Risk and Safety Aspects of

Risk Assessment and Mitigation Phase Report of San Diego Gas & Electric Company and Southern California Gas Company

Investigation 16-10-015 and I. 16-10-016

Arthur O'Donnell
Fred Hanes, P.E.
Martin Kurtovich, P.E.
Edwin A. Charkowicz, CPA

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EXECUTIVE SUMMARY

The San Diego Gas & Electric Company and Southern California Gas Company (aka Sempra Utilities) Risk Assessment and Mitigation Phase (RAMP) filing is the first of its kind. As such, this RAMP report is not a definitive evaluation of the utilities' filing, but may provide an example from which to learn and improve upon for subsequent RAMPs.

The framework and expectations for RAMP filings were established by decisions in the Risk-Informed Decision Making for General Rate Cases Rulemaking (D.14-12-025 in R.13-11-006) and in the subsequent Safety Model Assessment Proceeding (S-MAP) (D.16-08-018 in A.15-05-002, et al.). In these decisions, the Commission directed the Safety & Enforcement Division staff to provide an evaluation of the utilities' RAMP filings, to assess how utilities were identifying operational safety risks and applying risk management and mitigations to those risks, and to provide recommendations that can be incorporated in the subsequent GRCs.

SED's evaluation takes into account the completeness of the utilities' proposal and report including consistency and compliance with criteria established in D.16-08-018 and the Scoping Memo issued for this investigation (I.16-10-015/016):

- Whether or not key safety risks have been assessed;
- Whether or not alternatives have been fully considered and adequately discussed;
- Whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed wildfire mitigation spending have been adequately analyzed and discussed;
- Whether or not there are gaps in identifying risks and mitigation options; and,
- The efficiency of risk mitigation funding, proposed spending, and the amount or level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle.

In addition, the Commission in D.16-08-018 included as necessary elements of the utilities' RAMP filings "a description of safety culture, executive engagement and compensation," and a directive that should the utility identify "immediate" safety situations, they should be addressed in proceedings separate from the GRC.

SED is encouraged by the effort that the Sempra Utilities have put into this RAMP filing to follow the Commission's guidance and provide parties to the GRC with a better understanding of how risks are identified, prioritized and evaluated. Although some gaps remain, SED recognizes that this is an evolving process.

Staff's main job is to assess how well the utilities have described their approach and outcomes, not to make a determination of whether projected funding for mitigations is reasonable. Criticisms and recommendations made in this report should be taken in that context. Budgets and cost projections in the utilities' RAMP, as used in this report, are at best estimates, and will be refined based on the outcome of this RAMP and thorough vetting in the GRC.

In all, the utilities presented 28 risks that were considered significant, using the agreed upon cut-off for risks that scored 4 or above in terms of potential safety consequence. Staff agrees that this approach presented a manageable level of risk analysis for a first-time RAMP, although the Commission may decide upon a different threshold for inclusion in the future. Also, the methodology for evaluating the severity and probability of risks may change as a result of more experience and determinations made in the S-MAP.

The 28 risks outlined in this RAMP had risk scores that ranged from a high score of 2,551,888 for SDG&E Wildfires to a low score of 255 for SDG&E Workforce Planning. Each of the 28 risks are examined in their own chapters in the RAMP filing, unless there was significant overlap in the risk and risk mitigations shared by the companies. In those instances the risks were combined into a single chapter.

This report has not tried to exhaustively analyze each of the risks identified by the utilities. Instead, staff offers a Summary of the risk chapters in light of their apparent Strengths, Areas in Need of Improvement, and a Conclusion. Staff also selected a subset of risk chapters for a "deeper dive" into specifics of the utilities' descriptions and how they attempt to meet the criteria established by the Commission.

The following chapters were chosen for closer analysis:

- SCG-1 and SDG&E-2 (Combined) Catastrophic Damage Involving Third-Party Dig-Ins
- SCG-2 Employee, Contractor, Customer, and Public Safety
- SCG-3 and SDG&E-7 (Combined) Cyber Security
- SCG-4 and SDG&E-10 (Combined) Failure of a High Pressure Pipeline
- SDG&E-1 Wildfire Risk Mitigation

Staff may also offer observations and some questions, concerns and recommendations to enhance clarity. It is hoped that this will provide both the utility and intervenors with a road map for understanding how this RAMP was developed and major issues that require further development or closer examination in the testimony and hearings process for forthcoming GRCs.

Because of time constraints and the lack of a Commission approved standard for evaluation, this report does not specifically analyze the "safety culture" aspects of the utilities' presentations. This may be an area that is better explored in a workshop setting, or in testimony in the future GRCs. The utilities have not identified any immediate critical safety situations.

In addition, because the utilities are not purporting to have a fully mature system, staff will not attempt to critique how closely their model follows the Cycla 10-step model, which has been adopted as a benchmark for utility risk model maturity in the S-MAP.

Staff also notes its appreciation for the Sempra Utilities' responsiveness to our requests for additional information. Additionally, the California Council of Utility Employees (CUE) rates special appreciation for its discovery requests, which resulted in information that allows a more granular understanding of the estimated budgeting for risk mitigations and the calculations of risk-spend efficiency (RSE) that the utilities employ in this filing. A primary recommendation is that all utilities provide similar information in workpapers as part of their RAMP filings in the future. This will prove immeasurably valuable to both the CPUC and to participants in the rate case proceedings.

