



Risk Assessment Mitigation Phase
Risk Mitigation Plan
Climate Change Adaptation
(Chapter SDG&E-14)

November 30, 2016



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Executive Summary

This chapter addresses the risk of Climate Change Adaptation, or the adjustment in natural or human systems in response to actual or expected climatic changes. Identified threats to SDG&E's gas and electric system due to an evolving climate across the San Diego region include increasing temperatures, a higher potential for wildfire occurrence, accelerated sea level rise, and changes in rainfall patterns. SDG&E's 2015 baseline mitigation plan for Climate Change Adaptation consists of two controls:

1. **Meteorological Support** – Two SDG&E meteorologists allocate 10 percent of their time to climate-related activities to better understand the regional impacts of climate change.
2. **Climate Advisory Group** – In May 2015, SDG&E developed a climate advisory group with representatives from 13 departments. Through semi-annual group meetings and one-on-one communication, these department representatives have worked with SDG&E's meteorologists to identify vulnerabilities to the electric and gas systems due to the projected changes in climate. Their input was combined with a literature review of projected climate change impacts to Southern California, and was provided to the Department of Energy as the first deliverable of the Partnership for Energy Sector Climate Resilience in February 2016.

These controls 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. Examples of proposed activities are as follows:

- SDG&E will continue using the support of two meteorologists, who will dedicate time to researching and educating internal departments on how climate change will impact the electric and gas systems of SDG&E.
- SDG&E proposes the use of consultants to develop an in-depth review of climate change impacts and affected gas and electric assets over 2-3 years, to provide SDG&E risk managers with detailed asset-based risk assessments and potential mitigation strategies.
- SDG&E proposes to partner with a university team of experts to update SDG&E's projected impacts of climate change for both gas and electric threats.

A risk spend efficiency analysis was not performed for the Climate Change Adaptation risk because there is no linkage to adaptive or corrective actions which would have any measurable effect on the probability of their predicted safety consequences.

Risk: Climate Change Adaptation

1 Purpose

The purpose of this chapter (or plan) is to present the mitigation plan of San Diego Gas & Electric Company (SDG&E) for the risk of Climate Change Adaptation. The Intergovernmental Panel on Climate Change (IPCC), global scientists leading the assessment of climate change, define climate change adaptation as the adjustment in natural or human systems in response to actual or expected climatic changes.¹ This is different from climate change mitigation, which refers to human interventions to reduce anthropogenic forcing, including implementing processes to reduce greenhouse gas emissions.²

Climate change and adaptation are longer term (*e.g.*, 30 year) endeavors. Even so, Climate Change Adaptation is an emerging risk projected to expand over the coming decades. Identified threats due to an evolving climate across the San Diego region include increasing temperatures, a higher potential for wildfire occurrence, accelerated sea level rise, and changes in rainfall patterns that may have a broad reach across many departments within SDG&E.

This risk assessment will focus on the drivers of climate change and the potential resulting impacts to SDG&E. All climate-related impacts identified as threats to the SDG&E service territory of which the Company is aware are addressed in this risk. However, due to the long-term realization of a changing climate, there may be drivers and events currently unknown to SDG&E that may be included in the future. Further, the mitigation activities associated with this risk focus on informing and preparing the Company for climate change. However, there are efforts at SDG&E that, entirely or in part, address climate change. These efforts are captured in other risks presented in the Risk Assessment Mitigation Phase (RAMP) Report. Please refer to the mitigation activities of Wildfires Caused by SDG&E Equipment, Electric Infrastructure Integrity, and Catastrophic Damage Involving Medium-Pressure Pipeline Failure.

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 as 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 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 the 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

¹ https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html.

² https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-e-o.html.

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.³ 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.

2 Risk Information

As stated in the testimony of Jorge M. DaSilva in the Safety Model Assessment Proceeding (S-MAP) Application (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.”⁴ The Enterprise Risk Management (ERM) process and lexicon that SDG&E has put in place was built on the internationally-accepted ISO 31000 risk management standard. In the application and evolution of this process, the Company is committed to increasing the use of quantification within its evaluation and prioritization of risks.⁵ This includes identifying leading indicators of risk. Sections 2 – 8 of this plan describe the key outputs of the ERM process and resultant risk mitigations.

