormal field conditions, may also require enhanced inspections beyond those mandated by State and Federal rules and regulations in order to mitigate wildfire risks.

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.***

   The CEMA Program is a compliance requirement per CPUC Resolution (Res.) ESRB-4. CEMA (also referred to as "mid-cycle") inspections follow approximately six months after PG&E's routine maintenance schedule. CEMA inspections are used to identify and mitigate conditions that have changed since the routine inspection and to address conditions that are not safe to leave unresolved until the next routine inspection.

   This bi-annual inspection frequency helps identify and mitigate dead or dying trees in a timely manner in accordance with CPUC Res.ESRB-4, which directs "increasing vegetation inspections and removing hazardous, dead and sick trees and other vegetation near the IOUs' electric power lines and poles."

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")***

   VM performs a second inspection in many parts of our service territory, namely HFTDs, and SRAs that are at higher risk of tree mortality and/or wildfire risk, Federal Responsibility Areas, and Fire Hazard Severity Zones. CAL FIRE, the CPUC and PG&E have identified these areas as the highest likelihood of catastrophic wildfire risk.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

   PG&E uses operational and financial performance measurement processes/reviews to provide updates regarding the performance of different "sub-budgets" within the CEMA Program.

Table PG&E-7.3.5-5 displays the total inspections completed by the region for each quarter of 2020.

TABLE PG&E-7.3.5-5: 2020 CEMA QUARTERLY INSPECTIONS BY REGION

Region	Quarter	Inspections	Miles
Bay	Q1	135	1,662
Central Coast	Q1	129	1,684
Central Valley	Q1	123	2,187
North Coast	Q1	54	1,666
North Valley	Q1	74	1,751
Sierra	Q1	73	1,169
Total		**588**	
Bay	Q2	251	1,008
Central Coast	Q2	157	2,404
Central Valley	Q2	101	1,902
North Coast	Q2	77	1,685
North Valley	Q2	74	921
Sierra	Q2	73	1,465
Total		**733**	
Bay	Q3	193	1,096
Central Coast	Q3	79	1,361
Central Valley	Q3	123	2,949
North Coast	Q3	72	1,802
North Valley	Q3	47	1,236
Sierra	Q3	60	1,710
Total		**574**	
Bay	Q4	125	1,187
Central Coast	Q4	130	2,776
Central Valley	Q4	153	3,794
North Coast	Q4	75	2,121
North Valley	Q4	33	1,654
Sierra	Q4	94	2,185
Total		**610**	

5) Future improvements to initiative

PG&E will continue to use and build upon the CEMA second patrol program that utilizes two forms of inspections, ground and aerial, to patrol the distribution lines. Ground patrols involve a contract pre-inspector walking along the distribution lines inspecting for any issue that meets the scope of mid-cycle patrol. Ground patrols are the main method of inspection for the second patrol program. Aerial patrols involve a pre-inspector flying in a helicopter over the distribution lines inspecting any issue that meets the scope of the second patrol. To improve upon CEMA inspections, PG&E will begin updating our contracts with the intent of diversifying the pre-inspector vendors we use, continue to assess areas appropriate for aerial patrols, and evaluate the frequency of patrols in Wildland Urban Interface and non-HFTD areas.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

PG&E has not determined a long-term plan yet for this initiative. We will be assessing potential future CEMA improvements and second patrol procedure enhancements to boost focus on HFTD areas for inspectors to ensure efforts are concentrated on wildfire risk reduction. Long-term plan milestones are still under development with VMs Leadership team. These steps seek to drive toward decision-making based upon current second inspection in many parts of our service territory, namely HFTDs, and SRA that are at higher risk of tree mortality and/or wildfire risk, Federal Responsibility Areas, and Fire Hazard Severity Zones.

7.3.5.10 Other Discretionary Inspection of Vegetation Around Transmission Electric Lines and Equipment, Beyond Inspections Mandated by Rules and Regulations

WSD Initiative Definition: *Inspections of rights-of-way and adjacent vegetation that may be hazardous, which exceeds or otherwise go beyond those mandated by rules and regulations, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*

Please refer to Section 7.3.5.3 Detailed inspections of vegetation around transmission electric lines and equipment.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Section 7.3.5.3 for more information on future improvements for this initiative.

7.3.5.11 Patrol *Inspections of Vegetation Around Distribution Electric Lines and Equipment*

WSD Initiative Definition: *Visual inspections of vegetation along ROW that is designed to identify obvious hazards. Patrol inspections may be carried out in the course of other company business.*

Please see Section 7.3.5.2 (distribution inspections) above for a discussion of PG&E's vegetation inspection programs for distribution facilities. There is no specific program to perform "patrols" around distribution lines unique from the inspections described in Section 7.3.5.2.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each* individual *initiative.*

Response:

As stated above, please reference Section 7.3.5.2 for more information on future improvements for this initiative.

7.3.5.12 Patrol *Inspections of Vegetation Around Transmission Electric Lines and Equipment*

WSD Initiative Definition: *Visual inspections of vegetation along rights-of-way that is designed to identify obvious hazards. Patrol inspections may be carried out in the course of other company business.*

Please refer to Section 7.3.5.3 Detailed inspections of vegetation around transmission electric lines and equipment. There is no specific program to perform "patrols" around transmission lines unique from the inspections described in Section 7.3.5.3.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Section 7.3.5.3 for more information on future improvements for this initiative.

7.3.5.13 Quality *Assurance/Quality Control of Inspections*

WSD Initiative Definition: *Establishment and function of audit process to manage and confirm work completed by employees or subcontractors, including packaging QA/QC information for input to decision-making and related integrated workforce management processes.*

In addition to describing quality control/ quality assurance of inspections this section also addresses Action PGE-76 (Class B).

1) Risk to be mitigated/problem to be addressed:

PG&E assesses VM work performance using both QA and QV processes. Both QA and QV processes use sampling methodologies to determine which samples to assess. The QA effort is designed to validate program effectiveness and to provide confidence that the desired outcomes, including regulatory goals, are met. QV samples inspections and tree work recently completed to provide competence that work was performed in accordance with PG&E standards. QA and QV also identify areas where expectations are not being met.

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

QA and QV are accomplished through the physical inspection of sample locations. The objective of sampling is to provide confidence and to mitigate risk across the system. We verify the work quality and compliance rate for all trees in the geographic area covered by an audit/review. QA is the program that estimates compliance while QV is more specific to work quality.

For QA, PG&E uses the results of the QA Programs to identify and address compliance related issues through short-term corrective actions or long-term preventive actions.

QV chooses the work they review by sampling, which generates review locations where work has been listed by inspectors and/or invoiced by tree crews. PG&E uses the results of the QV Program Reviews to identify areas of work quality that need improvement as well as to take short term corrective actions.

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")

There is no regional prioritization as QA and QV will perform audits of the entire system and sample by Defined Scope (bundling circuits geographically). For QV, all mid-cycle reviews for 2021 will be in HFTD and SRA non-HFTD areas.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

The Quality Management Team has developed an annual audit plan based on Key Enterprise Risk. Key Enterprise Risk is compiled by Internal Audit and shared with Quality Management. Findings from the audits are shared with the LOB leadership for corrective action. In 2020, our QV goal was to complete approximately 2,000 audits. QV completed approximately 2,500 audits. QA completed 88 percent of its Distribution compliance audit goal for 2020. For 2021, the Veg QA and QV teams will conduct approximately 2,000 audits/reviews.