Rather than putting the line items and spending for each of the identified risks in each chapter, please refer to the spreadsheet table of the utilities' 2015 actual spending for Controls (existing mitigations) compared to the forecast Capital Expenses and O&M in Appendix A: SUMMARY TOTALS FOR ALL MITIGATION PROJECTS/PROGRAMS IN THE RAMP FILING, at the end of this document.

Overall Assessment

For the majority of the risks drivers identified, the utilities offered a complete – if sometimes cursory and occasionally redundant – narrative describing their various risks, and included the required elements of the RAMP. In general, they provided clear descriptions of the risk scenarios and the proposed mitigation measures, and they provided a reasonable basis for

understanding the intent of the mitigations and how they might be able to reduce the impact or frequency of the incidents.

Yet for several mitigations, there needs to be more effort in showing the correlation between the risk and the mitigations proposed.

Possibly the greatest shortcomings of the RAMP filing are in the lack of clearly defined mitigation alternatives, and the lack of risk-reduction analysis and RSE calculations for these alternatives when included. While staff points out concerns about some of the analyses provided by the utilities in describing their risk strategies and potential mitigation plans, the focus of this report is to provide guidance to the utilities as to how they might bolster their information and justifications for their proposed spending plans.

The concept of Risk-Spend Efficiency (RSE) has not been completely developed in the S-MAP proceeding, and the Sempra Utilities' RAMP represents the first attempt to quantify and RSE for identified risks as a way of measuring the impacts of mitigations. Because of the novelty of the approach, staff feels it is something that needs to be further reviewed and refined. Or, given the attempts in S-MAP to provide a more quantifiable methodology, perhaps it will be supplanted by some other process.

In any event, SED appreciates the utilities efforts to develop and illustrate the RSE process, and has asked that the utilities devote further explanation of how it works in this filing as part of the workshop. That will give parties more opportunity to ask questions and offer observations.

In addition, the utilities in the future need to do a better job clarifying and ranking the risk mitigations that are measured by the RSE and at the same time do a better job identifying metrics which correlate with the performance of the respective risk mitigation. This will help ensure that the utilities meet a specified goal that RAMP filings include "calculations of risk reductions and a ranking of mitigations based on risk reduction per dollar spent," as articulated in D.16-08-018, Ordering Paragraph 30.

This is admittedly an evolving area.

The following should be considered for improvement in the GRC presentation and workpapers:

- In the RSE, use plausible comparisons that connect causal relationships to information provided for making a sound decision on whether the increase in spending would be reasonable and the incident rate reductions possible.
- More thoroughly outline plans for enhancing existing mitigations, and provide more information to sufficiently describe how enhancements differ and improve baseline (Control) activities with an estimate of risk reduction.
- Improve the correlation of the RSE to the baseline risks and the proposed risk mitigations in order for the RSE to be used as intended.
- Address the requirement to provide an RSE for the alternative mitigation programs, and work on presenting reasonable and viable alternatives and provide sufficient explanation of alternatives and their potential for risk reduction.

In addition, based on the RAMP filing, staff is currently unable to completely assess one aspect of the RAMP that was specifically called for in the Scoping Memo: Whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed Wildfire mitigation spending have been adequately analyzed and discussed. This area might benefit from further exploration in a workshop.

In several chapters, this report references a concept called "dynamic segmentation" as a possibly useful tool for improving the risk analysis, especially for gas pipelines. A dynamic segmentation analysis[1] which objectively assigns probability of failure and cost of failure, to each risk would provide more deterministic data for decision making. As part of the initial workshop, staff will further describe this approach for discussion.

Staff recognizes that this RAMP filing is the first of its kind and that it has been difficult to quantify risk reductions in a manner that will fully support RSE calculations. Staff commends Sempra utilities, as well as the other utilities, for their efforts to gather the data necessary to make more quantitative predictions of risk reduction in future filings, as an ongoing aspect of the S-MAP proceedings.

[1] Pipeline Risk Assessment: The Definitive Approach and Its Role in Risk Management. 2015. W. Kent Muhlbauer, author.

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1 INTRODUCTION AND BACKGROUND

The combined San Diego Gas & Electric Company and Southern California Gas Company (aka Sempra Utilities) Risk Assessment and Mitigation Phase (RAMP) filing is the first of its kind. As such, this RAMP report is not a definitive evaluation of the utilities' filing, but may provide an example from which to learn and improve upon for subsequent RAMPs.

This staff report is being issued in accordance with the procedures adopted in prior rulemakings and application proceedings. On November 14, 2013, the Commission issued an *Order Instituting* Rulemaking *to Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the Rate Case Plan for Energy Utilities (the Risk OIR).*[2] The purpose of this rulemaking was to incorporate a risk-based decision-making framework into the Rate Case Plan (RCP) for the energy utilities' General Rate Cases (GRCs).[3] Such a framework and associated parameters would assist the utilities, parties, and the Commission in evaluating how energy utilities assess safety risks, and how they will manage, mitigate, and minimize such risks.

On December 9, 2014, the Commission issued D.14-12-025 to modify the rate case plan to incorporate a risk-based decision-making framework into the GRCs for the large energy utilities.[4] While each of the respondent utilities have begun incorporating elements of the new framework into the respective GRCs, the current application represents the first GRC to fully fall under the purview of D.14-12-025 and its requirement for a RAMP. The purpose of the RAMP, as described in the order, is to "provide a transparent process to ensure that the energy utilities are placing safety of the public, and of their employees,, as a top priority in the GRC proceedings."[5]

[2] Rulemaking (R.) 13-11-006
[3] In addition, this would apply to PG&E's Gas Transmission and Storage (GT&S) rate cases.
[4] D.14-12-025, Ordering Paragraph 3.
[5] D.14-12-025 at 35-36.

