Case: A.20-09-019
ALJ: Nojan
Witness: PG&E - Cullings

TURN Cross Examination Exhibit

Exhibit Number: TURN-

Sections from PG&E's Wildfire Mitigation Plans Discussing the Distribution WSIP

2019 WMP, February 6, 2019 – Section 4.2
2020 WMP, February 2020 – Sections 5.4.3.1 to 5.3.4.5
2021 WMP, February 5, 2021 – Sections 7.3.4.1 to 7.3.4.3

Pacific Gas and Electric Company
2019 Wildfire Safety Plan

February 6, 2019

4.2. Wildfire Safety Inspection Programs

TABLE 12: WILDFIRE SAFETY INSPECTION PROGRAMS KEY

Section	Title	Program Mapping	New or Existing, Including Cost Recovery Vehicle	Regulation Compliance	Associated Drivers
4.2.1	WSIP, Distribution	N/A	New - FRMMA/ WPMA	Exceeds regulatory requirements	D1, D2, D3, D4, D8[46]
4.2.2	WSIP, Transmission	N/A	New - TO[47]	Exceeds regulatory requirements	D1, D2, D3, D4, D8
4.2.3	WSIP, Substation	N/A	New - FRMMA/ WPMA & TO	Exceeds regulatory requirements	D1, D3, D4, D8

PG&E routinely inspects its distribution, transmission, and substation assets using a variety of methods, including observations when performing work in the area, periodic patrols and inspections, and targeted condition-based and/or diagnostic testing and monitoring. These routine inspections of PG&E's overhead and underground electric systems, including its electric substation inspections, are designed in accordance with GOs 95, 165, and 174 requirements. Basic elements include travel to the asset, ground and air visual observation, detection and assessment of abnormal conditions, notification, prioritization and execution of repairs, and documentation needed for safe and reliable operation.

46 D8 may vary depending on if the cause is known.

47 TO represents PG&E's Federal Energy Regulatory Commission-jurisdictional Transmission Owner (TO) rate case.

In addition to these routine inspections, and as part of PG&E's risk-based wildfire safety efforts, PG&E is conducting accelerated inspections of overhead electric facilities in HFTD areas to facilitate a proactive approach to repairing or replacing components that are at-risk of initiating fires. These accelerated inspections and repairs constitute the Wildfire Safety Inspection Program or WSIP.[48]

To develop the WSIP, PG&E used a risk-based approach including conducting a Failure Modes and Effects Analysis or "FMEA." The focus of the FMEA was to identify single points of failure of electric system components that could lead to fire ignition and then aid in the development of inspection methods that can most appropriately identify the condition of these respective components.

Each line of business performed the FMEA using the following methodology:

1. Establishing a cross-functional team of external professionals and PG&E SMEs with experience in field operations, engineering, and asset management.

2. Reviewing a list of asset components to identify potential single point failure ignition risks for categorization in an asset group.

3. Where available, developing an independent list of failure modes and frequencies from multiple internal and external sources using published reports, internal reports and SME interviews.

4. Mapping components to the final list of failure modes and relevant inspection methods.

5. In some cases, the failure mode does not have a readily observable issue that can be identified via a visual inspection. In those cases, non-destructive and destructive examination methods may be considered.

48 The WSIP was developed and implemented after the 2020 GRC forecast was submitted to the CPUC.

The new and enhanced risk-based approach identifies WSIP work by assessing the risk associated with each asset and by explicitly considering equipment modes of failure. PG&E expects that these efforts will continue to evolve as information is gathered and more is learned. PG&E will use the results of the current inspections to continue to shape a risk informed re-inspection program and schedule for subsequent inspections.

After PG&E identifies areas for WSIP inspections, inspectors are sent out to perform inspections. When an inspector identifies a maintenance condition, the inspector either immediately corrects the condition and records the correction or records the uncorrected deficiency, which is reviewed by a centralized review team. The review team initiates a corrective notification or "tag" in SAP Work Management in order to initiate, assign, plan, execute, and close out repairs to facilities. These tags are assigned a priority based on the risk posed by the condition and urgency of repairs (i.e., Priority A, B, E, or F). The review team process is designed to result in consistent application of the priority classification.

Finally, Geographic Information System (GIS) data concerning the location of electrical facilities is important to many of PG&E's wildfire risk reduction programs, including, but not limited to, inspection efforts and the WSIP, in order to understand the increased wildfire risk for each facility. Mapping and GIS data is also a critical component of PG&E's PSPS program discussed in Section 4.6. PG&E and other IOUs are working collaboratively with state agencies including CAL FIRE, the California Office of Emergency Services (Cal OES), and the CPUC to align utility capabilities and agency data and mapping needs. Recognizing the importance of GIS, PG&E is working to improve its GIS data, including designating a single point of contact at PG&E for all wildfire-related GIS needs.