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

2.1 Risk Classification

Consistent with the taxonomy presented by SDG&E and SoCalGas in A.15-05-002, SDG&E classifies this risk as a cross-cutting, business model/strategic risk as shown in Table 1.

Table 1: Risk Classification per Taxonomy

Risk Type	Asset/Function Category	Asset/Function Type
CROSS-CUTTING	BUSINESS MODEL/STRATEGIC	

³ Commission Decision (D.) 14-12-025 at p. 31.

⁴ A.15-05-002, filed May 1, 2015, at p. JMD-7.

⁵ Testimony of Diana Day, Risk Management and Policy (SDG&E-02), submitted on November 14, 2014 in A.14-11-003.

2.2 Potential Drivers⁶

When performing the risk assessment for Climate Change Adaptation, SDG&E first identified climate change as a driver of different weather-related impacts, including prolonged drought and changing rainfall patterns, rising sea levels, increases in temperature and the potential for heat waves, and an increase in wildfire potential in Southern California. These climate risks are projected to be realized over long-term periods, though it should be noted that impacts from drought and increased wildfire potential are already being realized in the San Diego region.

Also, SDG&E identified potential indicators of risk, referred to as drivers during the 2015 risk assessment for Climate Change Adaptation. These include, but are not limited to:

- Increases in the potential for wildfires and overall acres burned;
- Acceleration of sea level rise along the California coast;
- Changing rainfall patterns and an increased susceptibility to drought; or
- Increases in temperature and a growing number of heat waves.

2.3 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:

- Health, safety and environmental impacts to customers and the public;
- Project delays;
- Real and personal property damage;
- Damage to SDG&E equipment;
- Increased costs for construction and operations;
- Operational and reliability impacts;
- Regulatory and compliance impacts.

These potential consequences were used in the scoring of Climate Change Adaptation that occurred during the SDG&E's 2015 risk registry process. See Section 3 for more detail.