On August 18, 2016, in D.16-08-018 the interim decision in the ongoing Safety Model Assessment Proceeding (S-MAP)[6] adopted guidelines for what the RAMP submissions should include, as well as a basic evaluation checklist for RAMP submissions. A key element of the risk assessment models is conformance with the 10-step criteria developed by Cycla Corporation during PG&E's Test Year 2014 GRC as the tool to be used for evaluating the maturity, robustness, and thoroughness of a utility's risk-based methodology in GRCs.[7]

Among the directives of the decision that apply to this RAMP:

- The SDG&E and SoCalGas companies are directed to remove shareholders' financial interests from consideration in their risk models and decision frameworks used to support rate case expenditure proposals, especially at the operational level, unless the utility can make a good case for an exception in its RAMP filing.
- A modified RAMP procedure is adopted, and an OII shall be initiated following the request of each of the large utilities for their respective upcoming General Rate Cases.
- RAMP filings by SDG&E and SoCalGas shall explicitly include calculation of risk reduction and a ranking of mitigations based on risk reduction per dollar spent.
- Because the Sempra utilities (SDG&E and SoCalGas) have limited time to file a RAMP, SDG&E and SoCalGas shall file a RAMP based on its current risk evaluation and risk-based decision making methodologies, and additional requirements as listed in the ten major components that shall be included in the RAMP filings.

In addition, the Commission in D.16-08-018 included as necessary elements of the utilities' RAMP filings "a description of safety culture, executive engagement and compensation," and a directive that should the utility identify "immediate" safety situations, they should be addressed in proceedings separate from the GRC.

On September 1, 2016, SDG&E) and SoCalGas requested an investigation to evaluate their respective RAMP filings. On October 27, 2016, the Commission issued an Order Instituting Investigations,[8] and these two OIIs were consolidated on November 17, 2016, pursuant to a ruling from the assigned Administrative Law Judge (ALJ). On November 30, 2016, SDG&E and SoCalGas filed their consolidated RAMP report.

[6] A.15-05-002, et al.
[7] D.16-08-018, Ordering Paragraph 4.
[8] I.16-10-015 and I.16-10-016

The Commission directed the Safety and Enforcement Division (SED) to evaluate the RAMP submission for consistency and compliance to their respective risk models and to prepare a report. The Assigned Commissioner's scoping memo and ruling for OII 16-10-015/016 issued on January 11, 2017, set out the issues to be addressed in the consolidated proceeding related to the SED report are as follows:[9]

1. The completeness of the utilities' proposal and report including consistency and compliance with the S-MAP and D.16-08-018;
    a. Whether or not key safety risks have been assessed;
    b. Whether or not alternatives have been fully considered and adequately discussed;
    c. Whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed wildfire mitigation spending have been adequately analyzed and discussed;
2. Whether or not there are gaps in identifying risks and mitigation options;
3. The efficiency of risk mitigation funding, proposed spending, and the amount or level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle;

The Scoping Memo also provided for a workshop to address SED's report and to give parties an opportunity to propose or recommend whether additional workshops are necessary. While there is no expectation for hearings or a decision/ruling to adopt the SED report, the utilities are expected to use the evaluation to refine their GRC filings, which are due in September 2017.

[9] OII 16-10-015/016 ASSIGNED COMMISSIONER'S SCOPING MEMORANDUM AND RULING, pg.3, http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M171/K806/171806762.PDF

2 OVERVIEW OF SEMPRA'S RISK ASSESSMENT AND MITIGATION PHASE APPROACH

The Sempra Utilities combined their efforts to prepare the RAMP report. The companies also coordinated with Commission staff in the Safety & Enforcement Division and Energy Division to develop an acceptable process for completing the RAMP filing.

The utilities developed a 6-step approach for the RAMP that correlates with the Cycla 10-step approach. The approach starts with each company determining the safety risks that should be included in the filing, based on a 7x7 risk scoring matrix (based on a variation of the common formula that Risk = Consequence x Likelihood). Risks that rated a 4 or above on the Consequence component of the risk formula for Health, Safety and Environment attributes were included in the RAMP filing without respect to the total risk score. The 28 risks outlined in this RAMP had scores that ranged from a high score of 2,551,888 for SDG&E Wildfires to a low score of 255 for SDG&E Workforce Planning.

The companies took a structured approach to RAMP filing by including five chapters that outlined the overall framework and the reasons that certain methods were used for their report.

1. Chapter-A: Overview and Approach is the chapter that explains the nature, purpose and approach taken. This chapter explains the how they: a) identified the risk to be included in the RAMP, b) identified the controls and mitigations, c) determined the 2015 baseline figures and forecast 2017-2019 ranges for capex and Operations and Maintenance (O&M), d) calculated the Risk Spend Efficiency (RSE), and e) approached formulating the risk mitigation plan.
2. Chapter-B: Risk Management Framework outlines the risk taxonomy developed in the Safety Model Assessment Proceeding (S-MAP) and how the consequence frequency category scores are determined and generate a risk score.
3. Chapter-C: Safety Culture provides an overview of safety culture, organization and compensation and their importance to safety within the Companies. The safety organization structure and a self-assessment of their safety culture was provided. Management engagement was emphasized and lastly the impact safety performance has on compensation.

