Risk Assessment Mitigation Phase

Risk Mitigation Plan

Wildfires Caused by SDG&E Equipment (Including Third Party Pole Attachments)
(Chapter SDG&E-1)

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SDGE
A Sempra Energy utility

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Executive Summary

This is the risk of wildfires caused by SDG&E equipment, including third-party pole attachments. SDG&E has built a company-wide focus on addressing and minimizing wildfire-related risks to public health, safety and welfare since the catastrophic wildfires which devastated San Diego County in 2007. SDG&E's commitment to fire safety, prevention, mitigation, control, and recovery is a central focus within SDG&E. SDG&E's 2015 baseline mitigation plan for this risk consists of six controls:

1. **Inspection, Repair, Maintenance and Replacement Programs** – SDG&E evaluates the electric equipment in the field to verify, to the best of SDG&E's knowledge, that everything is in proper working condition.
2. **Vegetation Management** – SDG&E inspects each tree in accordance with a programmatic approach and is trimmed according to its assumed growth rate, supplemented by field observations.
3. **Design and Engineering Approaches** – SDG&E rebuilds its overhead system in a systematic way, while using the most current design and engineering standards and the large amount of weather and fuel data it has collected in recent years.
4. **Legal and Regulatory** – SDG&E seeks to work with regulators to create a safer system for its community.
5. **Rapid Response** – SDG&E coordinates with other first responder entities to develop plans to create a rapid response to emergencies that allows SDG&E more control in the event of an incident.
6. **Monitoring and Protection Programs** – SDG&E has continuous monitoring and detection programs for fire conditions.

These baseline mitigations focus on safety-related impacts (i.e., Health, Safety, and Environment) per guidance provided by the Commission in Decision 16-08-018 as well as controls and mitigations that may address reliability. The 2015 baseline mitigations will continue to be performed in the proposed plan. In addition, SDG&E is proposing to expand and add new mitigations within the six mitigations above to further address the risk of Wildfires. Examples of proposed activities are as follows:

- SDG&E proposes to add more funding to its existing wire mitigation program that would increase the rate of replacement of existing hardware and changing out of smaller copper conductor with stronger aluminum conductor within the Fire Threat Zone.
- SDG&E proposes to join with CalFire to create a program whereby SDG&E and CalFire personnel would jointly inspect certain areas of higher fire concern so that issues can be resolved as soon as possible, reducing concern from both agencies.

The risk spend efficiency was developed for the Wildfire risk. The risk spend efficiency is a new tool that was developed to attempt to quantify how the proposed mitigations will incrementally reduce risk.

The following is the ranking of the mitigation groupings from the highest to the lowest efficiency, as indicated by the RSE number:

1. Inspection, Repair & Hardening – Distribution (incremental mitigations)
2. Inspection, Repair & Hardening – Distribution (current controls)
3. Vegetation Management (incremental mitigations)
4. Monitoring and Detection Programs (incremental mitigations)
5. Advanced Protection (incremental mitigations)
6. Inspection, Repair & Hardening – Transmission (incremental mitigations)
7. Rapid Response (current controls)
8. Legal and Regulatory Mitigation (current controls)

Risk: Wildfires Caused by SDG&E Equipment (Including Third Party Pole Attachments)

1 Purpose

The purpose of this chapter (or plan) is to present the mitigation plan of San Diego Gas & Electric Company (SDG&E or Company) for the risk of wildfires caused by SDG&E equipment, including third-party pole attachments (referred to herein as Wildfires).

This risk is a product of SDG&E's September 2015 annual risk registry assessment cycle. Any events that occurred after that time were not considered in determining the 2015 risk assessment, in preparation for this Report. Note that while 2015 is used a base year for mitigation planning, risk management has been occurring, successfully, for many years within the Company. SDG&E and Southern California Gas Company (SoCalGas) (collectively, the utilities) take compliance and managing risks seriously, as can be seen by the number of actions taken to mitigate each risk. This is the first time, however, that the utilities have presented a Risk Assessment Mitigation Phase (RAMP) Report, so it is important to consider the data presented in this plan in that context. The baseline mitigations are determined based on the relative expenditures during 2015; however, the utilities do not currently track expenditures in this way, so the baseline amounts are the best effort of each utility to benchmark both capital and operations and maintenance (O&M) costs during that year. The level of precision in process and outcomes is expected to evolve through work with the California Public Utilities Commission (Commission or CPUC) and other stakeholders over the next several General Rate Case (GRC) cycles.

The Commission has ordered that RAMP be focused on safety related risks and mitigating those risks.[1] In many risks, safety and reliability are inherently related and cannot be separated, and the mitigations reflect that fact. Compliance with laws and regulations is also inherently tied to safety and the utilities take those activities very seriously. In all cases, the 2015 baseline mitigations include activities and amounts necessary to comply with the laws in place at that time. Laws rapidly evolve, however, so the RAMP baseline has not taken into account any new laws that have been passed since September 2015. Some proposed mitigations, however, do take into account those new laws.

The purpose of RAMP is not to request funding. Any funding requests will be made in the GRC. The forecasts for mitigation are not for funding purposes, but are rather to provide a range for the future GRC filing. This range will be refined with supporting testimony in the GRC. Although some risks have overlapping costs, the utilities have made efforts to identify those costs.

The catastrophic wildfires which devastated San Diego County in 2007, unprecedented in their sheer magnitude, have resulted in an enduring and lasting change reflected throughout SDG&E's' utility operations, systems, facilities, organization, goals and objectives. As evidenced by the many programs

[1] Commission Decision (D.) 14-12-025 at p. 31.

employed since these fires of 2003, 2007 and 2014, SDG&E has built a company-wide focus on addressing and minimizing wildfire-related risks to public health, safety and welfare. SDG&E's commitment to fire safety, prevention, mitigation, control, and recovery is a central focus within SDG&E. SDG&E has taken a leadership role in proactively addressing fire threats in the communities it serves and shares its personnel, resources, information, communications facilities, and fire-defense assets to help enhance the capabilities of the local communities to defend against any recurrences of catastrophic wildfire events in Southern California.

SDG&E performs a broad range of activities throughout the Company related to fire prevention and mitigation, all of which are subject to the direct supervision of senior management. The effectiveness of several of these activities is a performance measure for many SDG&E employees, some of whom are directly or indirectly responsible for contributing to and/or performing the mitigation efforts. Core to the mitigation activities are system design, construction, operation, maintenance and inspection aimed at significantly reducing the potential for SDG&E facilities to become the source of ignition for a fire. Nevertheless, the ubiquity of SDG&E's facilities and the range of operating conditions faced in the SDG&E service territory present some risk that SDG&E facilities might become the initiating or contributing source of ignition for a fire, regardless of how diligent these practices may be.

SDG&E's efforts continuously evolve. In coordination with many stakeholders, community leaders and the public, SDG&E shares and discusses, both formally in forums and informally in more casual meetings, its methods, programs and mitigation efforts with all interested parties. This helps to assure continuous improvement and maximum effectiveness across all affected areas. This outreach provides a platform for better coordination and idea sharing among emergency and first responder groups as well as local officials, cities and counties which are located within SDG&E's service territory.

The assessment and analysis performed in this chapter largely focuses on those Wildfires that could be caused by SDG&E's overhead electric transmission and distribution system and associated equipment. SDG&E strives to reduce or eliminate sources of ignition coming from its facilities, especially at times of peak weather when a small fire can turn into a large catastrophic fire. The mitigation activities discussed herein address and are applicable to all Wildfires, including those that do not involve utility facilities.

2 Background

Over the past several years, the risk of catastrophic Wildfires has increased significantly in Southern California due to a variety of factors. These can include drought, climate change, bark beetle infestations, and population growth into fire-prone areas. Environmental conditions such as dried fuels (e.g., chaparral) and severe wind events can turn a Wildfire that might otherwise be quickly contained by firefighting resources into an explosive and devastating situation.