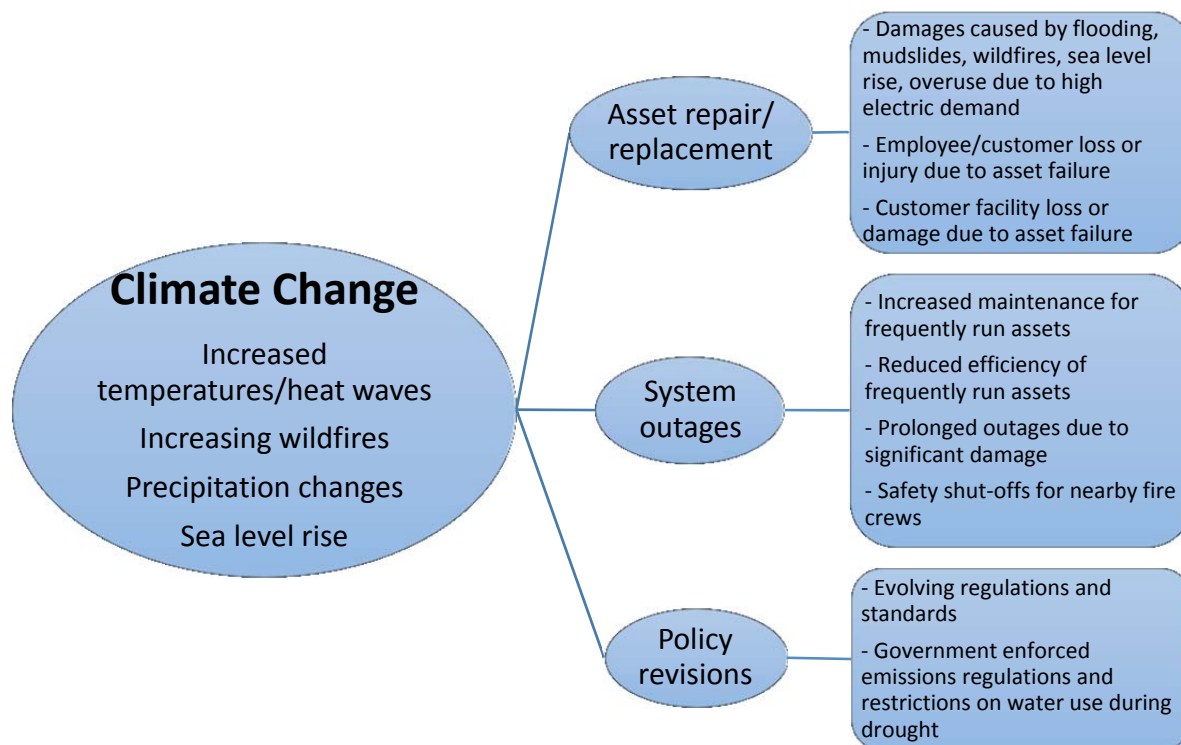
2.4 Risk Chart⁷

Figure 1 shown below is to pictorially depict the risk of Climate Change Adaptation. The large dot to the left illustrates the potential drivers that lead to a risk event, and the right side shows the potential consequences of a risk event. SDG&E developed this risk chart for the Climate Change Adaptation risk to summarize all the information provided above.

⁶ An indication that a risk could occur. It does not reflect actual or threatened conditions.

⁷ Climate change is a potential driver that can lead to a risk event. For example, a pipeline rupture (risk event) could occur because climate change may affect cathodic protection. Unlike other risks identified in this RAMP Report represented in the traditional bow tie diagram as the risk event, climate change as a driver did not suit that representation.

Figure 1: Risk Chart



3 Risk Score

The SDG&E and SoCalGas ERM organization facilitated the 2015 risk registry process, which resulted in the inclusion of Climate Change Adaptation 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.

3.1 Risk Scenario – Reasonable Worst Case

There are many possible ways in which an event can occur that may be related to climate change. 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 hypothetical 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 assumed a reasonable worst case scenario to develop a risk score for Climate Change Adaptation:

- Extreme winds in SDG&E’s Fire Threat Zone during a time of drought and elevated temperatures could cause a wire down event leading to a wildfire. This type of event could result in few serious injuries, service disruptions, and regulatory, legal and financial impacts.

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.

3.2 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 2: Risk ScoreTable provides a summary of the Climate Change Adaptation 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.

Table 2: Risk Score

Residual Impact				Residual Frequency	Residual Risk Score
Health, Safety, Environmental (40%)	Operational & Reliability (20%)	Regulatory, Legal, Compliance (20%)	Financial (20%)		
4	5	4	5	3	2,656

3.3 Explanation of Health, Safety, and Environmental Impact Score

In determining the scores for this risk, Subject Matter Experts (SMEs) identified the climate variables currently impacting the SDG&E service area, including wildfire, focused on the risk scenario. Research done by the Desert Research Institute indicates that 93% of San Diego residents polled from the wildland urban interfaces in San Diego County have been impacted by wildfire. Should a wildfire event take place, energy may be turned off for thousands of customers, either because of damaged equipment or for safety reasons, at the request of fire agencies attempting to put out the fire. This may have impacts on medical baseline customers who rely on power for their medical equipment. In addition, wildfires can affect indoor air

⁸ D.16-08-018 Ordering Paragraph 9.

quality for nearby residents by spreading ash and smoke, leading to decreased lung function and respiratory problems, increasing the risk of burns and injury from debris, and increasing the risk of injury due to motor vehicle accidents caused by smoke-related low visibility. Furthermore, catastrophic wildfire would have significant but short-term impacts on the environment by spreading smoke and ash to nearby regions, and burning vegetation in the immediate vicinity, which leads to a Health, Safety, and Environmental score of 4 (major).

The potential safety consequences of a changing climate are wide-reaching and include everything from long-term power outages to risks of wildfire, fast-moving floodwaters, and extreme heat. The long-term power outages would have the largest safety consequences on medical baseline customers, who require the use of powered medical devices. However, safety concerns would arise for all impacted customers in the event that the outages spanned a time of harsh weather conditions, including extreme heat or cold.