5) ***Future improvements to the initiative***

Quality Management Veg QA and Veg QV are beginning to use Survey123/Collector to perform audits/reviews. This is being done to align with how the LOB performs its work, and to efficiently communicate findings and take advantage of a system (front end, database, dashboards) rather than a paper-based process.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

PG&E has not determined a long-term plan yet for this initiative. PG&E would like for all QC efforts to be completely paperless and utilize digital products only. Enhancing our QC efforts will take an internal coordinated team approach to successfully implement a process that is effective and efficient. Long-term plan milestones are still under development and will continue to be discussed well beyond 2021.

ACTION PGE-76 (Class B)

1) *Explain what the verification process entails for the 100 percent of EVM work being checked, including the length of time it takes the WV process to be completed per circuit mile, and*

2) *Explain why it finds it necessary to increase the WV process for Routine Maintenance from 10 percent to 25 percent.*

Response:

1) Work verification involves the following steps:

   a) A Work Verification order is sent to the team performing EVM work on a line segment to ensure work is completed by both Pre-Inspectors and Tree crews
   b) Work verification personnel go to the field and verify that each EVM work checkpoint is completed. Work verification personnel collect data in the field and enter it into the collector tool as part of a survey.

c) All correlated points and surveys are reviewed by algorithmic scripts (computer coded directions) to ensure data integrity and completeness.
d) Once the script (computer coded directions) reviews the data, the segment is passed or failed in the collector tool so that operations has increased visibility.

Currently, PG&E does not track the length of time it takes to complete the Work Verification process per circuit mile.

2) In 2020, PG&E shifted the work model in our routine program to give contractors more autonomy to perform work with the goal of improving their efficiency. Since there is more contractor autonomy involved, PG&E took a proactive approach to check a higher percentage of the vendor work to ensure the work quality meets PG&E's standards.

Response to Critical Issue No. PGE-06, Remedy 2

Critical Issue Title:

Contradictory Reduction in Expenditure Allocation for Critical Vegetation Management Initiatives

2) As part of section 7.3.5.13, PG&E shall provide:

a) An analysis comparing the number of circuit miles of VM inspections by individual contractors to the number of miles audited of said individual contractors. This analysis must be presented in tabular format and include, at a minimum, the following sortable attributes:

i. HFTD designation (i.e., Zone 1, Tier 2, Tier 3, Non-HFTD)

ii. Circuit Protection Zone (CPZ)

iii. County

iv. VM inspection type (e.g., routine, EVM, and post-fire)

v. Distribution/transmission

vi. Name of company in VM auditing role

vii. Name of company in VM inspection role

b) The number and percentage of inspections (of each type: routine, EVM, and post-fire) that failed Quality Assurance/Quality Verification

c) The number of instances and percent of total instances in 2019 and 2020 in which an inspection QA/QV process has resulted in a reinspection;

d) For each instance in subparts b and c, identify the companies in both the inspection role and audit (QA/QV) role;

e) *For each instance in subparts b and c, above, the immediate and longer-term corrective actions PG&E has taken to remediate the issue(s).*

PG&E provides the requested data in Attachment 2021 WMP_Revision_PGE-06_Atch02. In the attachment, PG&E describes the data provided and provides explanations for areas where data is currently unavailable.

7.3.5.14 Recruiting *and Training of Vegetation Management Personnel*

WSD Initiative Definition: *Programs to ensure that the Utility is able to identify and hire qualified VM personnel and to ensure that both full-time employees and contractors tasked with VM responsibilities are adequately trained to perform VM work, according to the Utility's WMP, in addition to rules and regulations for safety.*

In addition to describing recruitment and training of vegetation management personnel, this section also addresses Actions PGE-72 (Class B), PGE-73 (Class B) and PGE-75 (Class B).

1) Risk to be mitigated/problem to be addressed:

VM work is dependent on having fully staffed PI and Tree Crew resources. There is an increased risk of a vegetation related outage or wildfire ignition events if this work is not completed in a timely manner.

Logging and tree felling are one of the most hazardous industries in the nation, and the Northern California forests pose a very different challenge than in most parts of the country, due to the dry conditions, tall trees and high-risk species. Safely removing a 200+ ft tall tree in proximity of a high voltage distribution line must be done by a qualified professional. Therefore, hiring and training workers from outside of California requires additional training in the unique vegetation conditions in California and Northern California in particular.

There is a limited pool of qualified personnel, which causes constraints when responding to emergency events (Snow, Wind, Wildfire) each year. Additional Contractor resources are also pulled away from PG&E during large natural disasters events in other parts of the county, as individual contracts are paid premium rates during emergency events.

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.

Without a qualified workforce PG&E is unable to complete VM work, to address this constraint in the coming years, PG&E is exploring approaches to increase the population of qualified tree workers to perform this work. We use our Pre-Inspector basics Structured Learning Path (SLP) to provide specific, well-defined training related to the work being performed. To bolster recruitment and the pipeline of qualified personnel, we have partnered with the IBEW and educational institutions, such as Butte Glenn Community College District, to establish a training program designed to provide the skills and knowledge necessary to perform tree crew work safely and competently.

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")

VM works with Contract Management to engage with contract vendors to recruit appropriate personnel to support VM programs across our service territory. Prior to identifying the most effective contract vendors we ensure the vendor is appropriate to perform the scope of work identified and we validate the vendors' safety presence in the industry. The VM Department regularly sources qualified talent for internal positions from current contract staff, who usually have extensive experience working in the industry and for PG&E. PG&E's efforts to recruit and train VM personnel will support VM across PG&E's service territory and, in particular, HFTD areas.

Certification is currently not a requirement for pre-inspectors. For pre-inspectors to become certified, they require a certain level of experience and on-the-job training. With that, PG&E has taken the approach of developing Tree Crew and Inspector Training programs to support a steady pipeline of qualified personnel who may later join our contract or internal VM workforce. PG&E's PI basics SLP and related training courses provides personnel with an opportunity to earn continuing education credit that can be used towards obtaining certification. Our educational partnerships allow us to provide employees and contractors with a direct path of obtaining certification.

4) Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, VM assisted in identifying additional resources, PG&E has partnered with the Utility Arborist Association a branch of the International society of Arboriculture (ISA) to support and expand their Utility Vegetation Management (UVM) Certificate Program. Our partners are excited that PG&E is providing full-tuition scholarships to the UVM offered through University of Wisconsin–Stevens Point as well. This is an on-line course comprised of six, 12-week course completed over two years. It is available to anyone in the utility or tree industry that wishes to obtain certification in UVM. Like the tree worker training program, this allows individuals a way to improve their skills resulting in a larger and better qualified workforce supporting PG&E Vegetation Operations to support efforts for promotions or just to better themselves. These courses are funded to continue through 2022.

5) Future *improvements* to initiatives

Since 2020, PG&E has been supporting Butte College in developing and funding a 5-week tree worker training program intended to develop and support individuals looking to make a transition to the utility tree worker industry. This course allows individuals the ability to be certified and competitive when seeking a job as a utility tree worker. Not only does this support retraining and return to work for individuals, it also allows employers the ability to hire someone who can start work immediately. In 2021, PG&E

will fund the digitization of course material to make material available online and to significantly reduce out of pocket cost for students currently purchasing hard copies of materials.