For example, in the Wildfires of 2003, there were nearly 400,000 acres burned, 3,200 poles destroyed or damaged, and over 500 pieces of electric facilities and transformers destroyed. In addition, there were 148 vehicles destroyed, 14 deaths, and 104 injuries. During the 2007 Wildfires, there were 368,566 acres burned, 2,665 electric facilities destroyed, 117 electric facilities damaged, 239 vehicles destroyed, 7 deaths, and 127 injuries. In 2014, 14 Wildfires occurred that resulted in 26,000 acres burned, 65 structures destroyed (including 46 homes), 1 fatality, 135 poles replaced and over $60 million in damages.

Although Wildfires are a significant risk across the entire service territory, SDG&E focuses its fire prevention efforts primarily in the Fire Threat Zone where the risk of Wildfire is highest. Currently, SDG&E's service territory is divided into the non-Fire Threat Zone (non-FTZ) and the Fire Threat Zone (FTZ), the latter also encompassing specific areas designated the Highest Risk Fire Areas (HFRA). These designations result from an examination of the location and amount of natural fuels available for a fire, topography, weather, wind patterns, and knowledge of historical fire and fire spread. As such, the bulk of the fire prevention effort occurs in the FTZ, although the guiding principles of SDG&E's fire prevention plan also apply to the non-FTZ as well. The Fire Threat Zone comprises approximately 3,400 miles of overhead distribution system.

In addition, on October 31 of each year, SDG&E submits to the CPUC a Fire Prevention Plan (FPP) in accordance with General Order (GO) 166. The FPP outlines in detail what SDG&E does to prevent and mitigate wildfires. It includes operating practices, maps including the FTZ, and other relevant information. SDG&E is incorporating it by reference.[2]

2.1 Safety Model Assessment Proceeding

SDG&E presented how it models and assesses its risk of Wildfires in the Safety Model Assessment Proceeding (S-MAP) on May 1, 2015. SDG&E submitted its Application (A.) 15-05-002 in that proceeding, which was accompanied by the supporting testimony of Mason Withers. Mr. Withers addressed SDG&E's quantitative prioritization method for Wildfire-related hardening projects including the Fire Risk Mitigation (FiRM) program and the Wildfire Risk Reduction Model (WRRM). "FiRM addresses fire risk by hardening critical areas, by replacing older line elements, by utilizing advanced technology, and by improving facilities to adequately handle known local weather conditions."[3] It focuses on mitigating risk via pole and conductor replacement in the FTZ. Due to the complexity of the Wildfire risk, SDG&E also developed a sophisticated modeling tool, the WRRM. The WRRM is a probabilistic computer model that can perform nearly 70 million fire behavior simulations. It conducts a risk assessment at every pole, using that pole's characteristics and environmental conditions. WRRM utilizes the following as a quantitative approach to risk management:

- Failure rates (before compared to after hardening);

[2] See http://www.sdge.com/documents/fire-prevention-plan.
[3] A.15-05-002 S-MAP, Direct Testimony of Mason Withers, at p. MW-4 lines 7-9.

- Change of ignition;
- Environmental conditions;
- Fire behavior;
- Consequence; and
- Cost of hardening project.

WRRM is also flexible to accommodate future development.

SDG&E uses both FiRM and WRRM to help inform its risk-related decision-making and prioritize projects. For RAMP, SDG&E utilized the WRRM to derive benefits for some of the applicable hardening proposals presented herein. This is discussed in detail in Section 8 below. SDG&E's Wildfire tools are extremely beneficial, especially given the budgetary and resource-intensive nature of hardening projects. That being said, the methods and level of detail associated with SDG&E's Wildfire risk tools may not be appropriate for other risks.

As Mr. Withers stated in his S-MAP testimony, "(a)n important notion is the idea of continuous improvement from a risk perspective. In general, it is unlikely SDG&E will ever know everything about wildfire risk. But it is possible for SDG&E to continue to increase its understanding of risk and evolve the processes, tools, and models used to mitigate wildfire risk."[4] SDG&E is currently working on improvements to its Wildfire tools. These include enhancements to the WRRM model along with a variant of the WRRM called the WRRM Ops model that will allow SDG&E more real time analysis during a weather event. SDG&E continues to strive towards enhancing its Wildfire tools to manage and mitigate risk.

3 Risk Information

As stated in the testimony of Jorge M. DaSilva in A.15-05-002, "SDG&E is moving towards a more structured approach to classifying risks and mitigations through the development of its new risk taxonomy. The purpose of the risk taxonomy is to define a rational, logical and common framework that can be used to understand analyze and categorize risks."[5] The Enterprise Risk Management (ERM) process and lexicon that SDG&E has put in place was built on the internationally-accepted IS0 31000 risk management standard. In the application and evolution of this process, SDG&E is committed to increasing the use of quantification within its evaluation and prioritization of risks.[6] This includes identifying leading indicators of risk. Sections 3 – 9 of this plan describe the key outputs of the ERM process and resultant risk mitigations.

[4] *Id*., at p.MW-7 lines 24-27.
[5] A.15-05-002, filed May 1, 2015, at p. JMD-7.
[6] Testimony of Diana Day, Risk Management and Policy (SDG&E-02), submitted on November 14, 2014 in A.14-11-003.

In accordance with the ERM process, this section describes the risk classification, possible drivers and potential consequences of the Wildfire risk.

3.1 Risk Classification

Consistent with the taxonomy presented by SDG&E and SoCalGas in the S-MAP, SDG&E classifies this as an operational, electric risk that may be related to overhead transmission and/or distribution lines. The risk classification is provided in Table 1.

Table 1: Risk Classification per Taxonomy

Risk Type	Asset Category	Asset Type
OPERATIONAL	ELECTRIC	TRANSMISSION (OVERHEAD) DISTRIBUTION (OVERHEAD)

3.2 Potential Drivers[7]

When performing the risk assessment for Wildfires, SDG&E identified potential indicators of risk, referred to as drivers. The identification and consideration of these drivers was based on studying SDG&E's history of wildfires in addition to wildfires in other utilities' service territories. These drivers are examples of ignition sources and are discussed more fully below. These include, but are not limited to:

- **Downed Conductor**: A downed conductor (or 'wire down') occurs when a conductor drops or breaks from its designed location on the pole and cross arm and ends up on the ground, sometimes in an energized mode. A wire down can result from a variety of factors, many of which are outside of SDG&E's control.

- **General Equipment Failure**: Electric equipment failure can be a source of a downed conductor or ignition. Failure of components such as connector, hot line clamps, and insulators can result in wire failure and end up in a wire down situation, sometimes in the energized mode.

- **Weather-Related Failure of SDG&E Equipment**: Weather plays a large part in the potential failure of SDG&E equipment. Excessive wind, lightning, and exposure to weather over time can degrade the integrity of the electrical components and lead to failure of one or more of the electrical parts causing a failure of the conductor.

- **Contact by Foreign Object**: Foreign objects coming into contact with SDG&E's facilities can also present sources of ignition. For example, Mylar balloons are highly conductive and will result in phase to phase faulting. In the worst-case this can cause the conductor to fail and land in an

[7] An indication that a risk could occur. It does not reflect actual or threatened conditions.

energized mode, causing arcing and sparking in dry conditions. In addition, vehicular contact will bring down conductors, and sometimes the entire pole, resulting in conductors laying on the ground in an energized fashion.

- **Failure of Third-Party Attachments**: As mandated by the CPUC, SDG&E must allow communication infrastructure providers to attach to utility poles when space is available. These providers may not properly install or inspect their equipment. This has led to contact of these attachments with the electrical facilities, leading to fire related incidents.

- **Vegetation Contact**: During storms and severe wind events, branches are shed by trees in the vicinity of SDG&E facilities. These can fall on conductors leading to conductor failure or, in the case of palm fronds, phase to phase contact and a cascade of sparks. In addition, trees that are many feet away from an energized conductor sometimes uproot and fall on the conductor, causing failure or sparking.

- **Not Observing Operational Procedures**: SDG&E revises its protocols and procedures based on certain conditions. For example, during red flag or fire warnings, SDG&E and its contractors may not perform welding or other activities that may generate potential ignition sources. If an employee or contractor does not adhere to such a procedure, it can cause an adverse consequence.

- **Lack of Internal or External Coordinated Response**: A well-coordinated response to a downed conductor aids in the suppression of a fire as well as the de-energization of the conductor in a safe manner. Lack of coordination could lead to uncontrolled fire, electrical exposure to first responders, and, possibly, injury or death.