3.4 Explanation of Other Impact Scores

Based on the selected reasonable worst case risk scenario, SDG&E gave the other residual impact areas each a score for the following reasons:

- **Operational and Reliability:** A score of 5 (extensive) was provided for this impact area based on, in accordance with the scenario, the ongoing potential for large wildfires. During the October 2007 wildfires that burned 13% of San Diego County, estimates were that full electric service restoration to all customers would take as long as 20 days.⁹ According to the 7X7 matrix, a score of 5 is defined as potentially effecting more than 50,000 customers; impacting multiple *critical* locations or customers; or substantial disruption of service for greater than 10 days.
- **Regulatory, Legal, and Compliance:** A score of 4 (major) was provided for this impact area. Climate change is already being discussed by the CPUC for regulatory consideration. In July of 2015, SDG&E executive leadership participated in a climate adaptation en banc hosted by the CPUC and highlighted the efforts of SDG&E in combatting the effects of climate change to build a more resilient system. The CPUC has also offered guidance to the major California utilities in responding to the projected impacts of climate change, urging them to develop inventories of affected assets and to identify and prioritize any vulnerabilities that may arise under a changing climate.
- **Financial:** A score of 5 (extensive) was given for this impact area due to the potential high cost of adaptation programs and the growing need to proactively build resiliency to weather-related hazards. Some of the largest adaptation projects across the country have been referenced, including SDG&E's Fire Risk Mitigation (FiRM) project. The FiRM project is a \$1 billion initiative that replaces older overhead distribution lines in the areas deemed most at-risk for wildfires, with stronger steel poles and additional technologies that will make the system more resilient to harsh weather conditions.¹⁰

The projected severity of climate-related disasters leads to the potential for long-term outages, which can result in increased liability. The widespread impacts possible with climate-related

⁹ http://www.oe.netl.doe.gov/docs/ESF12_SitRep11_CAWildfires_102907_100pm.pdf.

¹⁰ <http://www.sdge.com/key-initiatives/cleveland-national-forest-power-line-replacement-projects>.

events, including wildfire, can also lead to project delays and increased costs for construction and operations to repair or replace damaged infrastructure. In addition, with climate becoming an emerging political topic, increased regulatory consideration and development of stricter climate-related policies will be possible in the years to come.

3.5 Explanation of Frequency Score

Due to its definition as an emerging risk, in determining the scores for this risk, SMEs have reviewed recent climate projections, including the IPCC Fifth Assessment Report¹¹ and the U.S. Global Change Research Program’s National Climate Assessment,¹² to determine that significant climate change impacts will slowly build over the next 10-30 years. For this reason, the frequency score has been listed as a 3 (infrequent).

4 Baseline Risk Mitigation Plan¹³

As stated above, Climate Change Adaptation entails adverse impacts on system planning, system design and emergency operation that may occur due to the changing climate. The 2015 baseline mitigations discussed below include the current evolution of the utilities’ risk management of this risk. The 2015 baseline mitigations include the amount to comply with laws that were in effect at that time.

On June 25, 2013, President Obama announced his Climate Action Plan, which defined goals in cutting greenhouse gas pollution in the United States, preparing the country for impacts due to climate change, and leading international efforts and collaborations to address climate change. In response to this plan, the Department of Energy (DOE) developed the Partnership for Energy Sector Climate Resilience. This initiative brings together utilities from across the country in an effort to build the resilience of energy infrastructure to the rising impacts of weather extremes and climate change, thereby enhancing national energy security. This partnership began in November 2014 with SDG&E in attendance as an initial partner.

After joining the Partnership for Energy Sector Climate Resilience, SDG&E SMEs identified that future changes in climate may have wide-reaching impacts to the Company. Because of this, SDG&E began putting baseline mitigations in place. SDG&E’s 2015 risk mitigation plan consists of two controls: (1) Meteorology Support; and (2) Climate Advisory Group. These controls focus on safety-related impacts¹⁴ (i.e., Health, Safety, and Environment) per guidance provided by the Commission in D.16-08-018¹⁵ as well as controls and mitigations that may address reliability. Accordingly, the controls and mitigations described in Sections 4 and 5 address safety-related impacts primarily. Note that the controls and mitigations in the baseline

¹¹ Available at https://issuu.com/unipcc/docs/syr_ar5_final_full_wcover/1?e=25405816/36622773.