Once Butte College is comfortable that the course is working successfully, PG&E will foster the expansion of this program to other community colleges throughout California.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Recruiting and training of VM personnel is an effort that will expand well beyond 2030 as we continue the work started in 2020 that focuses on improving worker qualifications and supporting certification of employees and contractors. Long-term, PG&E plans to help improve the availability of tree workers not only in PG&E's service territory, but in the territories of other California IOUs. PG&E will continue to seek educational partnerships and explore other opportunities for employees and contractors to seek certification and advanced worker qualification.

ACTION PGE-72 (Class B)

Provide the pass-rate and identify the score required to pass the Pre-Inspector assessment.

Response:

All Pre-inspectors are required to pass inspection assessments with a score of 100 percent. PG&E works with pre-inspectors so that they are able to achieve the 100 percent score. We do not collect pass rate data because we work with pre-inspectors until they are able to pass, and pre-inspectors can only pass when they get 100 percent.

ACTION PGE-73 (Class B)

1) *Explain whether and how it ensures that PI work not completed by an ISA certified pre-inspector is verified by an ISA certified arborist during the WV process,*

2) *Furnish any supporting procedures and documents demonstrating that VM work is checked by an ISA certified arborist at some point in the process, and*

3) *Clarify if PG&E's understanding of "vast majority" of work professionals having ISA certification* correlates *to the "50 percent" of the WV Team being ISA Certified Arborists, mentioned earlier within its response to the "Work Verification" explanation of this section.*

Response:

1) There is no process in place to ensure that pre-inspection work not completed by an ISA certified pre-inspector is verified by an ISA certified arborist during the WV process. However, the WV team consists of about 90% ISA certified arborists. The other 10% of the team consists of individuals who are experienced in extensive forestry and/or utility line clearance work.

2) There are no procedures in place to demonstrate that all VM work is checked by an ISA certified arborist.

3) Yes, PG&E's understanding of "vast majority" of work professionals having ISA certification correlates to more than "50 percent" of the WV team being ISA Certified Arborists. Currently, 90 percent of PG&E's WV team have been ISA certified.

ACTION PGE-75 (Class B)

Explain the resources and processes it provides to employees to support ISA certification of its pre-inspectors.

Response:

ISA Certification is currently not a requirement for pre-inspectors. For pre-inspectors to become ISA certified, they require a certain level of experience and OJT. For example, to become an ISA Certified Arborist, you must be trained and knowledgeable in all aspects of arboriculture and meet a minimum qualification of having three or more years of on-the-job experience. With that, PG&E has taken the approach of developing Tree Crew and Inspector Training programs to support a steady pipeline of qualified personnel who may later join our contract or internal VM workforce. PG&E's PI basics SLP and related training courses provide contractors with an opportunity to earn continuing education credit that can be used towards obtaining ISA certification. Our partnership with Butte College also allows us to provide employees and contractors with a direct path to obtain the ISA certification. For more information, please see Section 5.4.2.

Response to Critical Issue No. PGE-06, Remedy 3

Critical Issue Title:

Contradictory Reduction in Expenditure Allocation for Critical Vegetation Management Initiatives

3) As part of section 7.3.5.14, PG&E shall provide (for both internal and contracted personnel):

a) The initial curriculum for VM training (i.e., training provided to those VM personnel identified in Table PG&E-5.4-1)

All personnel listed in Table 5.4-1, excluding Vegetation Control (VC), are

referred to collectively as “Pre-Inspectors” and are enrolled in the Pre-Inspector Structured Learning Path (SLP) to track their initial VM training. SLP initial VM Program training is contained in the following courses: VEGM 0101, VEGM 0102, VEGM 0103, VEGM 0104, VEGM 0105, VEGM 0106, VEGM 0107, VEGM 0108, and VEGM 0109. A final test assessment is included in VEGM 0110. VC personnel do not get assigned to the SLP. Instead, VC personnel take VEGM-0302 and VEGM-0303 for Vegetation Control.

Upon receiving LAN ID information as part of the onboarding process, all VM personnel, including VCs, are also profiled for Environmental training. The initial training curriculum for VM resources includes the following environmental courses: ENVR-0070, ENVR-9090, ENVR-9091, ENVR, 0220, ENVR-0402, and ENVR-9032. These trainings are due to be completed within 90 days of being profiled and receiving a LAN ID.

Copies of these Initial VM training materials are being provided as Attachment 2021 WMP_Revision_PGE-06_Atch03.

b) Continuing education/ “refresher” curriculum.

PG&E does not have a continuing education, or “refresher” curriculum for VM personnel. However, we are currently in the process of creating a refresher course that will be updated yearly. We intend for the refresher course to cover issues across various scopes of work identified in the previous year. We also anticipate that the refresher course will address any changes to our VM programs or changes to safety or work standards that have been implemented. We also intend to refresh our environmental expectations. This will be a required training for all VM personnel listed in 5.4-1, including VC. We expect to have this WBT ready for use in 2022.

c. The timeframe for completing VM training (both initial and continuing) and how often continuing education is required;

Currently, there is no set timeframe for VM personnel to complete the initial non-environmental trainings described in response to Remedy 3.a above. Our primary objective is for new VM personnel to learn the information in the required trainings so that they are prepared to safely perform VM work in the field. We recognize that individuals will require different amounts of time to fully internalize the information taught in the initial trainings. At the same time, as indicated in the 2021 WMP, VM personnel are not permitted to perform VM work until they pass the Pre-Inspector SLP. Once an individual passes the SLP coursework, the individual is permitted to begin performing VM work in the field. Our initial Environmental training must be completed within 90 days from the time it is profiled.

As stated in response to Remedy 3.b, PG&E does not currently have continuing education, or “refresher”, curriculum for VM personnel. Therefore, there is no timeframe for completing this type of curriculum.

d. The expenditure on training per VM personnel per year by position classification;

We understand this Remedy to be asking for direct costs incurred by PG&E. However, we do not track direct costs for VM personnel training by position because our contracts for VM work are not structured in this way. Training costs are built into the overall contract costs for various VM personnel employed by different vendors

Accordingly, to respond to this Remedy, we have prepared Attachment 2021 WMP_Revision_PGE-06_Atch04 to provide an estimate for the total costs associated with completion of the initial VM trainings required for the VM personnel listed in Table 5.4-1 for 2020 and 2021. In preparing the chart, we reviewed the initial training materials and have estimated the average amount of time it takes to complete each course. We then multiplied the estimated minutes by an average hourly Pre-Inspector rate of $65/hr. After performing that calculation, we multiplied the resulting sum by the amount of trainings completed in both 2020 and 2021. This resulted in a total spend of $1,345,727.50 for 2020 and 2021.

e) A detailed explanation of how PG&E tracks and verifies VM training (both initial training and continuing education);

The SLP is comprised of a series of initial training courses for VM personnel whose progress is overseen by the Vegetation Program Manager (VPM) to whom the contractor reports. The VPMs have a dashboard that allows them to track the progress of each learner that reports to them. The VPM can see updates as the learner completes each course of the SLP. The curriculum covers a wide range of topics including, but not limited to, introduction to Pre-inspection basics, electrical equipment, PG&E procedures, tree strike potential, and growth rates. Embedded within each training is a knowledge check for the module to ensure the VM personnel fully understand the course material. All personnel are required to complete each knowledge check with a score of 100% before moving on to the next training course. If a question is answered incorrectly, the individual is returned to the curriculum to review the material that was not comprehended. After reviewing the material, the individual has an opportunity to take the knowledge check again to pass. This process continues until the student has answered each question correctly.