Significant barriers to WSIP implementation include the availability of a qualified workforce that will enable PG&E to perform the targeted volume of work in the desired timeframe as well as potential limitations on available materials necessary to perform corrective actions within necessary timeframes. PG&E faces market challenges in the implementation of the WSIP program with an intense demand for skilled labor and constraints on the availability of equipment and materials. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel, equipment, and materials necessary to enable the implementation of this plan.

In addition, implementation of the WSIP can be further delayed by weather conditions, delays caused by property owners and governmental agencies, and environmental permitting issues. PG&E's land management and customer care teams work closely with PG&E's inspection teams to overcome these challenges as quickly as possible. PG&E tries to reach out to landowners in advance to obtain consent, but it may still cause some delays. Access limitations due to property owners or permitting constraints are execution risks where the state or federal governments can play a role in supporting PG&E's wildfire prevention efforts.

In the subsections below, PG&E describes its WSIP inspections for different types of facilities (e.g., distribution lines, transmission lines, and substations). For comparison, PG&E also describes the routine inspections for these same facilities in Attachment C.

4.2.1. WSIP Distribution

As discussed above, in late 2018, PG&E conducted a FMEA to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections required by GO 165. The FMEA identified failure mechanisms that could be inspected for and repaired as part of an accelerated inspection program focused on fire ignition risk.

In 2019, using this risk-based approach, PG&E is inspecting its distribution structures in HFTD areas, as well as nearby structures in close proximity and high risk of fire spread into the adjacent HFTD area (approximately 685,000 poles across approximately 25,200 miles). These inspections will focus on the failure mechanisms for transformers, conductors, connectors, insulators, fuses, switches, structures, third-party attachments, and splices that can initiate fires. To facilitate these inspections, PG&E will enhance its existing routine inspection program to include wildfire specific elements for 185,000 poles that are due for their five-year inspection cycle in 2019. Additionally, PG&E will conduct wildfire-specific inspections of the remaining 500,000 poles to identify and correct any components that pose a wildfire risk. Furthermore, PG&E will utilize drone inspections for difficult-to-access locations to identify abnormal asset conditions.

PG&E will complete all inspections of distribution poles in HFTD areas by May 31, 2019, and all high priority corrective actions identified by those inspections by June 30, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process, PG&E will take immediate action to address any issues identified as an imminent risk to public or workforce safety.

This schedule could be impacted by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.2.2. WSIP Transmission

In late 2018, PG&E conducted a FMEA of transmission assets to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections required by GOs 95 and 165. The FMEA identified failure mechanisms that could be inspected as part of an accelerated

inspection program. Beginning in December 2018, and continuing into 2019, using this risk-based approach, PG&E is performing inspections of transmission structures (poles and towers) in HFTD areas, as well as nearby structures outside the HFTD in close proximity and with high risk of fire spread into adjacent HFTD areas (approximately 5,700 miles of transmission line with more than 50,000 structures). These enhanced inspections focus on the failure mechanisms identified from the FMEA based on PG&E and industry information that identified components with a fire ignition risk.

The visual inspections include ground inspection of transmission poles and climbing inspection of transmission towers. The scope of these inspections is beyond the routine detailed ground inspections of a population of the towers and poles.

Drone inspections will be conducted on every structure in the WSIP scope, subject to any FAA restrictions that cannot be resolved,[49] and will complement and further enhance the ground and climbing visual inspections. This new technology was fully developed and deployed in a one-month time frame and incorporated the results of the FMEA. Helicopters will be used for additional aerial inspections for collecting infrared data to determine hot spots on conductors, insulators, and connectors requiring repair.

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49 Drone flight is governed by the Federal Aviation Administration (FAA), Part 107 of the Federal Aviation Regulations (14 CFR Part 107). Among other things, these regulations establish operational restrictions on drone flights which may affect PG&E's ability to conduct drone inspections on every transmission structure in the WSIP scope. PG&E will work with the FAA to resolve operational restrictions to the extent possible.