¹² Available at <http://nca2014.globalchange.gov/report>.

¹³ As of 2015, which is the base year for purposes of this Report.

¹⁴ The Baseline and Proposed Risk Mitigation Plans may include mandated, compliance-driven mitigations.

¹⁵ 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.”

and proposed plans are intended to address various events related to Climate Change Adaptation, not just the scenario used for purposes of risk scoring.

1. Meteorology Support

Two SDG&E meteorologists began allocating 10 percent of their time to climate-related activities to better understand the regional impacts of climate change. Activities included performing literature reviews of climate science, supporting the Company's Enterprise Risk Management efforts, and joining in collaborations with the San Diego Foundation and the San Diego Regional Climate Collaborative to identify the steps other local entities were taking in response to climate change. Examples of literature review sources include the Department of Energy, Scripps Institution of Oceanography, and other federal and local studies. SDG&E also began efforts in 2015 to publish a Vulnerability Report designed for use by the Company to outline the projected climate-related impacts across Southern California, and to identify potential risks to the Company and its infrastructure. The SDG&E Vulnerability Report was submitted to the Department of Energy as a first deliverable in the Partnership for Energy Sector Climate Resilience. That partnership is an initiative that brings together utilities from across the country in an effort to build the resilience of energy infrastructure to the rising impacts of weather extremes and climate change.

Additionally, SDG&E applied for and was awarded a California Energy Commission grant in November 2015 to investigate vulnerabilities to the Company's electric infrastructure due to sea level rise and coastal flooding, as well as vulnerabilities to the Company's gas infrastructure due to all climate-related hazards.

2. Climate Advisory Group

In May 2015, SDG&E developed a climate advisory group with representatives from 13 departments. Through semi-annual group meetings and one-on-one communication, these department representatives have worked with SDG&E's meteorologists to identify vulnerabilities to the electric and gas systems due to the projected changes in climate. Their input was combined with a literature review of projected climate change impacts to Southern California, and was provided to the DOE as the first deliverable of the Partnership for Energy Sector Climate Resilience in February 2016.

Due to the cross-cutting nature of this risk, SDG&E has identified vulnerabilities, addressed in other RAMP chapters, that have a climate change adaptation component. Such risks and vulnerabilities are listed in Table 3 below. These efforts were not included in this chapter because SDG&E largely performs mitigation activities for reasons beyond climate change. For example, SDG&E implemented FiRM to decrease the likelihood of a wildfire, not solely to mitigate climate change. SDG&E SMEs will continue to work with climate scientists to integrate the latest science, and refine climate projections in the future. Please note that only the risks and vulnerabilities included in SDG&E's RAMP Report are being provided below. Those risks not included did not have a Health, Safety, and Environmental score that met the Company's criteria for inclusion in RAMP.

Table 3: Vulnerabilities to Other RAMP Chapters

RAMP Chapter	Potential Climate Drivers	Potential Impacts
Wildfires Caused by SDG&E Equipment	<ul style="list-style-type: none"> • Increased fire risk to coastal canyons/wildland interfaces • Increasing frequency of drought resulting in longer wildfire seasons 	<ul style="list-style-type: none"> • Potential for damaged/destroyed wooden poles • Increased number of planned work cancellations due to high fire concerns • Potential for distribution impacts of household electricity and gas • Potential for impacts to job scheduling due to extreme fire potential in the spring
Electric Infrastructure Integrity	<ul style="list-style-type: none"> • Increased fire risk to coastal canyons/wildland interfaces • Changes in rainfall patterns, including higher intensity rainfall events and increased frequency of drought • Rising sea levels and storm surge • Increases in temperatures 	<ul style="list-style-type: none"> • Potential for damaged/destroyed wooden poles • Potential for distribution impacts of household electricity and gas • Increased susceptibility of flooding of low-lying substations and underground infrastructure • Delays in repairs and maintenance as a result of inaccessibility due to flooding • Increases in extreme heat waves, average temperatures, and overnight temperatures may result in stresses and a decrease of the useful life of current infrastructure
Catastrophic Damage Involving Medium-Pressure Pipeline Failure	<ul style="list-style-type: none"> • Increased susceptibility to drought • Changes in rainfall patterns • Increase in wildfire risk to coastal canyons/wildland interfaces 	<ul style="list-style-type: none"> • Potential decreased effectiveness of cathodic protection on pipelines due to dry soil • Mudslide and landslide prone areas may become more at-risk
Catastrophic Damage Involving High-Pressure Pipeline Failure	<ul style="list-style-type: none"> • Increased susceptibility to drought • Changes in rainfall patterns • Increase in wildfire risk to coastal canyons/wildland 	<ul style="list-style-type: none"> • Potential decreased effectiveness of cathodic protection on pipelines due to dry soil • Mudslide and landslide prone areas may become more at-risk