After each training course is completed, results are automatically captured in PG&E's learning management system, PG&E Academy, to track and verify completion of training. Each user has a unique identification in the system, and training data is tracked and retained even if the user leaves and later returns to a PG&E project.

When VM personnel complete their training, they send a request to our VM Support Tech team to request access to our VM database. VM support will confirm completion of training before any individual is granted access to our VM database. If a subsequent audit of users with access show missing training records, we will turn off their access until training is completed and confirmed.

f) Thresholds for passing/failing PG&E's VM training program initial training and continuing education;

As explained in the response Remedy 2.e above, the "threshold" to pass PG&E's initial VM training is 100% on each training module. If the individual participating in the initial VM training does not correctly answer a question following the training instruction, the individual can re-review the materials and re-attempt the knowledge check. This ensures that all VM personnel comprehend the key points of our training before they are permitted to work in the field.

Our key assessment course at the conclusion of the SLP, VEGM-0110, was designed to be a proctored exam that limits participants to three attempts to obtain a passing grade of 100%. However, the COVID-19 pandemic delayed our plan to implement the proctored exam.. Use of the proctored exam will be re-evaluated once when we can safely resume in-person trainings.

In the future, we will be adding program-specific courses based on different regulatory requirements. PG&E anticipates adding program-specific courses for our Distribution and Transmission VM programs. These courses will include knowledge assessments with a passing threshold. We are currently wrapping up the EVM program requirements exam, which will be done in 2021. We anticipate that the pass rate for the exam will be 84% or greater. This pass rate was identified by the PG&E Academy's Psychometrician and learning standard methodology.

g) VM training pass/fail rates by year and quarter for initial and continuing education;

We do not track pass/fail rates by year and quarter for initial VM training. As discussed, the software allows individuals to re-take the knowledge checks as many times as needed to fully comprehend the materials and respond to each question correctly. Therefore, there is no "fail rate." From the time of the initial rollout of the VEGM-0101 through VEGM-0110 SLP program in Q2 2020 through Q2 2021, 2,255 learners have completed the SLP coursework by passing the VEGM-0110 training exam with a 100% score. The breakdown for the "passing" VEGM-0110 score by quarter is as follows:

TABLE PG&E-REVISION NOTICE-7.3.5-2: SLP VEGM-0110 PASSING SCORES BY QUARTER

	Q1	Q2	Q3	Q4
2020	0	1437[(a)]	174	131
2021	263	250		

(a) The high rate of trainings in Q2 2020 is due to having all VM personnel complete the VEGM-0101 through VEGM-0110 at that time.

As indicated above, we do not currently have any continuing education courses for VM personnel that are used as "refresher" courses. Therefore, we cannot provide pass/fail rates for any such courses. We are, however, in the process of creating a refresher web-based training (WBT) that will be updated yearly.

h) If and how PG&E tracks and measures recall and retention of VM training

information after initial training is complete;

One way that we track retention of initial VM training comprehension is by our involvement in VM work audits. As part of the SLP, once training is completed by the VM personnel listed in Table 5.4-1, excluding the VC, a one-year audit tracking plan is initiated. These audits are completed by the Pre-Inspector's employer at the following intervals: Month 1, Month 3, Month 6, and Month 12. The Pre-Inspector's employer provides the results of the audit to PG&E for our review.

During PG&E's review of the audit reports, the Vegetation Program Managers (VPM) discuss the training progress of the VM personnel with the Contractor Supervisor to ensure that they are progressing and receiving the support and training aligned with the results of the audits. We do not expect that these initial audits will be perfect because the work of new employees is being reviewed. Therefore, the VPM will typically focus on whether there has been improvement in response to any identified errors previously made by new Pre-Inspectors. If improvement is not seen, the VPM may work with Contractor Supervisor to find a better job fit for the VM personnel, if possible. At the end of the SLP, the VPM will either approve the completion of the audit tracking in SLP if the employee is ready to work without the additional oversight of the contracting company or ask for additional audits, if needed.

In addition, PG&E tracks the work performed by Pre-Inspectors through audit reviews from the Quality Verification (QV) and the Quality Assurance (QA) teams. QV reviews a sample of inspections and recently completed tree work to validate that all work was performed in accordance with PG&E standards. This process provides confirmation that requirements have or have not been met. QA uses a random sample of PG&E systems to estimate the work quality rate for the VM process from PI to completion of tree work. Observations from QA findings identify trends that are used by local operations to provide corrections for urgent matters or attention to correct unacceptable trends. This process provides assurance that procedures are followed.

Finally, all EVM work is reviewed through the Work Verification (WV) process. The WV team validates all EVM work to verify that the work was completed to PG&E's scope.

i) A detailed explanation of how PG&E tracks, verifies, and encourages VM personnel to obtain certification from the International Society of Arboriculture (ISA);

PG&E currently tracks the ISA certification of VM team members as part of the onboarding process. We then check with the International Society of Arboriculture (ISA) to ensure the certification is current. At this time, approximately 25% of Vegetation Management Inspectors (VMI) are ISA certified.

PG&E encourages team members to obtain ISA certification and advanced certificates such as Utility Arborist or Tree Risk Assessment Qualification (TRAQ) through our conversations with vendors and contractors during our daily

interactions. In 2021, we have been providing TRAQ training to current ISA Certified Arborists through the Western Chapter International Society of Arboriculture (WCISA). This training consists of advanced tree risk identification, analysis, and evaluation skills.

PG&E is developing a new Pre-Inspector Training Certification Program in partnership with educational institutions such as the California Community College system and the Utility Arborist Association (UAA). Once established, this program will provide the skills and knowledge necessary to perform Pre-Inspector work safely and competently. The new Pre-Inspector Training Program will incorporate both classroom and in-the-field instruction. Those who successfully complete the program will receive a certificate that will assist in obtaining certification from the ISA. This program should increase the availability of certified Pre-Inspectors to help PG&E and industry VM-related wildfire risk mitigation efforts.

PG&E also has internal training courses that have been adapted to allow existing Arborists to obtain continuing education units (CEUs) to help renew their ISA Arborist Certifications. These courses include the completion of VEGM-0110 PI Basics completion, VEGM-9058 Burned Redwoods, and GAS-9638 Trenching Near Trees. Typically, CUEs are a cost to the learner, and these adaptations have provided opportunities for CEUs at zero cost. We will continue to look for opportunities to adapt other courses in this manner, where appropriate.