These infra-red inspections will be performed at strategic times of the year when respective lines are highly loaded. PG&E is also investigating the application of a new helicopter-based inspection technology being employed in Australia. This autonomous image capture employs the use of helicopters and asset-based high definition camera programming to capture images via helicopter mounted cameras at pre-programmed locations. This allows an accurate and rapid capture of images over detailed ground and climbing inspections and drone technology, with equivalent image results as drones. Other elements of the enhanced program include the following:

- The FMEA modes were incorporated into newly developed electronic inspection forms;
- New and enhanced job aids were developed to support the inspection forms;
- The condition prioritization matrix used to assess the priority and timing of corrective actions was adjusted to factor in the results of the FMEA and job aids; and
- Prioritization of the notifications was transferred from the field lineman and supervisor to a multi-discipline review team to establish a focused review process of the potential findings related to the asset condition.

The previously described inspection plan was implemented beginning in December 2018, with nearly 20 percent of the inspections completed by year end. As of the end of January 2019 approximately 56 percent of the inspections have been completed.

In a typical year, PG&E performs as many as 76,000 routine detailed inspections of transmission system poles and towers throughout its service territory.

PG&E will complete all inspections of transmission poles and towers in HFTD areas by May 1, 2019, and high priority corrective actions identified by those inspections by May 31, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process,

PG&E will take immediate action to address any issues identified as an imminent risk to public or employee safety.

This schedule could be affected by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.2.3. WSIP Substation

In early 2019, PG&E began performing a FMEA of substation assets to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections already performed in accordance with GO 174. The FMEA identified substation assets and their components and linked potential failure causes that could be inspected for as part of an accelerated inspection program. For 2019, using this risk-based approach, PG&E is inspecting approximately 200 sites located in HFTD areas, including substations, switching stations, and hydro power houses, with a specific focus on the failure mechanisms for transformers, conductors, connectors, insulators, switches, poles, and other equipment that can initiate fires. Additional risk focused work includes further evaluation of the risk of catastrophic equipment failure and fire initiation. Incremental efforts will focus on creating a defensible space around substation facilities consistent with CAL FIRE and CPUC recommended guidelines and evaluating and implementing animal abatement methods to prevent animal contact.

PG&E will complete all enhanced inspections of the approximately 200 sites in HFTD areas by May 1, 2019, and any high priority corrective actions identified by those inspections by May 31, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process, PG&E will take immediate action to address any issues identified as an imminent risk to public or workforce safety.

This schedule could be affected by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.3. System Hardening Overview

TABLE 13: SYSTEM HARDENING OVERVIEW KEY

Section	Title	Program Mapping	New or Existing, Including Recovery Vehicle	Regulation Compliance	Associated Drivers
4.3.2	Pole Material	Wildfire System Hardening	New - FRMMA/WPMA	Exceeds regulatory requirements	All
4.3.3	Pole Loading and Replacement				
4.3.4	Conductor				
4.3.5	System Protection	Automation and Protection (SCADA)	New – FRMMA/WPMA	Not Applicable	
4.3.6	Equipment	Non-exempt Surge Arrester Replacement Program	New - FRMMA / WPMA & TO (Light Duty Steel Poles)	Exceeds regulatory requirements	D3, D4 - Equipment failure

The System Hardening Program is an ongoing, long-term (more than five years) capital investment program to rebuild portions of PG&E's overhead electric distribution system. Under this program, PG&E is upgrading approximately 7,100 circuit miles in Tier 2 and Tier 3 HFTD areas. This program consists of ignition-risk-modeled and field-identified work that will result in a full rebuild of the overhead distribution system to increase its overall strength, replace aging assets, and reduce risk from external factors, such as vegetation contacting lines.

PACIFIC GAS AND ELECTRIC COMPANY

2020 WILDFIRE MITIGATION PLAN REPORT

RULEMAKING 18-10-007

FEBRUARY 7, 2020

5.3.4 Asset Management and Inspections

Explain the rationale for any utility ignition probability-specific inspections (e.g., "enhanced inspections") within the HFTD as deemed necessary over and above the standard inspections. This shall include information about how (i.e., criteria, protocols, etc.) the electrical corporation determines additional inspections are necessary.

Describe the utility's maintenance protocols relating to maintenance of any electric lines or equipment that could, directly or indirectly, relate to wildfire ignition. Include in the description the threshold by which the utility makes decisions of whether to (1) repair, or (2) replace electric lines and equipment. Describe all electric lines and equipment that the utility "runs-to-failure", those that the utility maintains on a risk-based maintenance plan, and those that are managed by other approaches; describe each approach. Explain the maintenance program that the utility follows and rationale for all lines and equipment.