- **Extreme Force of Nature Events**: SDG&E's overhead electrical facilities are fully exposed to the elements. Significant weather and wind-related events can cause a variety of problems related to equipment failure and downed conductors. Also, continual exposure to natural elements can degrade or weaken key components, conditions which may not be found until the following, scheduled inspection and repair cycle.

- **Climate Change Adaptation Impacts on Wildfires Caused by SDG&E Equipment:** Despite the proactive approach to mitigating fire risk, increases in temperature and prolonged periods of drought in the decades to come will likely lead to high risk fire areas expanding from the foothills and mountains into the lower elevation coastal canyons and wildland interfaces that were

previously considered at lower risk for fire growth. These prolonged periods of drought will also likely result in a longer wildfire season, potentially extending the focus of our threat monitoring and potential response from the fall months to year-round -- with the greatest increased threat in the spring and summer months.

These climate trends have already been realized across the region, culminating in previously unseen wildfire outbreak across coastal San Diego County in May of 2014. SDG&E also employed the help of the Skycrane in San Diego on July 1, 2016 (earlier than in prior years), in response to an increase in summertime wildfire activity across the region. Based upon the most recent climate science, these trends are likely to continue and worsen into the future.

Table 2 maps the specific drivers of Wildfires to SDG&E's risk taxonomy.

Table 2: Operational Risk Drivers

Driver Category	Wildfire Driver(s)
Asset Failure	• Downed Conductor. • Failure or ignition due vegetation contact with SDG&E equipment. • Failure or ignition due to third party attachment. • General equipment failure on system. • Contact by foreign object. • Weather related failure of SDG&E equipment.
Asset-Related Information Technology Failure	Not applicable
Employee Incident	• Not observing operational procedures (e.g. welding during fire warnings). • Lack of internal or external coordinated response.
Contractor Incident	• Not observing operational procedures (e.g., welding during fire warnings). • Lack of internal or external coordinated response.
Public Incident	• Contact by foreign object. • Downed conductor due to vehicle contact. • Lack of internal or external coordinated response. • Failure or ignition due to third party attachment.
Force of Nature	• Extreme force of nature events such as high winds, earthquakes, • Failure or ignition due vegetation contact with SDG&E equipment. • Weather-related failure of SDG&E equipment.

3.3 *Potential Consequences*

If one of the risk drivers listed above were to occur, resulting in an incident, the potential consequences, in a reasonable worst case scenario could include:

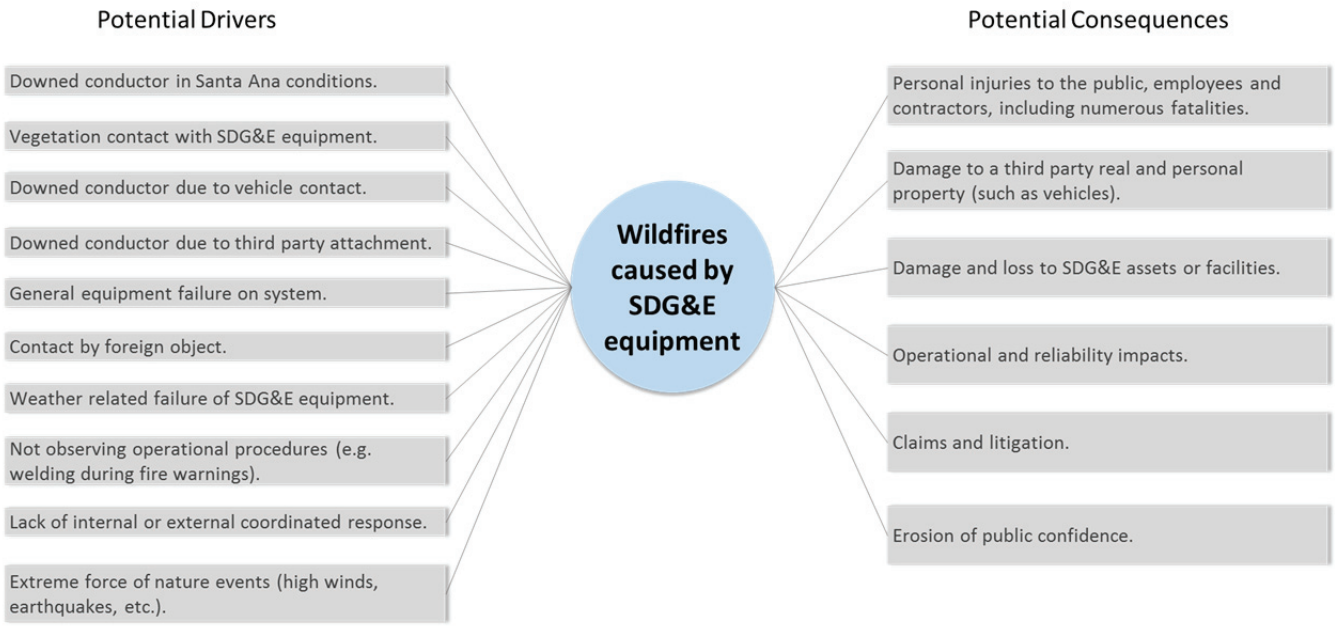
- Personal injuries to the public, employees and contractors, including numerous fatalities.
- Damage to third party real and personal property.
- Damage and loss of SDG&E assets or facilities.
- Operational and reliability impacts.
- Claims and litigation.
- Erosion of public confidence.

These potential consequences were used in the scoring of Wildfires that occurred during the development of SDG&E's 2015 risk registry process. See Section 4 for more detail.

3.4 *Risk Bow Tie*

The risk "bow tie," shown in Figure 1 is a commonly-used tool for risk analysis. The left side of the bow tie illustrates potential drivers that lead to a risk event and the right side shows the potential consequences of a risk event. SDG&E applied this framework to identify and summarize the information provided above.

Figure 1: Risk Bow Tie



4 Risk Score

The SDG&E and SoCalGas ERM organization facilitated the 2015 risk registry process, which resulted in the inclusion of Wildfires as one of the enterprise risks. During the development of the risk register, subject matter experts assigned a score to this risk, based on empirical data to the extent it is available and/or using their expertise, following the process outlined in this section.

4.1 Risk Scenario – Reasonable Worst Case

There are many possible ways in which a wildfire can occur. For purposes of scoring this risk, subject matter experts used a reasonable worst case scenario to assess the impact and frequency. The scenario represented a situation that could happen, within a reasonable timeframe, and lead to a relatively significant adverse outcome. These types of scenarios are sometimes referred to as low frequency, high consequence events. The subject matter experts selected a reasonable worst case scenario to develop a risk score for Wildfires:

- An ignition coming from an overhead SDG&E electric facility results in a catastrophic wildfire that causes multiple fatalities, numerous injuries, property damage, operational impacts, claims, and litigation.

Note that the following narrative and scores are based on this scenario; they do not address all consequences that can happen if the risk occurs.

4.2 2015 Risk Assessment

Using this scenario, subject matter experts then evaluated the frequency of occurrence and potential impact of the risk using SDG&E's 7X7 Risk Evaluation Framework (REF). The framework (also called a matrix) includes criteria to assess levels of impact ranging from Insignificant to Catastrophic and levels of frequency ranging from Remote to Common. The 7X7 framework includes one or more criteria to distinguish one level from another. The Commission adopted the REF as a valid method to assess risks for purposes of this RAMP.[8] Using the levels defined in the REF, the subject matter experts applied empirical data to the extent it is available and/or their expertise to determine a score for each of four residual impact areas and the frequency of occurrence of the risk.

Table 3 provides a summary of the Wildfire risk score in 2015. This risk has a score of 4 or above in the Health, Safety, and Environmental impact area and, therefore, was included in the RAMP. These are residual scores because they reflect the risk remaining after existing controls are in place. For additional information regarding the REF, please refer to the RAMP Risk Management Framework chapter within this Report.

[8] D.16-08-018 Ordering Paragraph 9.