Finally, although not directly related to ISA certification, PG&E is working to increase the available, qualified VM workforce to address the large amount of VM work taking place in the State. For example, PG&E has partnered with the IBEW and educational institutions, such as Butte Glenn Community College District, to establish a training program designed to provide the skills and knowledge necessary to perform tree crew work safely and competently. This Tree Crew Training Program provides both classroom and in-the-field instruction, which focuses on safety, climbing, and line clearance qualifications. As indicated, the goals of this initiative are to increase the availability of certified tree crew workers in the industry, to support our VM-related wildfire risk mitigation efforts, and to create a curriculum that can eventually be used by any educational institution.

j) A description of any PG&E-identified knowledge and training gaps in VM training curriculum for both employees and contractors and how PG&E has or is planning to remedy those gaps;

Issue #1: As discussed above, PG&E does not currently have a continuing education, or “refresher” curriculum for VM personnel. Given the large scope of VM work taking place every day, changes in environmental risks, and modifications to operational priorities, “refresher” courses for VM personnel would be helpful to ensure work and safety alignment.

To remedy this situation, we are currently in the process of creating a refresher WBT that will be updated yearly. We intend for the refresher WBT to cover issues identified in the previous year, changes to our VM programs, as well as changes to safety or work standards that may have been implemented. This will

be a required training for all VM personnel listed in Table 5.4-1 including VC. We expect to have this WBT ready for use in 2022.

Issue #2: Prior to 2021, PG&E was not effectively tracking ISA certification among VM personnel or additional credentials such as Utility Specialists and TRAQ credentials. We determined that we should improve tracking in this area because ISA certification, and the additional credentials identified, are important for ensuring that we have personnel with a demonstrated knowledge and skillset to properly assess trees as well as a high level of dedication to the VM profession. VM personnel with ISA certification can also receive higher work compensation, which can help with worker retention over time.

To remedy this situation, we implemented a system in 2021 to better track this issue by adding ISA certification procedures during the onboarding processes. We then check with ISA to ensure the certification is current. After onboarding, we encourage ISA certification through conversations with vendors and contractors during our daily interactions as through the other programs discussed above in response to Remedy 3.i.

k) An explanation of how PG&E ingrains expectations for VM quality, wildfire risk reduction, and safety in VM personnel training.

PG&E sets expectations for VM quality, wildfire risk reduction, and safety in VM personnel training in a variety of ways. VM quality, and the importance of accurate data, is introduced during initial training and is reinforced through interactions with local VPM and oversight by our Vegetation Management Inspectors (VMI) of field workers during work execution. Our newly formed VMI team interacts with contract field personnel daily on job sites and discusses expectations for all aspects of the VM program using the specific job site to direct conversations. The ratio of VMI to tree crews is approximately 1 to 20 (assuming an average tree crew size of 3 people). VPM, who are responsible for daily operations, interact with Pre-Inspectors when issues are identified to educate and correct behaviors.

Safety is also an important part of the initial VM training in SLP. Safety training courses include SAFE-0101 and SAFE 1503. SAFE-0101 covers tools and resources for contractors to remain safe during PG&E work activities, and SAFE-1503 reviews key information in preventing and mitigating fires while performing PG&E work. Both safety courses support the work of Vegetation Management Pre-Inspectors who provide real-time support to VM operations by ensuring safety and compliance with VM project scope, contract adherence, and PG&E standards and specifications. Evaluating the work of PG&E Pre-Inspectors is critical to the sustainability of our VM program. Validation of safe work practices has also been implemented in multiple work authentication processes that allow us to identify deficiencies and improve upon our protocols, including safety inspections carried out in our QA, QV, WV processes.

The QA, QV, and WV teams provide an additional layer of review to provide feedback and reinforce expectations of quality, wildfire risk mitigation, and safety. As discussed above, the QA team provides audit results, which VM uses to

address compliance related issues through short-term corrective actions or long-term preventive actions. The QV team provides audit results that VM uses to both identify areas of work quality that need improvement and take short-term corrective actions. WV provides review and validation of EVM work to determine if requirements have been met. All of these processes are aimed at ensuring that PG&E safely performs quality VM work throughout our service territory.

7.3.5.15 Remediation *of At-Risk Species*

***WSD Initiative Definition**: Actions taken to reduce the ignition probability and wildfire consequence attributable to at-risk vegetation species, such as trimming, removal, and replacement.*

In addition to describing the remediation measures, this section also addresses Actions PGE-57 (Class B), PGE-58 (Class B), PGE-59 (Class B), PGE-74 (Class B), and PGE-79 (Class B).

1) ***Risk to be mitigated/problem to be addressed:***

   In addition to overhead facility hardening, accurately identifying and mitigating trees at elevated risk of failure can reduce the risk of wildfire ignitions associated with vegetation contact with electric facilities.

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.***

   The ability to accurately identify and mitigate trees at elevated risk of failure has risk reduction value both on its own and in conjunction with system hardening. This work is focused on further limiting the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact by removing branches and limbs that are overhanging within 4 ft of the conductors and up to the sky.

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")***

   Tree failure mitigation is planned in Tier 2 and Tier 3 HFTD areas under PG&E's EVM program. EVM program prioritization starting in 2021 is based on the Vegetation Risk Model, which is a risk-informed model that allows us to prioritize our work at the Circuit Segment level. Circuit segments are the smallest non-overlapping sections of the distribution grid that can be de-energized.

   All EVM work is functionally conducted at the regional level. Regional capacity constraints require separate prioritization within each region because a universal prioritization might place too much or too little work in a given region. Pre-inspectors evaluate trees using PG&E's TAT during inspections, which is a tool that evaluates an individual tree's likelihood of failing and indicates whether to abate the tree. TAT incorporates historical data on tree failures, regional species risk, and local wind gust data and assesses different components of an individual tree's health to determine the risk of falling into PG&E lines or equipment.

4) Progress on initiative (amount spent, regions covered) and plans for next year

As described above, the TAT identifies trees at risk of failure. This tool went into effect March 2020 and has been in continuous use since that time. As PG&E addresses the challenges that come with implementing an evolving and expansive program, the miles to be worked under the EVM program will continue to be re-assessed on a year-by-year basis. PG&E completed 1,878 miles in 2020 (exceeding the target of 1,800 miles) and forecasts working approximately 1,800 circuit miles in 2021 for the EVM program.

5) Future improvements to initiative

In the future, PG&E will study post-EVM treatment outage and ignition data for opportunities to improve TAT effectiveness as part of our ongoing effort to improve our VM program. We anticipate that the results of this study will impact our VM practices beyond 2021. For further details on the Targeted Tree Species study, see Section 4.4.1.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

In the short-term, PG&E will continue the ongoing work of identifying and mitigating trees at elevated risk of failure. In the long-term, PG&E will study post-EVM treatment outage and ignition data for opportunities to improve TAT effectiveness. This study (which will be concluded in 2022), in conjunction with lessons learned, will be used to work toward a proactive analysis instead of reactive. The EVM program will continue to address approximately 1,800 miles per year as we continue to work through all HFTD Tier 2 and Tier 3 areas in a prioritized, risk-informed manner.

ACTION PGE-57 (Class B)

1) Explain the prioritization of hazard tree work in relation to the highest risk areas, and

2) Prioritization of work relative to TAT scoring.

Response:

1) Starting in 2021, EVM program prioritization is based on the 2021 Vegetation Risk Model, which is a risk-informed model that allows us to prioritize our work at CPZs. CPZs are the smallest non-overlapping sections of the distribution grid that can be de-energized.