	interfaces	
Employee, Contractor, and Public Safety	<ul style="list-style-type: none"> • Increase in fire risk region-wide, including coastal canyons/wildland interfaces • Increases in temperature and significant heat waves 	<ul style="list-style-type: none"> • Potential for wildfires to result in air quality issues due to smoke, evacuations, etc. • Health issues due to heat

5 Proposed Risk Mitigation Plan

The 2015 baseline mitigations outlined in Section 4 will continue to be performed in the proposed plan to, in most cases, maintain the current residual risk level. In addition, two new mitigations, Consultant Support and University Team, are being proposed. These incremental changes, along with updates about other controls are described in below. It should also be noted that some of the programs and projects proposed in the SoCalGas Climate Change Adaptation RAMP chapter extend to the gas infrastructure in the SDG&E territory. For these activities, please refer to the SoCalGas Climate Change Adaptation RAMP chapter.

1. Meteorology Support

SDG&E will continue to do this baseline activity during the 2017-2019 timeframe. Two meteorologists will dedicate time to researching and educating internal departments on how climate change will impact the electric and gas systems of SDG&E.

2. Climate Advisory Group

SDG&E will maintain this baseline activity in the proposed plan and continue to hold its climate advisory group.

3. Consultant Support

SDG&E proposes to use consultants to develop an in-depth review of climate change impacts and affected gas and electric assets. Similar future studies will be needed as climate science evolves. This initial review would likely take place over 2-3 years, though it would need to be revisited in future years as climate science evolves. The results would provide SDG&E risk managers with detailed asset-based risk assessments and potential mitigation strategies. Until the review is complete, SDG&E does not know at this time what actions or projects it may initiate given the results.

4. University Team

To further mitigate this risk, SDG&E proposes to partner with a university team of experts to update SDG&E's projected impacts of climate change. This partnership would consist of graduate-level teams researching the potential impacts of climate change on SDG&E infrastructure. The scope and length of time required to produce the final product could result in a cost closer to the low end of the range. In contrast, variables such as a premium added (because of the name recognition and distinguished personnel associated with the study) could support costs closer to the high end of the range.

6 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 Climate Change Adaptation. 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 Table 4 were estimated using assumptions provided by SMEs and available accounting data.

**Table 4: Baseline Risk Mitigation Plan¹⁶
(Direct 2015 \$000)¹⁷**

ID	Control	Risk Drivers Addressed	Capital¹⁸	O&M	Control Total¹⁹	GRC Total²⁰
1	Meteorology Support	Addressed/identified potential risks posed to the electric system by climate change	n/a	\$20	\$20	\$20
2	Climate Advisory Group	Addressed/identified potential risks posed to the electric system by climate change	Costs associated with this activity are captured in Meteorology Support			
	TOTAL COST		n/a	\$20	\$20	\$20

* Includes one or more mandated activities

¹⁶ Recorded costs were rounded to the nearest \$10,000.

¹⁷ 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.

¹⁸ 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.

¹⁹ 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).

²⁰ The GRC Total column shows costs typically presented in a GRC.