4. Chapter-D: Quantitative Risk Analysis/Probabilistic Modeling. This chapter talked about the long-term plan for eventually attaining a risk assessment paradigm which employs data driven analysis and probabilistic risk assessment. The companies stressed that they are not there yet.
5. Chapter-E: Data Collection. Discussed the state of the company's current efforts and planned efforts to utilize data in its progress toward a data driven risk assessment paradigm.
6. Chapter-F: Lessons Learned. As requested by the Commission, the companies provided a short compendium of lessons learned as a potential guide for other utilities and to build upon for iterative improvement to the RAMP process.

The 28 risks are examined in their own chapters unless there is significant overlap in the risk and risk mitigations shared by the companies, where the company risks were combined into a single chapter. Each chapter provides summary and background risk information, risk classification (drivers, consequences, scenario, and assessment), explanation of Health, Safety, and Environmental (HSE) and other impact, and frequency scores, baseline and proposed risk mitigation plans, explanation of risk spend efficiency (RSE) with estimate of risk reduction, and alternatives analysis.

The companies outlined how they quantified the relative risk reduction from the existing mitigation activities, the proposed incremental and new mitigation activities and the alternative risk mitigation activities that were contemplated but rejected. The companies variously acquired third-party data, internal historical data, and called on subject matter experts (SMEs) for their input.

For the most part, the companies relied on subject matter experts (SMEs) to determine the relative impact on risk reduction from proposed mitigation activities. This process does not allow for great transparency into assumptions or estimates, which somewhat impairs an assessment of their credibility. From the risk reduction estimates were applied to initial risk scores that were used to calculate the risk-spend efficiency (RSE).

Staff found that the utilities' more detailed calculation of RSE in workpapers provided in response the Coalition of Utility Employee's (CUE) data request were especially helpful in shedding light on how the companies utilized the inputs to achieve a particular RSE.

Next, the historical spending for the 2015 base year is used as the baseline for existing mitigation activities for both operational and maintenance (O&M) and capital expenditures (Capex). The test year of 2019 spending used for the proposed mitigation activities is based on the average of the 2017-2019 O&M forecast high and low estimates, and the 2017-2019 Capex forecast high and low estimates.[10]

To determine the relative risk reduction value for the mitigation activities within each risk the RSE is calculated. A simplified explanation of the RSE calculation follows below. The utilities' explained that at this beginning phase of RSE development they were not able to normalize the risk scores across all risks such that in this RAMP filing the RSE scores cannot be used to compare across other risks. The utilities are trying to develop the RSE to a point that it can be used to evaluate the relative risk reduction value within the chapter risk to evaluate their risk mitigation choices.

2.1 CALCULATING RISK SPEND EFFICIENCY

The concept of Risk-Spend Efficiency (RSE) has not been completely developed in the S-MAP proceeding, and the Sempra Utilities' RAMP represents the first attempt to quantify and RSE for identified risks as a way of measuring the impacts of mitigations. Because of the novelty of the approach, staff feels it is something that needs to be further reviewed and refined. Or, given the attempts in S-MAP to provide a more quantifiable methodology, perhaps it will be supplanted by some other process.

In any event, SED appreciates the utilities efforts to develop and illustrate the RSE process, and has asked that the utilities devote further explanation of how it works in this filing as part of the workshop. That will give parties more opportunity to ask questions and offer observations.

In order to calculate the RSE, a change in risk must take place, the normal expectation is for a risk reduction, either through reduction in the likelihood, probability or frequency of some adverse event, or a reduction to the expected consequence.

[10] The baseline Capex is only for 2015 spending, whereas the forecasts for GRC spending ranges is the average of the high and low estimates for all three years of forecast Capex spending (e.g. Sum: 2017-high and low plus 2018-High and low plus 2019-high and low divided by 6 equals the average annual capex for RSE purposes.) The same method of averaging was used for forecast O&M.

However, as was noted throughout the RAMP often a case was made that if the current risk mitigation activities (Controls) ceased or were held constant the risks could increase.

In this RAMP virtually all the RSE's were based on a change in frequency of drivers or incidents that changed the risk score. Since most of the risks were framed as a reasonable worst case scenario, it is difficult to measure a reduction in consequence.

As noted by Sempra in Chapter "A" of the RAMP, the level of maturity for this RAMP has not reached the level where most risks can be evaluated using objective data and probabilistic methods. Sempra and this RAMP rely extensively on Subject Matter Experts (SME) to determine the level of impact that a given mitigation activity will have on reducing the frequency of risk drivers and incidents.

Throughout the RAMP chapters, the input of the SME's are reflected in the initial risk scores and the evaluation of impact of risk mitigation activities. In several instances in the RAMP chapters, staff noted the use of objective data to support the RSE calculation, but it was not always clearly explained or justified well enough to provide the confidence in the resulting RSE score. Ultimately, the RSE score is a product of SME inputs.

The RSE risk reduction estimation process is explained in detail in Chapter A, and again in each chapter as a reminder to the reader In brief here are the steps outlined in the RAMP:

- Grouping of proposed mitigations for analysis. Due to the lack of discrete performance metrics applicable to each mitigation activity, mitigations are grouped in one of three ways so that a macro metric may be used for estimating the impact of mitigation on metric frequency. The grouping of mitigations is based on best fit to risk mitigation plan, based on their relationship to the current controls, drivers, consequences, and/or dependencies or whether the risk activities are closely related.
- Determine and designate whether the risk mitigation activity is incremental, new or current control mitigation.
- Determine the best methodology to quantify the mitigation impact. This is particularly relevant because this is where the risk managers and SMEs use their input to shape the RSE score. This step focuses on identifying what data to use for measuring risk reduction that could be a combination of various sourced data, including objective incident rate data, relevant peer data, industry data, or counterfactual situational data depending on the availability and quality of inputs. Additionally, the data may be supplemented by the knowledge and experience of the

SME's as well as their consideration of the situational factors that frame the risk, the counterfactual assumptions and the data from outside the company that will be used.