Description of programs to reduce ignition probability and wildfire consequence

For each of the below initiatives, provide a detailed description and approximate timeline of each, whether already implemented or planned, to minimize the risk of its equipment or facilities causing wildfires. Include a description for the utility's programs, the utility's rationale behind each of the elements of this program, the utility's prioritization approach/methodology to determine spending and deployment of human and other resources, how the utility will conduct audits or other quality checks on each program, how the utility plans to demonstrate over time whether each component is effective and, if not, how the utility plans to evolve each component to ensure effective spend of ratepayer funds.

Include descriptions across each of the following initiatives. Input the following initiative names into a spreadsheet formatted according to the template below and input information for each cell in the row.

1. *Detailed inspections of distribution electric lines and equipment*
2. *Detailed inspections of transmission electric lines and equipment*
3. *Improvement of inspections*
4. *Infrared inspections of distribution electric lines and equipment*
5. *Infrared inspections of transmission electric lines and equipment*
6. *Intrusive pole inspections*
7. *LiDAR inspections of distribution electric lines and equipment*
8. *LiDAR inspections of transmission electric lines and equipment*
9. *Other discretionary inspection of distribution electric lines and equipment, beyond inspections mandated by rules and regulations*

10. *Other discretionary inspection of transmission electric lines and equipment, beyond inspections mandated by rules and regulations*

11. *Patrol inspections of distribution electric lines and equipment*

12. *Patrol inspections of transmission electric lines and equipment*

13. *Pole loading assessment program to determine safety factor*

14. *Quality assurance / quality control of inspections*

15. *Substation inspections*

16. *Other / not listed [only if an initiative cannot feasibly be classified within those listed above]*

PG&E's maintenance programs are described in Section 5.3.3. Below is a description of PG&E's Asset Management Program and Inspection Programs.

Overview of PG&E's Asset Management Program and Inspection Program

PG&E's distribution asset strategies are described in its Asset Management Plans (AMPs). PG&E employs a risk-based asset management approach for its overhead facilities, which includes criticality of the assets. Generally speaking, there are two main approaches with respect to asset replacement: Proactive Replacement and Run to Condition, which are described in more detail below. PG&E is also including below an overview of its inspection programs generally and, in particular, Wildfire Safety Inspection Program (WSIP).

Proactive Replacement

Proactive replacement is employed for those assets whose failure have a higher risk of igniting a catastrophic wildfire. This approach involves replacing assets with a higher risk of failure, but before the end of their useful life. The following are proactive replacement programs:

- System Hardening in HFTDs (including replacing existing assets with covered conductor [primary and secondary], stronger poles, non-exempt equipment, transformers with FR3 oil, as well as undergrounding)
- Pole Replacement and Reinforcement
- Primary Conductor Replacement
- Non-Exempt Equipment Replacement (Fuses and Surge Arresters)

Run to Condition

Run to condition repair/replacement is employed for those assets whose failure have a lower risk of igniting a catastrophic wildfire. This approach involves routine and non-

routine inspections focused on the identification, assessment, prioritization, and documentation of compelling abnormal conditions, regulatory conditions, and third party caused infractions that negatively impact safety or reliability. These conditions are identified during patrols and inspections of PG&E's distribution facilities, and may occur as a result of operational use, degradation, environmental changes or third-party actions. The following assets are subject to Run to Condition:

- Crossarms, insulators and pole hardware
- Voltage regulating equipment
- Protection equipment
- Transformers
- Switching Equipment
- Secondary Conductor

Inspection Program

PG&E utilizes multiple means of assessment to proactively monitor the condition of its assets in HFTD areas. The pre-2019 baseline inspection program was primarily focused on the identification, assessment, prioritization, and documentation of compelling abnormal conditions, regulatory conditions, and third-party caused infractions that negatively impacted safety or reliability. These conditions may occur as a result of operational use, degradation, deterioration, environmental changes or third-party actions. PG&E routinely assesses its distribution, transmission, and substation assets using a variety of methods, including observations when performing work in the area, periodic patrols and inspections, and targeted condition-based and/or diagnostic testing and monitoring. Some of PG&E's current inspection approaches have been in place for years, while others are newer in their implementation. Common inspection approaches used at PG&E include routine patrol inspections, detailed visual inspections, LiDAR inspections, Infrared (IR) inspections, Intrusive pole inspections, and pole loading calculations. These routine assessments of PG&E's overhead and underground electric systems, including its electric substation inspections, are designed in accordance with GOs 95, 165, and 174 requirements.