Table 5: Proposed Risk Mitigation Plan²¹
(Direct 2015 \$000)

ID	Mitigation	Risk Drivers Addressed	2017-2019 Capital ²²	2019 O&M	Mitigation Total ²³	GRC Total ²⁴
1	Meteorology Support	Address/identify potential risks posed to the electric system by climate change	n/a	\$20 - 30	\$20 - 30	\$20 - 30
2	Climate Advisory Group	Addressed/identified potential risks posed to the electric system by climate change	Costs associated with this activity are captured in Meteorology Support			
3	Consultant Support	Organizing the training of different working groups around SDG&E impacted by climate change	n/a	120 - 180	120 - 180	120 - 180
4	University Team	Investigating the latest science to inform system planning decisions	n/a	230 - 300	230 - 300	230 - 300

²¹ Ranges of costs were rounded to the nearest \$10,000.

²² 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.

²³ The Mitigation Total column includes GRC items as well as any applicable non-GRC items.

²⁴ The GRC Total column shows costs typically represented in a GRC.

	TOTAL COST		\$0	\$370 - 510	\$370 - 510	\$370 - 510
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<input type="checkbox"/>	Status quo is maintained
<input type="checkbox"/>	Expanded or new activity
*	Includes one or more mandated activities

1. Meteorology Support

The 2019 O&M costs associated with this activity were determined by analyzing the amounts recorded in 2015. Because SDG&E does not anticipate changes to this activity, the base year was utilized as the forecast methodology. A range was developed to account for the fact that climate change is an emerging issue for which SDG&E may need to staff additional personnel or dedicate additional time in the future.

2. Climate Advisory Group

The costs associated with this activity are labor-related and are, therefore, captured in the Meteorology Support mitigation.

3. Consultant Support

The costs associated with obtaining a consultant were estimated using a zero-based forecast methodology to be between \$120,000-180,000. This range was determined using a cost estimate of \$10,000-15,000 per month based on similar consulting projects from past years.

4. University Team

SDG&E's involvement in this academic climate change study is estimated to be about \$225,000-\$300,000, using a zero-based forecast methodology. In SDG&E's experience with collaborating with universities and other academic institutions, the costs could vary. The current estimate is based on the need for one full-time doctoral student, one professor, and one part-time undergraduate or master's level graduate student.

7 Risk Spend Efficiency

The risk spend efficiency is a new tool that was developed to attempt to quantify how the proposed mitigations will incrementally reduce risk. A risk spend efficiency analysis was not performed for the Climate Change Adaptation risk because there is no linkage to adaptive or corrective actions which would have any measurable effect on the probability of their predicted safety consequences. Climate drivers are not "events" to be mitigated; however, they can reveal drivers of potential events or vulnerabilities. These climate change-related vulnerabilities identified in other RAMP chapters are discussed in Section 4. Risk spend efficiency calculations have been performed on the other RAMP risks that are vulnerable to the threats brought about by climate change and are analyzed in those risks, rather than in this chapter.

8 Alternatives Analysis

SDG&E considered alternatives to the proposed mitigations as it developed the proposed mitigation plan for the Climate Change Adaptation risk. Typically, alternatives analysis occurs when implementing activities, and with vendor selection in particular, 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.

8.1 Alternative 1 – Additional Resources

SDG&E considered hiring a climatologist, rather than working through SMEs, to perform the desired climate change research discussed in the proposed plan. SDG&E is interested in leveraging this additional expertise in the near future to conduct its initial climate change-related studies. However, at this time, there is not a long-term need for an additional resource. Accordingly, this alternative was dismissed due to the short-term nature of the resource need and the financial constraints that are coupled with hiring additional personnel.

8.2 Alternative 2 – Continue Current Efforts

SDG&E also considered continuing its current mitigation efforts without expanding to include the new mitigation activities (i.e., more research and studies). This alternative was dismissed in favor of the proposed plan because climate change is a dynamic issue that can have a potential safety impact. Preparing SDG&E for climate change, which in turn helps to keep customers and the public safe, is of the utmost importance and has significant value. Maintaining the status quo does not achieve the same level of risk reduction and awareness as the proposed plan.