- Calculate the risk reduction based on the estimate in the change in risk score. Sempra used the following formulaic method to provide a framework for each risk manager to calculate RSE values. This is the formula:

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

- For current controls the estimated change in risk score was based on the premise that an increased risk score would result if the current control was removed. The calculation based on degradation of mitigation results in a decrease in RSE. The inverse of this decrease in RSE score is meant to be a proxy for the RSE of the status quo mitigations.
- For incremental mitigations, a Potential Risk Score was calculated that represents the new risk score as if the incremental mitigation is put into place and the assumed risk reduction based on SME input was achieved. The risk reduction is the difference between the initial residual risk score and calculated Potential Risk Score. The change in risk score is then attributable to each mitigation activity in the group.

Factors that drive the RSE and which raised questions during the chapter reviews include:

- The estimate of risk reduction - If a proposed mitigation activity is estimated to have a 25% reduction in incident rate, that could have a significant impact on the RSE. It is important for the SMEs to provide their rationale for the expected rate of change in the incident rate by the proposed mitigation. When a counterfactual is used to determine the value of current mitigations, a causal link with the end state needs to be explained otherwise over or under stating the impact could skew the RSE value.
- The number of years of expected risk reduction - This is a key variable that often was not fully explained in the workpapers or the Chapter. Simply going from a 5-year duration to a 7-year duration impacts the RSE by 40%. Some examples of mitigation duration are:
    - The depreciable life of the asset.
    - The duration of implementation of the project.
    - The expected life of the program.
    - An arbitrary number given by the SME.
    - The three year term of the GRC.

- The total mitigation costs - Because there was a range of projected O&M and Capex costs the denominator becomes very important in determining the RSE value. The information supporting the range of anticipated spending is necessary and often not fully explained in the documentation. When the span of the range is small there is less potential variation in the RSE score. In some cases when there was a large mitigation cost the life of the asset was used

After review of the way the RSE methodology was employed in a discrete manner in each chapter, staff agrees with Sempra that in this RAMP it would be inappropriate to compare the RSEs across chapters for risk mitigation spending efficiency across chapters.

The unique choices and context used in each chapter to select the estimate in risk reduction, duration of expected risk reduction and subjectivity of proposed spending render the RSE relevant only to its respective chapter.

Lastly, these elements are brought together to describe the risks, consequences, controls, baseline, proposed, and alternate mitigations, costs of baseline and forecast mitigation activities and the outline and explanation of risk reduction using the RSE.

Because this RAMP filing is the first attempt at using these concepts, the underlying data and statistics are not always fully developed or available. Because of the lack of quantified data, what may seem reasonable for a first attempt may in the future be supplanted by methods that provide better estimates of risk reduction attributed to proposed mitigations. The RAMP initiative is considered an iterative process in which each successive filing provides learning and feedback in order to drive incremental improvements.

2.2 SEMPRA UTILITIES' RISK ASSESSMENT AND MITIGATION FRAMEWORK

According to information provided by the utilities in the S-MAP proceeding, Sempra Utilities' Enterprise Risk Management (ERM) framework was derived primarily from the International Organization for Standardization (ISO) 31000 and, to a lesser extent, the Committee of Sponsoring Organizations of the Treadway Commission (COSO): 2004 Enterprise Risk Management.

As the utilities began to develop their risk model and risk calculation framework in 2014, their approach to risk-based decision-making is still evolving and most steps in the framework have yet to be implemented. In the current GRC, the focus was on the first two steps of risk identification and risk evaluation. Because the utilities are not purporting to have a fully mature system, staff will not attempt to critique how closely their model follows the Cycla 10-step model, which is a task better left for the S-MAP proceeding.

SEMPRA uses a "Bowtie diagram" to map the progression of multiple risk drivers to eventual multiple impacts.

Figure 1 Sempra's Risk Bow-Tie Diagram

Since there could be multiple outcomes for a risk event, the utility calculates a risk score across five impact dimensions (health/safety, reliability, environmental, compliance, financial) for each outcome without applying any weights across the impact dimensions. The total risk score for the risk event is calculated as the simple, non-weighted sum for all the different outcomes resulting from that failure event. Since the risk contribution from all five impact dimensions is summed without applying weights, each of the five impact dimensions is effectively given equal weight.

Rather than repeating the Sempra Utilities' description here, staff will refer parties to the relevant chapters of the RAMP, which do a more complete job of describing the approach used. More important for this evaluation is the assessment of individual risks, their drivers and how the utilities are proposing to reduce those risks via mitigation programs.

3 SEMPRA'S TWENTY EIGHT SAFETY RISKS

In the sections below, each RAMP risk chapter is summarized and, in a few cases, a more detailed review of the specifics is provided. The purpose is to provide feedback to SoCalGas and SDG&E on chapter Strengths, Areas in Need of Improvement and a Conclusion on whether the chapter met the RAMP reporting requirements.