Table 3: Risk Score

Residual Impact				Residual Frequency	Residual Risk Score
Health, Safety, Environmental (40%)	Operational & Reliability (20%)	Regulatory, Legal, Compliance (20%)	Financial (20%)		
7	6	5	6	5	2,551,888

4.3 Explanation of Health, Safety and Environmental Impact Score

In the 2003 and 2007 Wildfires in SDG&E's service territory, there were a total of 648,844 acres burned, 5,485 electric facilities destroyed, 180 electric facilities damaged, 387 vehicles destroyed, 21 deaths and 231 injuries. Based on magnitude of this damage, the Wildfire risk was scored a 7 (catastrophic) in the impact area of Health, Safety, and Environmental as there is a demonstrated potential for many fatalities and life threatening injuries to the public or employees, as well as immediate, severe and possibly irreversible impacts to the environment.

4.4 Explanation of Other Impact Scores

Based on the selected reasonable worst case risk scenario, SDG&E gave the following scores to the remaining impact areas:

- **Operational and Reliability**: In the Operational and Reliability impact area, Wildfires were rated a 6 (severe). In the past, Wildfires have resulted in loss of electricity to customers. Using the 7X7 matrix, an impact score of 7 was deemed inappropriate because previous Wildfires in SDG&E's service territory did not operationally affect over a million customers. Therefore, a score of 6, potentially affecting more than 100,000 customers from an operational perspective, was selected for this category.
- **Regulatory, Legal, and Compliance**: Following the past two Wildfire events, SDG&E was subject to governmental and regulatory investigations. Therefore, Wildfires was given a 5 (extensive) for the Regulatory, Legal, and Compliance category, as there is the potential for governmental and regulatory investigations.
- **Financial**: Wildfires were given a 6 (severe) in the Financial impact area. Wildfires can cause widespread destruction resulting in numerous lawsuits and increases in SDG&E's insurance premiums. By looking at the outcome from past events, the subject matter experts estimated that Wildfires can create a financial impact in the $1-3 billion range.

4.5 Explanation of Frequency Score

As described above, San Diego County experienced large Wildfires in 2003 and 2007. In addition, in 2014 San Diego had fires along the coast, areas not typical for large fires. SDG&E has assigned a

frequency score of 5 (frequent) which reflects the occurrence of a Wildfire every 1-3 years. The reasoning was based on the historical record of wildfires in the San Diego area, the potential new trend of wildfires along the coast, and the consideration of the potential of any one of those fires turning into a wildfire under the right conditions.

5 Baseline Risk Mitigation Plan[9]

SDG&E has extensive operational programs in place to mitigate Wildfires risk. The 2015 baseline mitigations discussed below include the current evolution of the utilities' risk management of this risk. The baseline mitigations have been developed over many years to address this risk. They include the amount to comply with laws that were in effect at that time. These programs are designed to monitor the system closely whenever and wherever the threat of fire is elevated so that, in the event of an ignition, the threats to public safety from fire are abated or mitigated as fully and quickly as possible. SDG&E's baseline mitigation plan for this risk consists of six controls: (1) Inspection, Repair, Maintenance and Replacement Programs, (2) Vegetation Management, (3) Design and Engineering Approaches, (4) Legal and Regulatory, (5) Rapid Response, and (6) Monitoring and Protection Programs. Within these baseline mitigations, many of the projects and programs are mandated, compliance activities pursuant to CPUC General Orders and other directives.

Subject matter experts from Electric Transmission and Distribution Engineering and Electric Distribution Operations collaborated to identify and document them. These controls focus on safety-related impacts[10] (i.e., Health, Safety, and Environment) per guidance provided by the Commission in D.16-08-018[11] as well as controls and mitigations that may address reliability.[12] Accordingly, the controls and mitigations described in Sections 5 and 6 address safety-related impacts primarily. Note that the controls and mitigations in the baseline and proposed plans are intended to address various events related to Wildfires, not just the scenario used for purposes of risk scoring.

1. Inspection, Repair, Maintenance and Replacement Programs

The purpose of the Inspection, Repair, Maintenance and Replacement Programs is to evaluate the SDG&E electric equipment in the field to verify, to the best of SDG&E's knowledge, that everything is in proper working condition. Many of the projects and programs within this mitigation are mandated in accordance with General Orders and other Commission directives. SDG&E performs its inspections in

[9] As of 2015, which is the base year for purposes of this Report.
[10] The Baseline and Proposed Risk Mitigation Plans may include mandated, compliance-driven mitigations.
[11] D.16-08-018 at p. 146 states "Overall, the utility should show how it will use its expertise and budget to improve its safety record" and the goal is to "make California safer by identifying the mitigations that can optimize safety."
[12] Reliability typically has an impact on safety. Accordingly, it is difficult to separate reliability and safety.

accordance with GO 165. If the equipment does not meet SDG&E standards, it is repaired or replaced. This process is in place to improve and maintain safety levels for employees, contractors and the public.

An example of one of the Repair, Maintenance and Replacement Programs is SDG&E's Quality Assurance/Quality Control (QA/QC) program whereby one-third of the poles and facilities within the HRFA are inspected and repaired, as needed, on a three-year rolling cycle. This program helps to determine that the system will perform as designed and minimize the potential of downed conductors.

In addition to the QA/QC program, the FiRM program activities and WRRM model, discussed in Section 2, are included in this mitigation.

2. Vegetation Management

SDG&E currently has a robust and award-winning vegetation management program. This program catalogs over 460,000 trees that are near existing power lines. Each tree is inspected in accordance with a programmatic approach and is trimmed according to its assumed growth rate, supplemented by field observations. SDG&E also inspects for tree disease and root stability, and if necessary will seek to remove a diseased or unstable tree and replace it with a more appropriate species. This program complies with mandatory regulatory requirements (i.e., General Order 95 Rule 35, and California Public Resource Codes (PRC) 4292 and 4293), and, in some areas, exceeds the minimum regulatory requirements.

3. Design and Engineering Approaches

Using the large amount of weather and fuel data it has collected in recent years, SDG&E hardens its overhead system in a systematic way, while using the most current design and engineering standards, many of which are mandated by the CPUC or are industry best practices. In doing so, SDG&E is hardening its system to be safer and more resilient to the negative effects of weather and fire. An example of one of the Design and Engineering Approach programs is SDG&E's wood-to-steel program for both the transmission and distribution facilities. This program evaluates the condition of poles in the FTZ/HRFA and, where indicated, replaces wood with steel poles, which have higher design load criteria and associated higher factors of safety.

4. Legal and Regulatory

SDG&E seeks to work with regulators to create a safer system for its community. Two examples of programs under the Legal and Regulatory category include the use of marker balls and avian protection equipment. Marker balls are used as a visual warning to pilots to prevent aircraft from contacting electric facilities. On rare occasions, aircraft can be the cause of wildfire ignitions, and contact

avoidance mitigates that risk. Avian protection uses non-conductive material to cover-up electric facilities so that large birds are not electrocuted. Birds that contact electric facilities typically fall and can cause fires. The use of avian protection both prevents a fire from occurring and protects the bird. Both programs are required by the CPUC's General Order 165.

5. Rapid Response

There is a need for SDG&E to be able to coordinate with other first responder entities before, during and after an event in order to minimize the impact of a fire as well as minimize disruption in service to electric customers. An example is SDG&E's mitigation efforts in firefighting and fire-recovery activities. SDG&E has plans in place to mobilize an appropriate range of resources, including trained firefighters, communications capabilities, data and information collection, and command facilities, to address fire threats and to assure the earliest possible recovery from a fire event. These plans have generally served to create a rapid response to emergencies that allows SDG&E more control in the event of an incident.

6. Monitoring and Detection Programs

Continuous monitoring and detection programs for fire conditions have become a cornerstone of SDG&E's fire safety program. With early notice, SDG&E can move towards more conservative operation of its system, provide customers in affected areas with early warning of specific fire conditions, and stage crews in appropriate areas to monitor for potential sources of ignition. An example of one of these programs is the gathering and analyzing of data from SDG&E's extensive weather network, which includes over 170 weather stations. This network is one of the largest and densest networks of weather stations in the country and is used to determine where and when the threat of a wildland fire will present itself. The system facilitates the immediate organization and implementation of an SDG&E response to the threat. The program has developed into a highly sophisticated early warning detection program that allows SDG&E to monitor and predict issues before they occur.