   We understand “hazard tree work” to be referencing the risk posed by entire trees or large portions of trees failing and striking electrical facilities. This tree failure risk is primarily mitigated by the selective removal of trees based on our

TAT. See Section 7.3.5.15. As part of the EVM program, TAT assessment is performed on all trees with potential to strike facilities and trees worked according to the TAT result.

Trees assessed for failure risk are prioritized in accordance with our Vegetation Management Priority Tag Procedure (TD-7102P-17). A Priority 1 tag must be mitigated within 24 hours of identification when reported. A Priority 1 condition is a hazard that meets any of the following scenarios:

- The vegetation is in contact or showing signs of previous contact with a primary conductor.
- The vegetation is actively failing or at immediate risk of failing and could strike the facilities.
- The vegetation presents an immediate risk to the facilities.

A Priority 2 tag must be mitigated within 30 days, unless constrained. A Priority 2 condition meets the following scenario:

- The vegetation has encroached within the PG&E minimum clearance requirements and is not in contact with a conductor.

2) The TAT evaluation does not designate prioritization between trees, it only provides direction of whether to abate or to not abate a specific tree. TD-7102P-17 is utilized for trees requiring priority mitigation and describes scenarios for proper prioritization.

ACTION PGE-58 (Class B)

1) Provide the top 10 at-risk EVM species categorized by geographical area, and

2) Provide a list of vegetation work prescribed based on specific tree species if such exists and differs from at-risk identification.

Response:

1) PG&E does not use a top 10 list for at-risk species. However, see below for a list of 10 species with the highest estimated overall risk per EVM region. The species included in the list only includes species that have caused >1% of the region's outages.

TABLE PG&E-7.3.5-6: HIGHEST RISK SPECIES BY REGION

Region	Species
Sierra	Oak
	Gray Pine
	Pine
	Cottonwood, Freemont
	Willow
	Lodgepole Pine
	Black Oak
	Live Oak
	Eucalyptus
	Valley Oak
Bay	Gray Pine
	Black Oak
	Blue Gum
	Tan Oak
	Live Oak
	Acacia
	Madrone
	Monterey Cypress
	Douglas Fir
	Liquid Ambar (Sweet Gum)
Central Coast	Gray Pine
	Alder
	Sycamore
	Blue Gum
	Tan Oak
	Monterey Pine
	Madrone
	Cottonwood, Freemont
	Coast Live Oak
	Douglas Fir
Central Valley	Blue Gum
	Italian Stone Pine
	Cottonwood, Freemont
	Gray Pine
	Oak
	Poplar
	Black Oak
	Interior Live Oak
	Valley Oak
	Pine
North Coast	Willow
	Tan Oak
	Black Oak
	Gray Pine
	Pine
	Bishop Pine
	Alder – Red
	Grand Fir
	Madrone
	Live Oak

Region	Species
North Valley	Blue Gum
	Gray Pine
	Cottonwood, Freemont
	Poplar
	Valley Oak
	Black Oak
	Oak
	Eucalyptus
	Live Oak
	White Fir

2) Tree work is not prescribed based on specific species, but regional species risk values are an input to TAT results. Therefore, species risk values are a contributing factor to whether or not a tree should be abated, as determined by the TAT.

ACTION PGE-59 (Class B)

1) Provide the percentage of trees within PG&E's inventory that are classified as a "Green Hazard Tree," and

2) Provide the percentage of both "Green Hazard Trees" worked and removed in relation to

a) Identified "Green Hazard Trees,"

b) Total tree inventory,

c) Work performed on tree inventory, and

d) Total tree removals.

Response:

For the 2020 Patrol year, the following are the percentages of Green Hazard trees for EVM and Routine VM.

TABLE PG&E-7.3.5-7: GREEN HAZARD TREE PERCENTAGE (EVM & ROUTINE VM))

	EVM	Routine VM
Percentage of trees within PG&E's inventory that are classified as a ""Green Hazard Tree,"	2.8%	1.44%
Percentage of both "Green Hazard Trees" worked and removed in relation to		
a) Identified "Green Hazard Trees"	38.6%	65.5%
b) Total tree inventory	5.9%	0.95%
c) Work performed on tree inventory	11.2%	1.62%
d) Total tree removals	13.2%	8.53%

ACTION PGE-79 (Class B)

Provide quantitative determinations of effectiveness for its fuel management efforts broken down by geographical area, demonstrating how PG&E tracks effectiveness when optimizing its processes based on geography.

Response:

At this time, it is still unknown if the use of fire retardant for the Transmission UDS Program will be approved. PG&E is unable to determine the effectiveness until the environmental evaluations have been completed.

ACTION PGE-74 (Class B)

1) Explain how it verifies and improves the TAT,

2) Provide the timeline/frequency of verification and improvements, and

3) Provide a list of SMEs that contributed to and "endorsed"40 the TAT.

Response:

1) PG&E performs TAT field verification on 100% of trees tall enough to strike our electrical facilities as part of our EVM. In addition, PG&E will be working with external resources to study TAT effectiveness and improvement as part of our Target Tree Species Study. (See 4.4.1 Targeted Tree Species Study).

2) This Target Tree Species Study is planned to be completed by Q2 2022. In connection with the study, PG&E will set up a system for continuous monitoring of TAT for ongoing evaluation.

3) The SMEs that contributed to and endorsed the TAT are members of the Department of Environmental Science, Policy and Management Ecosystem Sciences Division, University of California, Berkeley, and the Urban Forest Ecosystems Institute of California Polytechnic State University (Cal Poly). A list of the names of the SMEs will be provided directly to the WSD.

7.3.5.16 Removal and Remediation of Trees with Strike Potential to Electric Lines and Equipment

WSD Initiative Definition: *Actions taken to remove or otherwise remediate trees that could potentially strike electrical equipment, if adverse events such as failure at the ground-level of the tree or branch breakout within the canopy of the tree, occur.*

PG&E does not perform a separate effort to identify, remove and remediate trees with strike potential. This is one risk that our inspectors assess and take action to resolve as part of our other vegetation management activities. Therefore, please refer to Sections 7.3.5.2 (Detailed inspections of vegetation around distribution electric lines and equipment), 7.3.5.3 (Detailed inspections of vegetation around transmission electric lines and equipment), and 7.3.5.15 (Remediation of At-Risk Species) for information regarding efforts to identify and remove or remediate trees with strike potential, sometimes referred to as “hazard trees”.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Sections 7.3.5.2, 7.3.5.3, and 7.3.5.15 for more information on future improvements for this initiative.

7.3.5.17 Substation *Inspections*

WSD Initiative Definition: *Inspection of vegetation surrounding substations, performed by qualified persons and according to the frequency established by the Utility, including record-keeping.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.5.17.1: Substation Inspections, Distribution
- 7.3.5.17.2: Substation Inspections, Transmission

7.3.5.17.1 Substation *Inspections, Distribution*

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

PG&E is assessing the area around Electric Distribution Substations in Tier 2 and Tier 3 HFTDs to identify flammable fuels and vegetation for removal in order to minimize ignition spread outside of facilities and to provide improved structure defense capability for firefighting purposes by ensuring there is a safe distance between vegetation and critical infrastructure.

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.