In general, each chapter was reviewed to determine whether:

- The chapter described the risk, and explained each in terms of its potential consequence.
- SDG&E and SoCalGas explicitly included calculation of risk reduction and a ranking of mitigations based on risk reduction per dollar spent.
- The utilities' proposal was complete and reported:
    a. Whether or not key safety risks have been reasonably assessed;
    b. Whether or not alternatives have been fully considered and adequately discussed;
    c. Whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed wildfire mitigation spending have been adequately analyzed and discussed;
    d. Whether or not there are gaps in identifying risks and mitigation options;
    e. The process and reasonableness of the calculated efficiency of risk mitigation funding, proposed spending, and the amount or level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle;

In the following chapter reviews there were a few that were chosen for a more detailed commentary to provide a greater level of feedback to the respective companies. The feedback should be considered across the board for all the safety risk chapters in preparation of their GRC.

The following chapters that were chosen for a closer analysis:

- SCG-1 and SDG&E-2 (Combined) Catastrophic Damage Involving Third-Party Dig-Ins
- SCG-2 Employee, Contractor, Customer, and Public Safety
- SCG-3 and SDG&E-7 (Combined) Cyber Security
- SCG-4 and SDG&E-10 (Combined) Failure of a High Pressure Pipeline
- SDG&E-1 Wildfire Risk Mitigation

3.1 SEMPRA'S TOP RISKS SUMMARIZED

The following matrix is provided for illustrative purposes. It shows summary information for the risk scenario (reasonable worst case), a brief summary of identified risk drivers, the risk score, the combined control spending for 2015 O&M and capital expenditures (Capex), and the mid-point of the 2019 forecast range for O&M mitigation spending combined with the proposed mitigation spending mid-point of the high/low range for the 2017 through 2019 Capex forecast (includes non-GRC and GRC mitigation spending). The reason that the mid-point of forecasted 2017-2019 project Capex plus 2019 forecast O&M is included here is to show the potential magnitude of the mitigation spending on safety related risks and the total risk score.

Because the 2015 controls only include the one year of 2015 Capex, it is provided as a point of reference and may not be comparable to the 3-years of forecast Capex spending that includes both non-GRC and GRC amounts. In Appendix A, at the end of the report, there is a comparison of the 2015 controls to the average high/low range forecasted 2017 through 2019 Capex, plus the forecast 2019 O&M that provides a rough gauge of forecast spending potential related to the potential impact of incremental mitigation activities.[11]

These dollar amounts are for illustration of how proposed spending might change, given choices made by the utilities. They are only estimates at this point but will be refined based on the RAMP proceeding and continuing analysis. The utilities intend to present a firmer set of figures for their mitigations as part of the GRC testimony and workpapers.

[11] The amounts included in the tables in this report purposefully combine the GRC and non-GRC spending because it illustrates the total actual and proposed spending associated with the mitigation projects and risk reduction.

Table 1: Top Risks, Drivers, Scores, Control Costs and Forecast Mitigation Costs

Risk Chapter	Safety Scenario (Worst Case)	Drivers	Asset Scored	Total 2015 Control (000)	Forecast 2019* Mid-Pt O&M Forecast + Capex (000)
SCG -1 and SDG&E-2, Catastrophic Damage involving Third-Party Dig-Ins	A natural gas pipeline ruptures due to third-party excavation work in a populated business district during business hours, which results in fatalities, injuries, and substantial property damage.	**Employee Incident Due to Failure to:** • adequately perform locate and mark tasks underground gas infrastructure • respond to a one-call center request in the required timeframe • perform "standby" duties when a third party is excavating in the vicinity of a high pressure gas pipeline **Contractor (Excavator) or Public Incident Due to Failure to:** • comply with excavation laws or best practices re underground gas infrastructure • call a one-call center or USA in required time frame for locate and mark prior to their excavation • notify the Company before starting work, and Company does not "standby" near a high pressure gas pipeline	233,365	$22,967 SCG $2,597 SDG&E	$39,755 SCG $3,684 SDG&E
SCG-2 Employee, Contractor, Customer, and Public Safety	Employees and/or contractors did not follow a policy or procedure that results in fatalities – whether an employee, contractor, customer, or a member of the public. This could also have operational and regulatory impacts, and litigation and financial costs could also stem from this type of occurrence.	• Deviation from policies or procedures, fundamental safety principles, or general safety rules, or other legal or regulatory safety requirements • Employees exposed to workplace hazards • Gas hazards are not properly identified • Untimely response to identified gas hazards • Effective corrective actions to prevent a reoccurrence are not instituted • Motor vehicle laws or safe driving practices are not followed	233,365	$134,302	$194,999

SCG-3 and SDG&E-7 - Cyber Security	An advanced, persistent threat infiltrates energy delivery management, monitoring, and safety systems to prepare for a coordinated attack that disrupts operator control systems; disables or destroys backup and redundant system protection and recovery assets; disrupts communication capabilities; and remotely launches attacks during a major local event.	• Technology Failure • Human Threats • Public Incident • Force of Nature • See - NIST SP 800-30 Threat Descriptions	44,548	$6,832 SCG $8,029 SDG&E	$64,654 SCG $15,368 SDG&E
SCG-4 and SDG&E -10 High Pressure Pipeline	A natural gas high pressure pipeline failure in a populated residential area resulting in fatalities, injuries, and property damage. The incident resulted in reliability concerns in the surrounding gas network threatening curtailments and loss of core customers.	• Corrosion (external corrosion, internal corrosion, and stress corrosion cracking) • Manufacturing Threat • Construction/Fabrication • Outside Forces • Incorrect Operation • Equipment	36,950	$559,090 SCG $103,919 SDG&E	$839,836 SCG $79,860 SDG&E
SCG-5 and SDG&E-9 Workplace Violence	An active shooter at a well-populated SDG&E facility takes action, which results in injuries and fatalities.	• Human error • Process failure - to detect or prevent • System Failure	23,107	$2,459 SCG $9,146 SDG&E	$7,058 SCG $24,534 SDG&E
SCG-6 Physical Security of Physical Gas Infrastructure	A terrorist group uses explosives to rupture major transmission lines, which results in a fire. Employees and members of the public may sustain injuries. This also may result in severe disruption to the gas supply with potentially widespread curtailments of both core and noncore customers.	• Intentional Damage • Human Error • Process Failure • System Failure	23,107	$7,133	$31,949