6 Proposed Risk Mitigation Plan

The 2015 baseline mitigations outlined in Section 5 will continue to be performed in the proposed plan, in most cases, to maintain the current residual risk level. In addition, SDG&E proposes to expand and add new mitigations to further address the risk of Wildfires.

While SDG&E acknowledges that it has a mature and comprehensive fire mitigation program, it is continuously analyzing and developing new technologies, systems and processes to further its ability to prevent wildfires. As such, SDG&E's proposed plan includes additional measures to be added to the

baseline activities to enhance fire prevention. The information provided below describes the proposed (with a focus on expanded and new) mitigations for the years 2017, 2018 and 2019.

1. Inspection, Repair, Maintenance & Replacement Programs

With inspection programs comes the recognition of what needs to be repaired. SDG&E proposes to add more funding to its existing wire mitigation program that would increase the rate of replacement of existing hardware and changing out of smaller copper conductor with stronger aluminum conductor within the FTZ. The replacement effort would focus on feeder and branch lines in particular. This would expand existing rebuild efforts in areas where the threat of fire is higher. Further, it should be noted that there can be potential challenges in implementing hardening and replacement work, such as obtaining applicable permits. Therefore, the amount and timing of work related to this mitigation in a given period of time may be uncertain and/or vary.

2. Vegetation Management

SDG&E proposes to join with CalFire to create a program whereby SDG&E and CalFire personnel would jointly inspect certain areas of higher fire concern so that issues can be resolved as soon as possible reducing concern from both agencies. The benefit of joint inspection is that SDG&E's electric facilities would be scrutinized from two different perspectives, with the goal of reducing ignition sources and creating a safer system.

3. Design & Engineering Approaches

Improved design and engineering practices will hopefully result in a strong, more resilient system. Accordingly, SDG&E anticipates that the Design and Engineering Approaches mitigations will continue through 2019 at the same level as described in the baseline plan.

4. Legal and Regulatory

SDG&E anticipates that the Legal and Regulatory mitigations will continue through 2019 at the same level as the baseline plan.

5. Rapid Response

Based on SME experience, SDG&E has found that climate change will impact its efforts on preventing Wildfires which may be caused by SDG&E Equipment. As discussed in Section 3.2, these climate trends have already been realized across the region culminating in SDG&E employing the help of the Skycrane earlier than in historical experience. Based upon the most recent climate science, these trends

are likely to continue and worsen into the future. The anticipated, prolonged fire season is likely to result in an increase in performing Rapid Response activities

6. Monitoring and Detection Programs

SDG&E proposes to add two programs. The first provides for a situational, web-based fire awareness tool that allows SDG&E access to fire perimeter data from the fire agencies as they update their systems, allowing SDG&E to see and react if necessary to threats to its electric system. The second proposed program is a cutting-edge fire awareness tool that uses imaging equipment on firefighting aircraft to provide real-time fire perimeter data as the aircraft is helping to fight a fire. This allows SDG&E to react with a more concerted effort to address the threats to its overhead electric system.

7 Summary of Mitigations

Table 4 summarizes the 2015 baseline risk mitigation plan, the risk driver(s) a control addresses, and the 2015 baseline costs for mitigating Wildfires. While control or mitigation activities may address both risk drivers and consequences, risk drivers link directly to the likelihood that a risk event will occur. Thus, risk drivers are specifically highlighted in the summary tables.

SDG&E does not account for and track costs by activity, but rather, by cost center and capital budget code. So, the costs shown in were estimated using assumptions provided by SMEs and available accounting data.

Table 4: Baseline Risk Mitigation Plan[13]
(Direct 2015 $000)[14]

ID	Control	Risk Drivers Addressed	Capital[15]	O&M	Control Total[16]	GRC Total[17]
1	Inspection, Repair, Maintenance and Replacement Programs*	• Asset Failure	$102,080	$640	$102,720	$69,680
2	Vegetation Management	• Asset Failure • Force of Nature	n/a	23,100	23,100	23,100
3	Design and Engineering Approaches	• Asset Failure • Force of Nature	3,840	n/a	3,840	1,750
4	Legal and Regulatory*	• Public Incident	600	740	1,340	190
5	Rapid Response	n/a	n/a	5,660	5,660	5,660
6	Monitoring and Detection Programs	• Asset Failure • Force of Nature	830	450	1,280	1,280
	TOTAL COST		$107,350	$30,590	$137,940	$101,660

* Includes one or more mandated activities

While all the controls and baseline costs presented in Table 4 mitigate Wildfires, some of the controls also mitigate other risks presented in this RAMP Report. Specifically, customer communication related to fire preparedness is also included in the risk of Employee, Contract and Public Safety. In addition, SCADA programs and falling conductor protection (FCP) programs are included as mitigations for both the Wildfire risk herein as well as the Electric Infrastructure Integrity risk.

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[13] Recorded costs were rounded to the nearest $10,000.
[14] The figures provided in Tables 4 and 5 are direct charges and do not include Company overhead loaders, with the exception of vacation and sick. The costs are also in 2015 dollars and have not been escalated to 2016 amounts.
[15] Pursuant to D.14-12-025 and D.16-08-018, the Company is providing the "baseline" costs associated with the current controls, which include the 2015 capital amounts. The 2015 mitigation capital amounts are for illustrative purposes only. Because projects generally span several years, considering only one year of capital may not represent the entire mitigation.
[16] The Control Total column includes GRC items as well as any applicable non-GRC jurisdictional items. Non-GRC items may include those addressed in separate regulatory filings or under the jurisdiction of the Federal Energy Regulatory Commission (FERC).
[17] The GRC Total column shows costs typically presented in a GRC.

Table 5 summarizes SDG&E's proposed mitigation plan, associated projected ranges of estimated O&M expenses for 2019, and projected ranges of estimated capital costs for the years 2017-2019. It is important to note that SDG&E is identifying potential ranges of costs in this plan, and is not requesting funding approval. SDG&E will request approval of funding in its next GRC. There are non-CPUC jurisdictional mitigation activities addressed in RAMP; the costs associated with these will not be carried over to the GRC. As set forth in Table 5, the utilities are using a 2019 forecast provided in ranges based on 2015 dollars.

Table 5: Proposed Risk Mitigation Plan[18]
(Direct 2015 $000)

ID	Mitigation	Risk Drivers Addressed	2017-2019 Capital[19]	2019 O&M	Mitigation Total[20]	GRC Total[21]
1	Inspection, Repair, Maintenance & Replacement Programs*	• Asset Failure	$895,080 - 1,163,600	$1,250 - $1,630	$896,330 - 1,165,230	$506,790 - 522,230
2	Vegetation Management	• Asset Failure • Force of Nature	n/a	23,550 - 30,620	23,550 - 30,620	23,550 - 30,620
3	Design & Engineering Approaches	• Asset Failure • Force of Nature	36,150 - 46,990	n/a	36,150 - 46,990	32,030 - 32,990
4	Legal & Regulatory*	• Public Incident	1,270 - 1,650	580 - 750	1,850 - 2,400	80 - 100
5	Rapid Response	n/a	n/a	6,350 - 8,260	6,350 - 8,260	6,350 - 8,260
6	Monitoring and Detection Programs	• Asset Failure • Force of Nature	1,350 - 1,760	1,640 - 2,130	2,990 - 3,890	2,990 - 3,520
	TOTAL COST		$933,850 - 1,214,000	$33,370 - 43,390	967,220 - 1,257,390	$571,790 - 597,720

Status quo is maintained
Expanded or new activity
* Includes one or more mandated activities

1. Inspection, Repair, Maintenance and Replacement Programs

The costs associated with this item may vary due to specific unknown field conditions encountered at a specific job site, along with other unknown specific environmental factors.

2. Vegetation Management

[18] Ranges of costs were rounded to the nearest $10,000.
[19] The capital presented is the sum of the years 2017, 2018, and 2019 or a three-year total. Years 2017, 2018 and 2019 are the forecast years for SDG&E's Test Year 2019 GRC Application.
[20] The Mitigation Total column includes GRC items as well as any applicable non-GRC items.
[21] The GRC Total column shows costs typically represented in a GRC.