In 2019, the WSIP assessed the defensible space surrounding 176 Electric Distribution Substations using CAL FIRE recommendations as guidance. During these inspections, it was determined that a programmatic approach would be needed to:

- Meet or exceed CAL FIRE recommendations (PRC 4291) for defensible space by clearing vegetation in and around Tier 2 and Tier 3 HFTD Electric Distribution Substations

- Provide for routine annual[94] ground-based inspections by qualified persons and vegetation maintenance operations of defensible space in and around Electric Distribution Substations within or adjacent to a Tier 2 or Tier 3 HFTD. Inspections and maintenance operations are recorded electronically.

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")

The Electric Distribution Substations inspected were located within or adjacent to the CPUC's current Tier 2 and Tier 3 HFTD. Inspections took place in order of highest threat (Tier 3) to lowest (Tier 2) HFTD area. Areas adjacent to Tier 2 and Tier 3 HFTD areas are referred to as Buffer Zones.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, inspections were performed at all 176 Electric Distribution Substations within or adjacent to Tier 2 and Tier 3 HFTD (i.e., in HFTD areas

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94 PG&E's planned inspection timeframe for all assets is November 15 of the prior year through November 15 of the current year (i.e., 11/15/20-11/15/21 for the 2021 plan year) however delays including inaccessible facilities, sensitive environments or other limitations may delay some inspections for the current plan year by a few weeks, but still ensuring completion by the end of the end of the calendar year (i.e., 12/31/21).

or Buffer Zones). Inspections included prescription of vegetation work for defensible space maintenance and continued adherence to CAL FIRE recommendations. In 2021, these inspections of Electric Distribution Substations within or adjacent to Tier 2 and Tier 3 HFTD will continue.

5) Future improvements to initiative

For 2021, PG&E will inspect 263 Electric Distribution Substations not within a Tier 2 or 3 HFTD for purposes of achieving defensible space and fuel reduction beyond Tier 2 and Tier 3 HFTD. In addition, during routine defensible space inspections of Distribution Substations within a Tier 2 and Tier 3 HFTD, PG&E will identify and pursue vegetation removal and thinning work on undeveloped privately owned land neighboring PG&E property for further risk reduction purposes.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

This program is funded through 2024. The work is ongoing and focuses on assessing the area around Electric Distribution Substations in Tier 2 and Tier 3 HFTDs to identify flammable fuels and vegetation for removal. In addition, during routine, defensible space inspections of Distribution Substations within a Tier 2 and Tier 3 HFTD, PG&E will identify and pursue vegetation removal and thinning work on undeveloped privately owned land neighboring PG&E property for further risk reduction purposes. PG&E will continue inspections and prescription of vegetation work for defensible space maintenance and continued adherence to CAL FIRE recommendations.

7.3.5.17.2 Substation *Inspections, Transmission*

WSD Initiative Definition: N/A. *This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

PG&E is assessing the area around ET Substations and Hydro Facilities in Tier 2 and Tier 3 HFTDs to identify flammable fuels and vegetation for removal in order to minimize ignition spread outside of facilities and to provide improved structure defense capability for firefighting purposes by ensuring there is a safe distance between vegetation and critical infrastructure.

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.

In 2019, the Wildfire Safety Inspection Program (WSIP) assessed 46 ET Substations and 63 Hydro facilities for defensible space using CAL FIRE recommendations as guidance. During these inspections, it was determined that a programmatic approach would be needed to:

- Meet or exceed CAL FIRE recommendations (PRC 4291) for defensible space by clearing vegetation in and around Tier 2 and Tier 3 HFTD ET Substations and Hydro facilities.

- Provide for routine annual[95] ground-based inspections by qualified persons and vegetation maintenance operations of defensible space in and around ET Substations and Hydro facilities within or adjacent to a Tier 2 or Tier 3 HFTD. Inspections and maintenance operations are recorded electronically.

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")

The ET Substations and Hydro facilities inspected were located within or adjacent to the CPUC's current Tier 2 (Elevated) and Tier 3 (Extreme) HFTD. Inspections took place in order of highest threat (Tier 3) to lowest (Tier 2) HFTD area.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, inspections were performed at all 46 ET Substations and 63 Hydro facilities within or adjacent to Tier 2 and Tier 3 HFTDs. Inspections included prescription of vegetation work for defensible space maintenance and continued adherence to CAL FIRE recommendations. In 2021, these

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95 *Id.*

recurring cycle inspections of ET Substations and Hydro facilities within or adjacent to Tier 2 and Tier 3 HFTDs will continue.

5) Future improvements to initiative

In 2021, PG&E will inspect 41 ET Substations not within a Tier 2 or 3 HFTD to achieve defensible space and fuel reduction beyond Tier 2 and Tier 3 HFTD. In addition, during routine, defensible space inspections of Transmission Substations within a Tier 2 and Tier 3 HFTD, PG&E will identify and pursue vegetation removal and thinning work on undeveloped privately owned land neighboring PG&E property for further risk reduction purposes.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

This program is funded through 2024. The work is ongoing and focuses on assessing the area around ET Substations and Hydro Facilities in Tier 2 and Tier 3 HFTDs to identify flammable fuels and vegetation for removal. In addition, during routine, defensible space inspections of Transmission Substations within a Tier 2 and Tier 3 HFTD, PG&E will identify and pursue vegetation removal and thinning work on undeveloped privately owned land neighboring PG&E property for further risk reduction purposes. PG&E will continue inspections and prescription of vegetation work for defensible space maintenance and continued adherence to CAL FIRE recommendations.

7.3.5.18 Substation *Vegetation Management*

WSD Initiative Definition: *Based on location and risk to substation equipment only, actions taken to reduce the ignition probability and wildfire consequence attributable to contact from vegetation to substation equipment.*

For this initiative, PG&E has several sub-initiatives including:

- 7.3.5.18.1: Substation Vegetation Management, Distribution
- 7.3.5.18.2: Substation Vegetation Management, Transmission

7.3.5.18.1 Substation *Vegetation Management, Distribution*

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

In accordance with CAL FIRE defensible space recommendations (PRC 4291), PG&E removes flammable fuels and remove or trim vegetation in and around Electric Distribution Substations within or adjacent to Tier 2 and Tier 3 HFTDs to minimize ignition spread outside of facilities and provide improved structure defense capability for firefighting purposes and to reduce risk of potential loss.

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.

In 2019, the WSIP assessed the defensible space surrounding 176 Electric Distribution Substations using CAL FIRE recommendations as guidance. Following the inspections, PG&E determined that it needed to perform additional work in 2020 to remove fuel and vegetation to meet or exceed CAL FIRE recommendations for Defensible Space around the inspected facilities.

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")

The 176 Electric Distribution Substations inspected in 2020 are located within or adjacent to the CPUC's current Tier 2 (Elevated) and Tier 3 (Extreme) HFTDs. Facility VM operations were prioritized in order based on the highest threat (Tier 3) to lowest (Tier 2) HFTD areas.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, PG&E will perform continued facility VM and maintenance operations at 169 Electric Distribution Substations within or adjacent to Tier 2 and Tier 3 HFTDs. PG&E is in the process of performing VM and maintenance operations at the remaining 7 Electric Distribution Substations. Each of these Distribution Substations requires extensive permitting. Facility VM work performed included mechanical weed abatement, tree trim, newly identified hazard trees, and brush and debris removal in accordance with CAL FIRE recommendations for defensible space. In 2021, all 176 Electric Distribution Substations will receive maintenance operations, and additional CAL FIRE recommended tree, brush and debris compliance work will be prioritized based on the highest risk in (Tier 3) to lowest in (Tier 2) HFTD areas.