SCG-7 Workforce Planning	An employee performs work that she/he has had minimal experience performing and causes a service disruption, which results in injuries to one or more individuals – whether an employee, contractor, customer or member of the public. A regulatory investigation is opened and/or adverse litigation is initiated.	• Improved economic environment incentivizes employees to find new jobs or retire • Aging workforce correlates with higher attrition rates and accelerated job movement due to vacancies	5,774	$4,748	$7,097
SCG-8 Records Management	Employees, relying on inadequate records, mismark the location of a natural gas pipeline, which ultimately leads to a pipeline failure. This results in severe injuries and disruption of service for an extended period. This also results in a legal consequences including regulatory investigation with financial impacts.	• Insufficient training of employees • Insufficient time or resources to devote to the appropriate records management practices • Insufficient data back-up policies, procedures or processes	4,734	$28,415	$125,622

SCG-9 and SDG&E-14 – Climate Change Adaption	An extreme rain event hits the SoCalGas territory after several years of drought resulting in high risk areas giving way to land/mudslides and flooding in low-lying areas. There are damages to access roads and multiple exposures of high pressure pipelines along with one of the pipelines failing. Multiple-year projects are required involving extensive permitting and repairs to restore the infrastructure with millions of dollars in costs. 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.	• Increases in the potential for wildfires and overall acres burned • Acceleration of sea level rise along the California coast (Storm Surge) • Changing rainfall patterns and an increased susceptibility to drought • Increases in temperature and a growing number of heat waves.	2,656	$700 SCG $23 SDG&E	$16,925 SCG $438 SDG&E
SCG-10 Catastrophic Damage involving Medium-Pressure Pipeline Failure	A medium pressure pipeline failure due to a control device malfunction, which results in uncontrolled gas release causing injuries to employees and the public. This also results in over 1,000 customers without gas supply for at least 24 hours.	• Corrosion • Natural Forces • Other Outside Force Damage • Pipe, Weld or Joint Failure • Equipment Failure • Incorrect Operations	2,344	$109,318	$520,176

SCG-11 Catastrophic Event Related to Storage Well Integrity	An uncontrolled release of gas that occurs over an extended period of time due to a storage well structural integrity issue that requires complex well control operations and results in numerous reports of public impacts, supply issues and extensive customer impacts. The release of gas into the atmosphere results in an environmental impact and increased regulatory oversight in the form of new regulations and requirements.	• Injuries to the public and/or employees and property damage caused by rupture and/or resultant fire • Environmental damage • Loss of stored gas • Loss of injection and withdrawal capacity • New legislation and/or regulations • Adverse litigation and associated financial consequences • Erosion of public confidence	1,826	$47,060	$357,230
SDG&E-1 Wildfire Risk Mitigation	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.	• Downed Conductor: • General Equipment Failure • Weather-Related Failure of SDG&E Equipment • Contact by Foreign Object • Failure of Third-Party Attachments • Vegetation Contact • Not Observing Operational Procedures • Lack of Internal or External Coordinated Response • Extreme Force of Nature Events • Climate Change Adaptation Impacts on Wildfires Caused by SDG&E Equipment	2,551,888	$137,949	$1,112,300
SDG&E-3 Employee, Contractor, Customer, and Public Safety	An employee or contractor not following a policy or procedure results in the fatality of one or more individuals – whether an employee, a contractor, or a member of the public.	• Deviation from policies or procedures • Non or improper use of personal protection and safety equipment • Not following motor vehicle safe driving practices • Damages to gas pipelines, electric infrastructure and facilities • Workplace hazards posed to employees	73,796	$108,958	$226,214

SDG&E-4 DER Safety and Operational Concerns	First responders and/or Company employees respond to a circuit believed to be de-energized, DER isolation fails to work, and DER energizes/back-feeds the circuit, which could result in a life-threatening injury or fatality to a first responder/employee. This could also result in moderate affects to a critical location or customer (as well as potential customer privacy implications) and/or adverse financial consequences.	• Failures of voltage control devices • Reverse power flow in distribution circuits and transformers • SDG&E personnel working on a DER circuit • Contractor personnel working on a DER circuit • Reverse power flow in distribution transformers • Outages on circuits with high DER penetration • Emergencies on circuits or premises with installed DER	73,139	$1,682	$2,497
SDG&E-5 Reliatibility Planning & Mitigation	Similar to the September 2011 Southwest Blackout, the loss of multiple transmission assets due to a significant event. Potential consequences include life threatening injuries or few fatalities. The operational impacts affect critical customers and entire metropolitan areas leading to severe and long-term consequences to the environment. Blackouts may involve regulatory compliance violations, litigation, and financial consequences.	• Generation resource constraints • Grid reliability events • Loss of key transmission assets • Software bug in the energy management system • Human error	44,458	$7,527	$455,079
SDG&E-6 Fail to Blackstart	Service territory suffers complete blackout, Palomar Energy Center is unavailable. Restoration process fails. Due to prolonged effects of blackout, impacts to community including fatalities, environmental impacts, and financial implications.	• Lack of availability of equipment on the Cranking Path • Inadequately maintained Blackstart equipment • Inadequately maintained Cranking Path • starting requirements • Inadequate Blackstart training	44,548	$80	$20,902