The costs for this new program were estimated based on high level assumptions only and will need to be refined in SDG&E's Test Year 2019 GRC, as well as scaled to the actual number of facilities inspected.

3. Design and Engineering Approaches

The costs associated with the Design & Engineering Approaches mitigation are consistent with historical recorded costs. The range shown in Table 5 provides flexibility given that the mandates and scope of work may change in the 2017-2019 timeframe.

4. Legal and Regulatory

The costs associated with the Legal and Regulatory mitigation are consistent with the recorded costs in 2015. The range shown in Table 5 provides flexibility given that the mandates and scope of work may change in the 2017-2019 timeframe.

5. Rapid Response

The ranges shown in Table 5 were estimated based on a known expansion of the fire season. However, if the season continues to grow, additional dollars will be needed to permit the use of mitigations such as the Skycrane even earlier.

6. Monitoring and Detection Programs

The costs for the Monitoring and Detection Programs were estimated based on high level assumptions only and will need to be refined in SDG&E's Test Year 2019 GRC.

8 Risk Spend Efficiency

Pursuant to D.16-08-018, the utilities are required in this Report to "explicitly include a calculation of risk reduction and a ranking of mitigations based on risk reduction per dollar spent."[22] For the purposes of this Section, Risk Spend Efficiency (RSE) is a ratio developed to quantify and compare the effectiveness of a mitigation at reducing risk to other mitigations for the same risk. It is synonymous with "risk reduction per dollar spent" required in D.16-08-018.[23]

As discussed in greater detail in the RAMP Approach chapter within this Report, to calculate the RSE the Company first quantified the amount of Risk Reduction attributable to a mitigation, then applied the Risk Reduction to the Mitigation Costs (discussed in Section 7). The Company applied this calculation to each of the mitigations or mitigation groupings, then ranked the proposed mitigations in accordance with the RSE result.

[22] D.16-08-018 Ordering Paragraph 8.
[23] D.14-12-025 also refers to this as "estimated mitigation costs in relation to risk mitigation benefits."

8.1 General Overview of Risk Spend Efficiency Methodology

This subsection describes, in general terms, the methods used to quantify the *Risk Reduction*. The quantification process was intended to accommodate the variety of mitigations and accessibility to applicable data pertinent to calculating risk reductions. Importantly, it should be noted that the analysis described in this chapter uses ranges of estimates of costs, risk scores and RSE. Given the newness of RAMP and its associated requirements, the level of precision in the numbers and figures cannot and should not be assumed.

8.1.1 Calculating Risk Reduction

The Company's SMEs followed these steps to calculate the Risk Reduction for each mitigation:

1. **Group mitigations for analysis:** The Company "grouped" the proposed mitigations in one of three ways in order to determine the risk reduction: (1) Use the same groupings as shown in the Proposed Risk Mitigation Plan; (2) Group the mitigations by current controls or future mitigations, and similarities in potential drivers, potential consequences, assets, or dependencies (e.g., purchase of software and training on the software); or (3) Analyze the proposed mitigations as one group (i.e., to cover a range of activities associated with the risk).
2. **Identify mitigation groupings as either current controls or incremental mitigations:** The Company identified the groupings by either current controls, which refer to controls that are already in place, or incremental mitigations, which refer to significantly new or expanded mitigations.
3. **Identify a methodology to quantify the impact of each mitigation grouping:** The Company identified the most pertinent methodology to quantify the potential risk reduction resulting from a mitigation grouping's impact by considering a spectrum of data, including empirical data to the extent available, supplemented with the knowledge and experience of subject matter experts. Sources of data included existing Company data and studies, outputs from data modeling, industry studies, and other third-party data and research.
4. **Calculate the risk reduction (change in the risk score):** Using the methodology in Step 3, the Company determined the change in the risk score by using one of the following two approaches to calculate a Potential Risk Score: (1) for current controls, a Potential Risk Score was calculated that represents the increased risk score if the current control was not in place; (2) for incremental mitigations, a Potential Risk Score was calculated that represents the new risk score if the incremental mitigation is put into place. Next, the Company calculated the risk reduction by taking the residual risk score (See Table 3 in this chapter.) and subtracting the Potential Risk Score. For current controls, the analysis assesses how much the risk might increase (i.e., what the potential risk score would be) if that control was removed.[24] For incremental mitigations, the analysis assesses the anticipated reduction of the risk if the new mitigations are implemented. The change in risk score is the risk reduction attributable to each mitigation.

[24] For purposes of this analysis, the risk event used is the reasonable worst case scenario, described in the Risk Information section of this chapter.

8.1.2 Calculating Risk Spend Efficiency

The Company SMEs then incorporated the mitigation costs from Section 7. They multiplied the risk reduction developed in subsection 8.1.1 by the number of years of risk reduction expected to be realized by the expenditure, and divided it by the total expenditure on the mitigation (capital and O&M). The result is a ratio of risk reduction per dollar, or RSE. This number can be used to measure the relative efficiency of each mitigation to another. Figure 2 shows the RSE calculation.

Figure 2: Formula for Calculating RSE

$$Risk\ Spend\ Efficiency = \frac{Risk\ Reduction * Number\ of\ Years\ of\ Expected\ Risk\ Reduction}{Total\ Mitigation\ Cost\ (in\ thousands)}$$

The RSE is presented in this Report as a range, bounded by the low and high cost estimates shown in Table 5 of this chapter. The resulting RSE scores, in units of risk reduction per dollar, can be used to compare mitigations within a risk, as is shown for each risk in this Report.

8.2 Risk Spend Efficiency Applied to This Risk

SDG&E analysts used the general approach discussed in Section 8.1, above, in order to assess the RSE for the Wildfires risk. The RAMP Approach chapter in this Report, provides a more detailed example of the calculation used by the Company.

The analysis addresses eight mitigation groupings:

(a) Rapid Response
- Response readiness focuses on anticipating fires and being prepared to extinguish them should they spark. Initiatives include Crew Staging, Mobilization, Mobile Command Centers, Wildfire Prevention Teams, Fire Brigades and Community Outreach programs.

(b) Vegetation Management
- Programs include tree trimming, removing brush from the vicinity of poles, and improving joint pole attachment agreements. These mitigations focus on eliminating contact between trees and energized lines, as well as removing combustible fuel from the base of poles where sparks may drop when equipment operates and/or fails.

(c) System Hardening, Inspection & Repair Programs - Distribution
- Programs include strengthening lines through conductor replacement, replacing wood poles with steel, assessing tie lines and long spans along with other inspection and maintenance programs. These mitigations focus on eliminating system failures which could result in direct contact between energized components and the ground triggering sparks.

(d) Aviation Protection

- Program increases the number of locations where highly visible balls are suspended, decreasing the likelihood of an aircraft versus wire collision in which both downed infrastructure and downed aircraft could trigger fires.

(e) Advanced Detection (Situational Awareness)
- This set of activities focus on enhancing situational awareness to inform and enable all of the other programs. Programs include maintaining weather stations, highly localized weather forecasting, development of the Fire Prevention Index (FPI), data sharing including fuel studies and the WRRM.

(f) Advanced Protection
- Program enables SDG&E to remotely disable automatic protection equipment so that, under heightened fire risk situations, equipment can be prevented from operating in the field, pushing operations and potential sparks to the controlled environment of the substation.

(g) Incremental System Hardening, Inspection & Repair Programs – Distribution
- Programs include wood to steel pole program (D) and work in the Cleveland National Forest.

(h) System Hardening, Inspection & Repair Programs – Transmission
- Programs include wood to steel pole program (T) and work in the Cleveland National Forest.

The risk reduction analysis drew on several data sources, including: Outage Management System (OMS) Data, the log of SDG&E-triggered fire events, SDG&E's WRRM, NTSB Aviation Accident Database, and estimates based on subject matter expertise.