In 2019, PG&E began a Wildfire Safety Inspection Program or "WSIP" to expedite and expand the routine detailed inspections performed in Tier 2 and Tier 3 HFTD areas. Basic elements include travel to the asset, ground and or aerial visual observation documented with electronic form (checklist) and with pictures, detection and assessment of abnormal conditions, corrective notification creation, prioritization and execution of repairs, and documentation needed for safe and reliable operation. To develop the WSIP inspection checklist, PG&E used a risk-based approach including conducting a Failure Modes and Effects Analysis or "FMEA" (described in further detail in Section 5.3.1). The 2019 focus of the FMEA was to identify single points of failure of electric system components that could lead to fire ignition and then aid in the development of inspection methods that can most appropriately identify the condition of these respective components.

In the last half of 2019, PG&E worked to refine the FMEA a for each major overhead electric asset family (transmission, distribution, and substation) to create detailed inspection checklists appropriate to the failure modes which can create ignition potential as well as other negative outcomes.

Going forward, the detailed overhead inspection checklists will be consistently applied to all assets of an asset family. This means that overhead detailed compliance inspections have largely been coupled to the fire ignition evaluation protocols, rather than being separately funded and managed. Additionally, PG&E has begun evaluation and development of circuit-based asset management strategies, which seek to focus resources of various types, including inspections, on assets with higher risk profiles. As PG&E gathers additional data regarding early asset deterioration or pre-failure indicators, predictive failure modelling may improve. Such evolved predictive models could utilize data on vegetation and equipment type, age, and condition. Over time, it is possible that detailed asset inspection checklists may be customized to align with asset condition and environmental data as indicated by those models.

PG&E's detailed and supplemental inspections and patrols are guided by the inventory of electric facilities in our Geographic Information System (GIS). The overlay of facility type, asset health, geographic risk factors are considered when determining the most appropriate patrol and inspection cycle for the asset or circuit. Recognizing the importance of GIS, PG&E continues to improve its GIS data, including designating single points of contact at PG&E for all wildfire-related GIS needs. To refine PG&E's PSPS models and GIS datasets, during supplemental (enhanced) inspections, each inspector utilizes a consistent assessment checklist, validates certain asset traits, and makes a guided assessment of the asset condition. In addition, the electronic checklist captures a geolocation at the time of inspection initiation, which may be used to reaffirm the existing geoposition data in PG&E's systems of record. This data is captured in PG&E's systems of record and made available for PSPS event impact modelling, among other uses.

Expansion of data collection during post-asset failure, detail inspections, and other advanced inspection methods are expected to further refine PG&E's ability to assess equipment health. PG&E continues to build capabilities for predictive asset performance modelling via tools such as System Tool for Asset Risk (STAR). The STAR model supports decisions on when to schedule inspections or work for higher risk assets in other areas, based on factors beyond fire ignition risk. The shift towards such condition-based and risk-informed patrol and inspections is underway and will be refined as PG&E acquires additional asset performance data and refines its predictive failure models based on actual results. Further details of specific inspection protocols are provided in subsequent tables and narrative.

PG&E continues to work to enhance its ability to efficiently collect and house asset registry data, including the results of patrol and inspection activities. Detailed inspection protocols and electronic tools planned for use in 2020 and beyond, link to the inventory of electric assets in the GIS, and data collected via detail inspection will be captured in SAP. By harmonizing our core data sources (SAP and GIS, for example) the results of asset activities (installation, repair, replacement, inspection) can be made consistently available to all programs and models. Future enhancements to predictive models could include asset age, state of wear, operating history, expected lifecycle, and probability of

failure to inform patrol and inspection cycles as well as asset repair and replacement programs.

See Attachment 1, Table 24 for the details and data associated with the initiatives discussed in this section.

5.3.4.1 Detailed Inspections of Distribution Electric Lines and Equipment

Detailed inspections of distribution electric lines and equipment involves careful visual examination of overhead assets by a qualified Compliance Inspector or similar Journeyman Lineman in accordance with the TD-2305M (Electric Distribution Preventive Maintenance Manual, EDPM). Before conducting patrols or inspections, PG&E Compliance Inspectors, hiring hall, and contract personnel are required to be current with their journeymen classification and pass trainings and assessment. The program is moving from a prescriptive time cycle frequency to an approach driven by risk, with the highest risk assets requiring more frequent and in-depth inspections than lower risk assets. Aligned with the overall risk-informed approach for asset management, inspection priority is driven by asset health and consequences of asset failures. As a result of this approach, it is anticipated to have selective Structures/Lines with high consequence that will require a higher degree of inspections.