5) Future improvements to initiative

In 2021, PG&E will improve the defensible space program with herbicide treatment plans within defensible space zones for improved long-term control and abatement of noxious weeds and reoccurring/regenerating brush species, where permitted. Also, PG&E will perform additional vegetation thinning and/or removal work beyond CAL FIRE recommended zones for defensible space.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

This program is funded through 2024. The work is ongoing and in accordance with CAL FIRE defensible space recommendations (PRC 4291), it focuses on the removal of flammable fuels and the removal or trim of vegetation in and around Electric Distribution Substations within or adjacent to Tier 2 and Tier 3 HFTDs. PG&E will also look to improve the defensible space program with herbicide treatment plans, where permitted. PG&E will perform additional vegetation thinning and/or removal work beyond CAL FIRE recommended zones for defensible space, where permitted. Electric Distribution Substations will receive maintenance operations while additional CAL FIRE recommended tree, brush and debris compliance work will be prioritized from highest (Tier 3) to lowest (Tier 2) HFTD area.

7.3.5.18.2 Substation *Vegetation Management, Transmission*

WSD Initiative Definition: *N/A. This is a "PGE-defined sub-initiative" that supports the response for the (parent) WSD-defined Initiative.*

1) Risk to be mitigated/problem to be addressed:

In accordance with CAL FIRE defensible space recommendations (PRC 4291), PG&E removes flammable fuels and removes or trims vegetation in and around ET Substations and Hydro facilities within or adjacent to Tier 2 and Tier 3 HFTDs to minimize ignition spread outside of facilities, provide improved structure defense capability for firefighting purposes, and reduce risk of potential loss.

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.

In 2019, the WSIP inspected 46 ET Substations and 63 Hydro facilities for defensible space using CAL FIRE recommendations as guidance (See Section 7.3.5.17.1). Following the inspections, PG&E determined that it needed to perform additional work in 2020 to further remove fuel and vegetation to meet or exceed CAL FIRE recommendations for defensible space around the inspected facilities.

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")

The 46 ET Substations and 63 Hydro facilities inspected in 2020 are located within or adjacent to the CPUC's current Tier 2 (Elevated) and Tier 3 (Extreme) HFTD. Facility VM operations were prioritized in order of highest threat (Tier 3) to lowest (Tier 2) HFTD area.

4) Progress on initiative (amount spent, regions covered) and plans for next year

In 2020, PG&E performed continued facility VM and maintenance operations at 46 ET Substations and 63 Hydro facilities within or adjacent to Tier 2 and Tier 3 HFTD. Facility VM work performed included mechanical weed abatement, tree trim, newly identified hazard trees, and brush and debris removal in accordance with CAL FIRE recommendations for defensible space. In 2021, all 46 ET Substations and 63 Hydro facilities will receive maintenance operations while additional CAL FIRE recommended tree, brush and debris compliance work will be prioritized from highest (Tier 3) to lowest (Tier 2) HFTD area.

5) Future improvements to initiative

In 2021, PG&E also looks to improve the defensible space program with herbicide treatment plans within defensible space zones for improved long-

term control and abatement of noxious weeds and reoccurring/regenerating brush species, where permitted. In addition, PG&E will perform additional vegetation thinning and/or removal work beyond CAL FIRE recommended zones for defensible space, where permitted.

ACTION PGE-25 (Class B)

1) *Integrate discussion on long term planning within the respective section of each individual initiative.*

Response:

This program is funded through 2024. The work is ongoing and in accordance with CAL FIRE defensible space recommendations (PRC 4291), it focuses on the removal of flammable fuels and the removal or trim of vegetation in and around ET Substations and Hydro facilities within or adjacent to Tier 2 and Tier 3 HFTDs. PG&E will also look to improve the defensible space program with herbicide treatment plans, where permitted. PG&E will perform additional vegetation thinning and/or removal work beyond CAL FIRE recommended zones for defensible space, where permitted. ET Substations and Hydro facilities will receive maintenance operations while additional CAL FIRE recommended tree, brush and debris compliance work will be prioritized from highest (Tier 3) to lowest (Tier 2) HFTD area.

7.3.5.19 Vegetation *Inventory System*

WSD Initiative Definition: *Inputs, operation, and support for centralized inventory of vegetation clearances updated based upon inspection results, including (1) inventory of species,(2) forecasting of growth, (3) forecasting of when growth threatens minimum ROW clearances ("grow-in" risk) or creates fall-in/fly-in risk.*

1) ***Risk to be mitigated/problem to be addressed:***

   PG&E's VM Department currently uses multiple centrally managed systems via various platforms, databases and collection devices based on programmatic requirements to document planned and completed tree work. By using multiple centralized systems, there is a decrease in visibility regarding work being performed at different times and in different locations.

   The solution to this issue is to build or identify a tool that is flexible and accessible enough to manage our various program requirements and to support our work processes.

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.***

   With increased integration between our databases and data, additional visibility of what work is being performed at what times could be achieved to reduce the risk of overlapping programs, reduce potential of disruption to our customers, and enable better risk-informed planning and decision-making.

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")***

   This tool will be prioritized and implemented system-wide on core VM programs.

4) ***Progress on initiative (amount spent, regions covered) and plans for next year***

   In 2020, PG&E began reviewing data requirements from the Wildfire Safety Division to ensure that the system that is developed and implemented will support its requirements. PG&E also began drafting a project plan and documenting processes to support the development of a vegetation inventory system. PG&E is reviewing work management platforms and is planning to perform proof-of-concepts with one or more vendors in 2021 to begin to test how platforms may perform with current data collected in VM programs as well as to collect additional data required by the WSD Guidance 10 Data standards. VM is also engaging with PG&E's internal Information Technology department to define and plan database support.

5) Future improvements to initiative

PG&E will continue to work on a project plan in 2021. This project plan will be utilized as a working document to move this initiative forward. As with all projects plans, we will expect changes to this document as new requirements are identified.

ACTION PGE-25 (Class B)

1) Integrate discussion on long term planning within the respective section of each individual initiative.

Response:

PG&E is drafting a project plan that will be used as a working document to move toward the long-term goal of having one vegetation inventory system. PG&E will continue to document processes in support of this process as well as to review and test work management platforms. Long-term plan milestones are still under development.

7.3.5.20 Vegetation *Management to Achieve Clearances Around Electric Lines and Equipment*

WSD Initiative Definition: *Actions taken to ensure that vegetation does not encroach upon the minimum clearances set forth in Table 1 of GO 95, measured between line conductors and vegetation, such as trimming adjacent or overhanging tree limbs.*

VM to achieve clearances around electric lines and equipment is conducted as part of the routine and EVM programs as described in Section 7.3.5.2 for the primary distribution efforts related to “achieving clearances” and Section 7.3.5.3 for transmission efforts on that front.

ACTION PGE-25 (Class B)

1) *Integrate* discussion *on long term planning within the respective section of each individual initiative.*

Response:

As stated above, please reference Section 7.3.5.2, and Section 7.3.5.3 for more information on future improvements for this initiative.