- **Rapid Response (current control)**

The time that fire has to grow before a responder intervenes is a major determinant in how large it becomes and how difficult it is to extinguish. Approximately 10% of fire events are intercepted by SDG&E teams before local and State first responders need to get involved, and all of these events are contained to less than a quarter acre. Of the fires that expand beyond a quarter acre, 20% progress beyond 10 acres, and one in fifteen of those expand beyond 100 acres. Without SDG&E's rapid response measures, three fires which would otherwise be contained to under 0.25 acres would run a one in 75 chance of developing into a wildfire of at least 100 acres. Approximately, one in twenty such fires would yield the consequences outlined in RAMP.

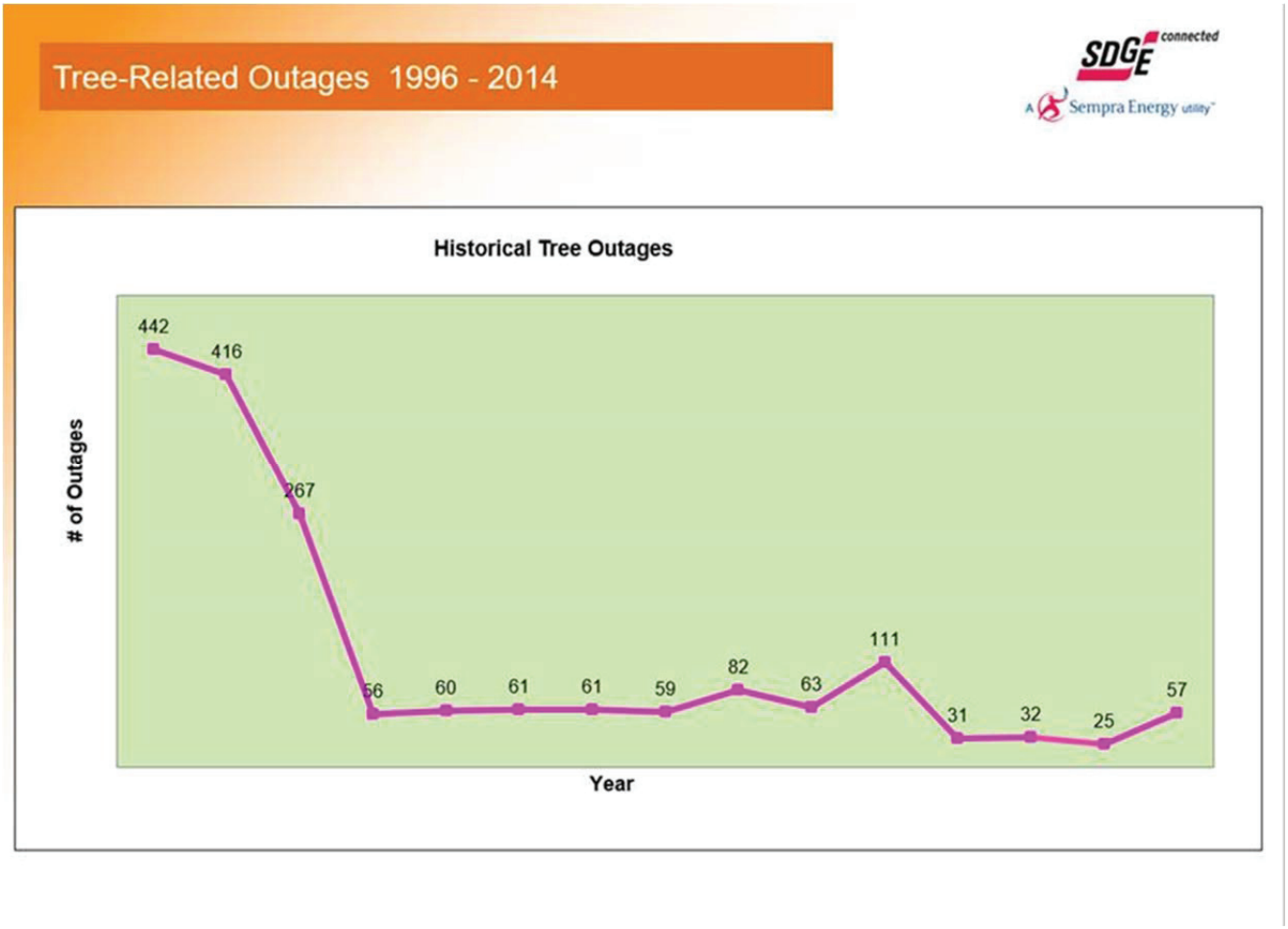
$$\frac{\text{Annual events caught by utility} \times \text{Fraction of uncaught events which develop beyond 0.25 acres} \times \text{Fraction of events over 0.25 acres that develop beyond 100 acres} \times \text{Fraction of events over 100 acres that yield the anticipated consequences}}{\text{Rate of serious wildfires anticipated under RAMP}}$$

This amounts to an increase in serious wildfires of 0.3% if the rapid response measures were abandoned.

- **Vegetation Management (current control)**

Approximately 15% of fire events are attributable to vegetation causes. In the mid-1990s, SDG&E experienced over 400 tree-caused outages per year. Following an enhancement to the tree pruning and

vegetation management specification, tree-caused outages dropped precipitously, and have held between 25 and 57 in the 2011-2014 timeframe.



Analysts estimated that if the enhanced trimming were discontinued, tree outages would rebound from current levels (estimated at 40 per year) to pre-1998 levels (estimated at 420 per year). Of the outages avoided, about one in twenty are the type that could result in a ground-level ignition event.

$$\%\ \text{Fires due to Trees/Arcing} \times \frac{\text{Pre-1998 Tree Outage Rate} - \text{Current Tree Outage Rate}}{\text{Current Tree Outage Rate}} \times \text{Proportion of avoided outages which would result in ignition}$$

This amounts to wildfire risk potentially increasing by approximately 7% if the current enhanced tree specification was abandoned.

- **System Hardening, Inspection & Repair Programs – Distribution (current control)**

The bulk of spending and benefits in this program are attributable to the Fire Risk Mitigation (FiRM) initiative to harden circuits through the replacement of poles and conductors. This mitigation would

address wire-down incidents, which account for 25% of fires triggered by SDG&E's infrastructure. The Wildfire Risk Reduction Model combines GIS data with localized fire risk factors (fuel, dryness, wind, etc.) to quantify the risk reductions associated with changes to SDG&E's infrastructure.

WRRM places a unitless value of 12,857,000 points to the risk reduction which would be achieved by replacing all wire and poles with brand new overhead infrastructure. The FiRM team has modeled their Incremental projects for 2017, which have a unitless value of 1,214,000 points. It is assumed that the 2018 and 2019 projects will yield the same results. Finally, it is assumed that the overwhelming majority of wire down incidents are attributable to small wire and poles, but to be conservative that fraction has been set at 90%.

$$\text{\% Fires due to Wires Down} \times \frac{\text{WRRM Risk Reduction due to planned replacements}}{\text{WRRM Risk Reduction if all poles \& wire was replaced}} \times \text{\% Wires down due to poles and small conductor}$$

This amounts to a 6.4% reduction in the likelihood of triggering a wildfire.

- **Aviation Protection (current control]**

Aircraft hit wires approximately once per year in California. SDG&E serves about one-tenth of California's population, and it has been assumed that as a result there is one tenth of the infrastructure and aircraft passing through SDG&E's territory and running the risk of a collision. It is further assumed that marker balls reduce the likelihood of a collision by 50% and that SDG&E would be able to mark one tenth of potential locations in that time. If an aircraft were to collide with a wire and trigger a fire, it would increase the annual number of fire events by approximately 1%.

$$\text{Annual aircraft vs. wire events in CA} \times \text{Fraction of CA population in SDGE territory} \times \text{Estimated effectiveness of marker balls} \times \text{Percentage increase of fire events due to one aircraft event}$$

This amounts to a reduction in wildfire likelihood of 0.005%.

- **Advanced Detection (current control)**

As a situational awareness measure which enables other mitigations in this chapter, Advanced Detection has no direct and measureable benefits in and of itself. Either its cost may be loaded into an existing mitigation, or a portion of the benefit from an existing measure may be allocated back to this measure. In this case, SDG&E chose to allot 4% of the benefits accrued in the Hardening, Inspection and Repair mitigation back to the Advanced Detection measure, resulting in a 0.4% reduction in likelihood.