For 2020, PG&E intends to perform detailed overhead inspections on 100% of HFTD Tier 3, and 33% of HFTD Tier 2 assets. Additional inspections in HFTD Tier 2 may result from operational execution and from safety field re-assessments of open corrective notifications, as outlined in the WSIP Compliance Plan and Utility Bulletin: TD-8999B-001. Future year inspection scope will be developed to align with overall asset preventive maintenance strategies and will be informed by results of the 2020 preventive and corrective maintenance activities. Future year cycles may shift toward risk-informed and condition-dependent cycles linked to PG&E predictive models. Methods and tools of inspections will continue being evaluated for potential future use depending on technology availability and effectiveness.

Progress Timeline

1. ***Before the upcoming wildfire season:*** PG&E will expand its use of prescriptive mobile inspection checklists to overhead assets in all HFTD tiers. Additionally, PG&E will have expanded the FMEA completed for WSIP Distribution 2019, to incorporate additional asset failure indicators which are observable during visual inspection.

2. ***Before the next annual update:*** PG&E will review the results of the 2020 detailed inspections and consider modifying future inspection checklists and guidance documents to reflect lessons learned.

3. ***Within the next 3 years:*** PG&E plans to move all electric patrol and inspection activities to digital data collection platforms (e.g., mobile applications) and away from paper record keeping. PG&E will revisit the commonalities of transmission and distribution overhead asset inspections with the intent to consolidate tools, methods, and personnel qualifications. PG&E will also determine if adjusting asset inspection cycles or modalities is likely to have adverse impacts on system safety or performance.

4. ***Within the next 10 years:*** PG&E anticipates moving to a risk-informed circuit-based inspection protocol that prescribes the timing for preventive maintenance activities aligned to multiple asset and environmental factors. This may shift the percentage of total annual structures and line miles away from the current proposal.

5.3.4.2 Detailed Inspections of Transmission Electric Lines and Equipment

Detailed inspections of transmission electric lines and equipment involves careful visual examination of overhead assets by a qualified Transmission Troubleman/Inspector or similar Journeyman Lineman in accordance with the TD-1001M (Electric Transmission Preventive Maintenance Manual, ETPM). Before conducting patrols or inspections, PG&E inspectors, hiring hall, and contract personnel are required to be current with their journeymen classification and pass trainings and assessment. In connection with WSIP, PG&E formulated certain new procedures to guide WSIP enhanced inspections and updated existing procedures. Additionally, mobile applications were developed to document the inspection activity and resulting findings.

In late 2018, PG&E conducted an FMEA of transmission assets to better understand any additional inspections and analysis that could be implemented to reduce wildfire risk in addition to the inspections required by GOs 95 and 165. Beginning in December 2018, using this risk-based approach, PG&E performed inspections of transmission structures (poles and towers) in HFTD areas, as well as nearby structures outside the HFTD in close proximity and with high risk of fire spread into adjacent HFTD areas (approximately 5,700 miles of transmission line with more than 50,000 structures). These enhanced inspections focused on the failure mechanisms identified from the FMEA based on PG&E and industry information that identified components with a fire ignition risk. The visual inspections included checklist-guided ground inspection of transmission poles and climbing inspection of transmission towers. Aerial inspections were conducted on every structure in the WSIP scope, subject to any FAA or other legal restrictions, to complement the ground and climbing visual inspections. Helicopters were also used for additional aerial inspections for collecting infrared data to determine hot spots on conductors, insulators, and connectors requiring repair.

From 2020 onward, the detailed inspection checklist for electric transmission lines and equipment has been updated to incorporate baseline compliance guidelines as well as WSIP-identified fire risk considerations, and extensions to the FMEA. Additionally, detailed inspections of electric transmission lines have been coupled with aerial inspection methods to provide the additional aloft vantage points for each structure assessed during a given cycle. The program is moving from a prescriptive time cycle frequency to an approach driven by risk, with the highest risk assets requiring more frequent and in-depth inspections than lower risk assets. Aligned with the overall risk-informed approach for asset management, inspection priority is driven by asset health and consequences of asset failures. As a result of this approach, it is anticipated to have selective Structures/Lines with high consequence that will require a higher degree of inspections. The inspection frequency of assets varies by both HFTD and line risk prioritization and will continue to evolve as models are refined. For 2020, PG&E intends to perform detailed overhead inspections on 100% of HFTD Tier 3, and 33% of HFTD Tier 2 assets. Additional inspections may result from operational execution and from safety field re-assessments of open corrective notifications, as outlined in the WSIP Compliance Plan and Utility Bulletin: TD-8999B-001. Results from these inspection cycles will be used to further refine the inspection methods and recurrence to align with their risk-spend efficiency. Methods and tools of inspections will continue being evaluated for potential future use depending on technology availability and effectiveness.

Quality checks of transmission detailed inspection tasks was previously completed via supervisor work verification and paperwork review. From 2019 onward, PG&E adopted a practice of centralized gatekeeping review of inspection findings. The centralized gatekeeper teams follow prescriptive guidance, including decision trees and use visual aids to drive consistency in their review of issues reported during inspections.

Progress Timeline

1. ***Before the upcoming wildfire season:*** PG&E will have expanded the FMEA completed for WSIP Transmission 2019, to incorporate additional asset failure indicators which are observable during visual inspection.

2. ***Before the next annual update:*** PG&E will review the results of the 2020 detailed inspections and consider modifying future inspection checklists and guidance documents to reflect lessons learned.

3. ***Within the next 3 years:*** PG&E plans to move all electric patrol and inspection activities to digital data collection platforms (e.g., mobile applications) and away from paper record keeping. PG&E will revisit the commonalities of transmission and distribution overhead asset inspections with the intent to consolidate tools, methods, and personnel qualifications. PG&E will also determine if adjusting asset inspection cycles or modalities is likely to have adverse impacts on system safety or performance.

4. ***Within the next 10 years:*** PG&E anticipates moving to a risk-informed circuit-based inspection protocol that prescribes the timing for preventive maintenance activities aligned to multiple asset and environmental factors. This may shift the percentage of total annual structures and line miles away from the current proposal.

5.3.4.3 Improvement of Inspections

Improvement of inspections is accomplished via review of audit and quality assurance findings, executive reviews, and internal guidance (GOV-1038S) which highlight areas of opportunity. Improvement in inspections may focus on one or more of: efficacy in proactive detection of asset anomalies, consistency in identifying or classifying asset anomalies, efficiency in providing quality inspection results. In the near-term, improvement of inspections will seek to apply internal best practices identified during WSIP 2019 consistently across the asset families (transmission, distribution, and substation). For example, the transmission approach to inspection gatekeeping via Centralized Inspection Review Team (CIRT) is being more broadly adopted for distribution. And, the use of gatekeeper decision trees and other job aids that support more consistent evaluation and prioritization of inspection findings. Improvement may also take on the form of enhancing tools and documentation that guide the activity, such as mobile electronic checklists. Concurrent with expanded deployment of mobile inspection applications and tools, PG&E will develop process control measures (data analysis) to more rapidly assess for abnormalities in patrol and inspection findings. Additionally, exploration of new or novel inspection protocols may also lead to improvements in inspection program efficacy, consistency, or efficiency.

Progress Timeline

1. ***Before the upcoming wildfire season:*** PG&E will have expanded the FMEA completed for WSIP 2019 to incorporate additional asset failure indicators which are visible during inspection. PG&E will have established baseline inspection quality control measures to proactively highlight abnormal results and drive corrective activities.

2. ***Before the next annual update:*** PG&E will review the results of the 2020 detailed inspections and consider modifying future inspection checklists and guidance documents to reflect lessons learned. PG&E anticipates completing a pilot of new inspection protocols (Ultrasonic) to assess its efficacy and efficiency in identifying abnormal conditions as compared to detailed visual inspections.

3. ***Within the next 3 years:*** PG&E plans to move all electric patrol and inspection activities to digital data collection platforms (e.g., mobile applications) and away from paper record keeping. PG&E will revisit the commonalities of transmission and distribution overhead asset inspections with the intent to consolidate tools, methods, and personnel qualifications. PG&E will also determine if adjusting asset inspection cycles or modalities is likely to have adverse impacts on system safety or performance.

4. ***Within the next 10 years:*** PG&E anticipates moving to a risk-informed circuit-based inspection protocol that prescribes the timing for preventive maintenance activities aligned to multiple asset and environmental factors. PG&E may also pilot additional patrol or inspection modalities not yet in common usage at the utility.

5.3.4.4 Infrared Inspections of Distribution Electric Lines and Equipment

Infrared inspections of distribution electric lines and equipment began in 2012 as means to identify system components and in-line conductor splices that require repair and/or replacement. Electric distribution preventive maintenance programs use IR imaging and temperature-measuring systems to identify faulty components and initiate repairs or replacement proactively. IR imaging systems detect and record heat being radiated in their fields of view. IR cameras use an image-scanning technique to identify heat radiated from a target and its background. IR imaging systems capture and store the heat images pictorially for immediate or future evaluation. By using IR imaging systems, the operator can pinpoint the precise location of the hottest spot on the target being observed. Distribution IR program utilizes trained contractors to identify hot spots (abnormal temperature) for corrective action. IR assessment potentially prevents wire down equipment failures and helps pinpoint areas for maintenance and conductor replacement. Any findings are coupled with the IR image and SAP corrective maintenance tags are created and prioritized in accordance with TD-2022P-01.