- **Advanced Protection (incremental mitigation)**

Advanced protection features a level of fault detection which enables SDG&E to become aware of wire-down events as the wires are falling and cut potential before the wires hit the ground. The technology requires sensors to be installed upstream and downstream of potential fault locations in order to recognize the fault signatures from both sides of the interruption. SDG&E must therefore make strategic decisions about where to install the devices, and can generally protect about 20% of each circuit upon which they install the technology. SDG&E expects to install on 10% of their circuits. The technology is assumed to be 80% effective, applies to about 70% of event types (Wire Down, Tree Contact, Vehicle, and a portion of the remaining causes), and because of redundancy with other mitigation measures, the effectiveness of the technology is discounted another 70%.

% Circuits to receive Advanced Protection	×	% of each circuit to be covered	×	% Estimated effectiveness of A.P.	×	% Applicable Causes	×	Redundancy Factor

This amounts to a reduction in wildfire likelihood of 0.34%

- **System Hardening, Inspection & Repair Programs – Distribution (incremental mitigation]**

The incremental distribution hardening spend is assumed to have a similar benefit ratio to the current WRRM-based distribution hardening spend. The projected risk reduction for the incremental distribution hardening efforts amounts to 5.3%.

- **System Hardening, Inspection & Repair Programs – Transmission (incremental mitigation)**

The transmission hardening spend has been assumed to be less efficient than the distribution spend on the basis that fewer fires are triggered by transmission systems than by distribution systems. As such the per-dollar benefit of the transmission programs was fixed to approximately 40% of the per-dollar distribution benefit. The projected risk reduction for the transmission hardening efforts amounts to 3.6%.

8.3 Risk Spend Efficiency Results

Based on the foregoing analysis SDG&E calculated the RSE ratio for each of the proposed mitigation groupings. Following is the ranking of the mitigation groupings from the highest to the lowest efficiency, as indicated by the RSE number:

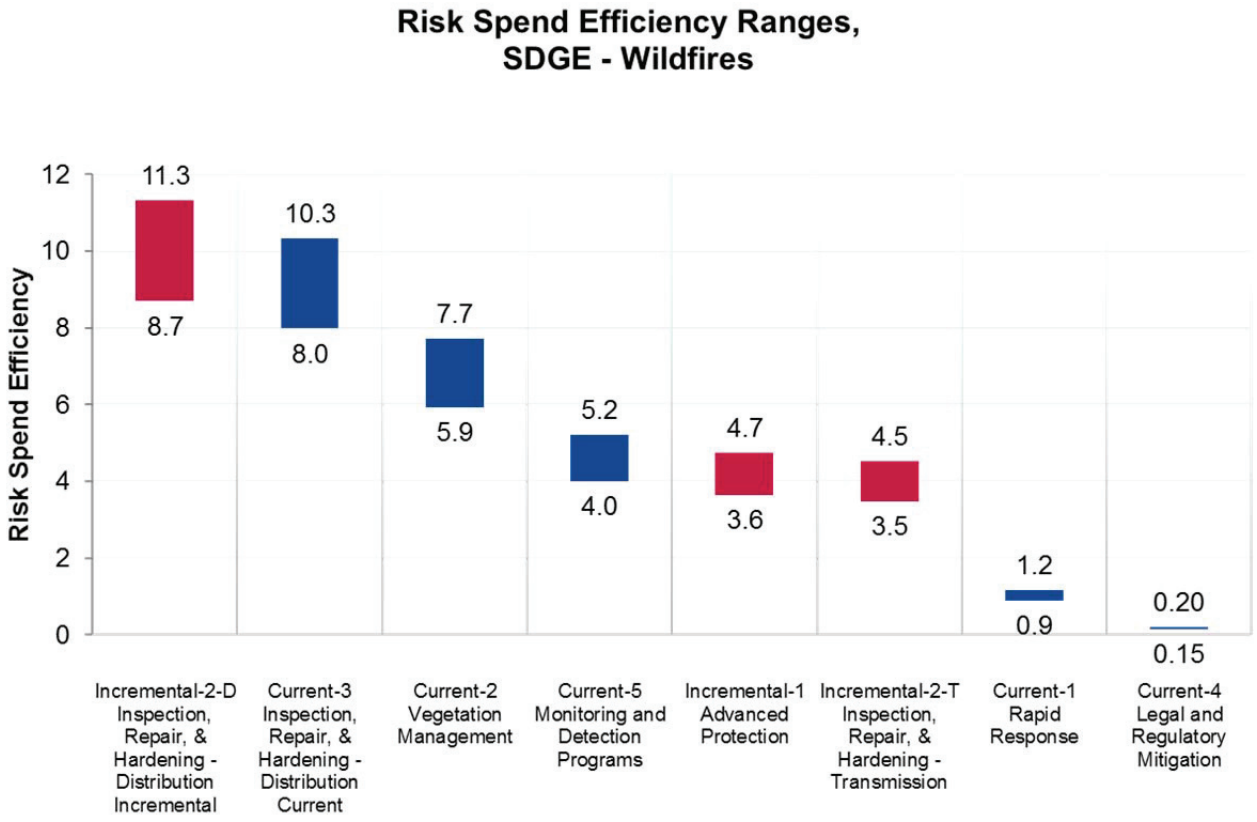
1. Inspection, Repair & Hardening – Distribution (incremental mitigations)
2. Inspection, Repair & Hardening – Distribution (current controls)
3. Vegetation Management (incremental mitigations)
4. Monitoring and Detection Programs (incremental mitigations)
5. Advanced Protection (incremental mitigations)
6. Inspection, Repair & Hardening – Transmission (incremental mitigations)
7. Rapid Response (current controls)
8. Legal and Regulatory Mitigation (current controls)

Figure 3displays the range[25] of RSEs for each of the SDG&E Wildfires risk mitigation groupings, arrayed in descending order.[26] That is, the more efficient mitigations, in terms of risk reduction per spend, are on the left side of the chart.

[25] Based on the low and high cost ranges provided in Table 5 of this chapter.

[26] It is important to note that the risk mitigation prioritization shown in this Report, is not comparable across other risks in this Report.

Figure 3: Risk Spend Efficiency



9 Alternative Analysis

SDG&E considered alternatives to the proposed mitigations as it developed the proposed mitigation plan for the Wildfires risk. Typically, alternatives analysis occurs during vendor selection and when implementing activities, to obtain the best result or product for the cost. The alternatives analysis for this risk plan also took into account modifications to the proposed plan and constraints, such as budget and resources.

9.1 Alternative 1 – Extensive Use of Falling Conductor Protection (FCP)

Currently, SDG&E uses a programmatic approach to fire prevention (as noted in its Fire Prevention Plan). For this alternative, SDG&E has considered replacing its programmatic program with the exclusive use of FCP. Depending on the physical configuration of the circuit, FCP may be faster to deploy; however, FCP is a new technology and has not yet been in place long enough to fully evaluate its effectiveness. In addition, long circuits with branches near or at the end of circuits are problematic due to their physical location in relation to monitors.

Currently, Engineering estimates the methods to be 70% effective when an FCP operates. Also, the dependency on circuit configuration, where a switch must be in communication with a reactive monitor device downstream in order for the coordination and algorithm to function, essentially would negate the use of FCP, especially on smaller, end of circuit branches. Further, the intent of FCP is to stop or decrease the likelihood of an ignition occurring due to a wire down event. Nonetheless, it does not address the issue of a wire coming down. System hardening would still need to be deployed. Accordingly, SDG&E dismissed this alternative in favor of its proposed plan to test FCP monitoring along with system hardening measures.

9.2 Alternative 2 – Undergrounding the FTZ

Consideration to underground the overhead electric system in the FTZ was considered as an alternative. If this alternative were pursued, the likelihood of the system serving as a source of ignition would be reduced. But, moving equipment underground does not fully remove the risk of fire due to some of the components being pad mounted (such as switches) that are a factor in events such as vehicular incidents. In addition, the cost of undergrounding electrical equipment would be very expensive (estimated in the billions of dollars) due to difficult terrain, unknown land and environmental issues, as well as the added cost of the facilities. Undergrounding also can increase restoration times due to underground fault location.