Going forward , infrared inspections will be deployed as appropriate alongside the suite of other inspection tools and techniques include enhanced visual inspections, drones or helicopters and other emerging technologies. PG&E does not have a discrete plan for how many circuit miles will be inspected using IR systems in HFTD areas. One of several reasons that IR inspections will be deployed in a targeted manner is that the effectiveness of IR inspections can be heavily influenced by the level of electric load in the lines being inspected. If the electric load is low, it can be more difficult to capture meaningful data through IR inspections. As such PG&E is continuing to evaluate the effectiveness of various inspection methods, when performed, IR work is tracked by line miles inspected, and findings per 100 miles inspected. In addition, to the vendor's QC program, PG&E receives the work product weekly and reviews the records prior to any invoice approvals.

Progress Timeline

1. ***Before the upcoming wildfire season:*** Apply IR distribution inspections as determined to be appropriate as part of the overall asset inspection program as described above. No enhancements are planned before the upcoming wildfire season.

2. ***Before the next annual update:*** Continue evaluating IR alongside other inspection methods to optimize overall asset inspection approaches, particularly in HFTD Tiers 2 and 3.

3. ***Within the next 3 years:*** PG&E will begin utilizing predictive modelling to identify and schedule inspections for higher risk conductors in other areas. The model will factor in the conditions of the conductor based on the results of its last inspection and other factors such as age, weather, and loading to develop the risk profile.

4. ***Within the next 10 years:*** No specific refinements are planned aside from continued enhancements to the predictive models.

5.3.4.5 Infrared Inspections of Transmission Electric Lines and Equipment

Infrared (IR) inspection is an effective tool within the transmission overhead preventive maintenance program. IR inspection reduces the potential for component failures and facility damage and facilitates a proactive approach to identifying abnormal components and conductor for repair/or replacement. Electric transmission system inspections and preventive maintenance programs use IR imaging and temperature-measuring systems to identify faulty components and initiate repairs or replacement proactively. IR imaging systems detect and record heat being radiated in their fields of view. IR cameras use an image-scanning technique to identify heat radiated from a target and its background. IR imaging systems capture and store the heat images pictorially for immediate or future evaluation. By using IR imaging systems, the operator can pinpoint the precise location of the hottest spot on the target being observed.

Going forward, infrared inspections will be deployed as appropriate alongside the suite of other inspection tools and techniques which include enhanced visual inspections, drones or helicopters and other emerging technologies. PG&E does not have a discrete plan for how many circuit miles will be inspected using IR systems in HFTD areas. One of several reasons that IR inspections will be deployed in a targeted manner is that the effectiveness of IR inspections can be heavily influenced by the level of electric load in the lines being inspected. If the electric load is low, it can be more difficult to capture meaningful data through IR inspections. As such PG&E is continuing to evaluate the effectiveness of various inspection methods.

Progress Timeline

1. ***Before the upcoming wildfire season:*** Apply IR inspections as determined to be appropriate as part of the overall asset inspection program as described above. No enhancements are planned before the upcoming wildfire season.

2. ***Before the next annual update:*** Continue evaluating IR alongside other inspection methods to optimize overall asset inspection approaches, particularly in HFTD Tiers 2 and 3.

3. ***Within the next 3 years:*** PG&E will begin utilizing predictive modelling to identify and schedule inspections for higher risk conductors in all areas. The model will factor conditions of the conductor based on factors such as condition, environment, design and age to develop the risk profile.

4. ***Within the next 10 years:*** No specific refinements are planned aside from continued enhancements to the predictive models.

PACIFIC GAS AND ELECTRIC COMPANY

2021 WILDFIRE MITIGATION PLAN REPORT

RULEMAKING 18-10-007

FEBRUARY 5, 2021

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. One key component of the 2021 Wildfire Distribution Risk Model are the data inputs from enhanced inspection results from 2019 and/or 2020. 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 2022, 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 339,728 units of overhead distribution enhanced inspections and projects on 100 percent of distribution poles in Tier 3 and 33 percent of the distribution poles in Tier 2. Additionally, PG&E also completed 45 percent of the distribution poles in non-HFTD areas.

For 2020 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.

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 3 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.