SDG&E- 8 Aviation Incident	SDG&E helicopter has mechanical failure which leads to aviation crash that results in employee injuries or fatalities and fire.	• Aircraft or other equipment failure not related to maintenance • Pilot error or inexperience inclusive of intrusion into airspace • Disgruntled individual or terrorist attack • Inadequate visual markings or lighting of overhead transmission/distribution lines	23,108	$79	$ 9,708
SDG&E-11 Unmanned Aircraft System Incident	Collision of UAS with infrastructure, manned aircraft or personnel on the ground that damages electric assets or causes injury or death and outage.	• Aircraft or other equipment failure • Malicious third-party software • Pilot error/inexperience • Inadequate pre-flight risk assessment • Intrusion into incorrect airspace • Disgruntled individual or terrorist attack • Radio interference with the vehicle	7,380	$ -	$137
SDG&E-12 Infrastructure Integrity	An energized wire down event occurs due to overhead electric infrastructure failure. While energized, the downed wire caused arcing, fires, and damage to structures, causing serious injuries to anyone within the ground vicinity. This event also results in claims, litigation and associated financial impacts.	• In-service equipment past its useful life • In-service equipment overloaded beyond specifications • In-service equipment designed to protect other assets failing to operate as designed (e.g., switch/relay) failing to operate as designed • In-service equipment failing in excessive volumes • Failure of Energy Management Systems (EMS), SCADA, or other • In-service equipment not designed for operation in accordance with modern safety standards	5,112	$55,138	$536,743

SDG&E-13 Records Management	Employees, relying on inadequate records, mismark the location of a natural gas pipeline, which ultimately leads to a pipeline failure. A similar scenario and consequences could occur with an electric facility, where inadequate records could lead to mismarking the location of a power pole or underground structure, ultimately leading to failure of the electrical equipment or structure. Both scenarios result in severe injuries and disruption of service for an extended period.	• Insufficient training of employees • Insufficient time or resources to devote to the appropriate records management practices • Insufficient data back-up policies, procedures or processes	4,734	$33,187	$111,374
SDG&E-15 Public Safety Events	Trespassers on SDG&E property attempt to steal copper wire. Contact with equipment results in injuries and operational disruptions.	• Failure of security systems • Failure of security systems • Non-compliance with security procedures • Intentional acts involving SDG&E electric infrastructure • Unintentional acts involving SDG&E electric infrastructure	2,344	$25,771	$54,815
SDG&E-16 Catastrophic Damage involving a Medium Pressure Gas Pipeline Failure	A medium pressure pipeline failure due to a control device malfunction, which results in uncontrolled gas release causing injuries to employees and the public, and/or results in over 1,000 customers without gas supply for at least 24 hours.	• Injuries to employees/the public • Property damage • Operational and reliability impacts • Adverse litigation and resulting financial consequences • Increased regulatory scrutiny • Erosion of public confidence	2,344	$16,844	$238,170
SDG&E-17 Workforce Planning	A less-experienced employee fills a position recently vacated by a long-time experienced employee due to retirement and due to lack of experience, the employee performs work that gives rise to serious injuries.	• Economic factors • Increasing number of retirement-eligible critical employees • Lack of job satisfaction • Transition to newer and/or emerging technology • Higher demand for specialized skills • Company culture that encourages movement between jobs	255	$1,854	$5,336

4 ANALYSIS OF TOP RISKS

The following chapter reviews were chosen for a more detailed commentary to provide a greater level of feedback to the respective companies. The feedback should be considered across the board for all the safety risk chapters in preparation of their GRC.

4.1 SCG-1 AND SDG&E-2, CATASTROPHIC DAMAGE FROM 3RD-PARTY DIG-INS

SUMMARY

These two chapters on the risk of third-party excavation damage follow a standard outline, addressing most of the Commission's requirements.

The worst-case risk scenario is described this way: *"A natural gas pipeline ruptures due to third-party excavation work in a populated business district during business hours, which results in fatalities, injuries, and substantial property damage."*

This risk is the highest for SCG and is the highest involving gas operations for SDG&E each with overall risk scores of 233,365. Excavation damage is a leading cause of pipeline catastrophes. Typical events involve a contractor or farm worker performing excavation with a back-hoe or similar heavy equipment, without awareness of a gas pipeline in the work area.

Risk Spending Efficiency (RSE) values were presented for both current groups of controls and for proposed incremental mitigations. SDG&E makes the point that their total pipeline mileage is 1/6 that of SCG so that the RSE (Risk Spending Efficiency was multiplied by a 1/6 "true-up" factor to allow side-by-side comparison with the RSE values for SCG.

Staff is concerned, however, about the assumptions made and the data used to develop the risk score and to calculate the RSEs. Further, no RSE was presented to illustrate why the alternative mitigations were rejected.

STRENGTHS

Both companies describe their risk drivers and current controls in detail. SDG&E presents two groups of incremental activities: in-field dig-in prevention and improvements; and admin-side analysis. SCG adds incremental public awareness to that list.

The risk score was calculated from the SEMPRA 7x7 Risk Evaluation Framework and Subject Matter Expert opinion. The high score is a result of high sub-scores for Health, Safety and Environmental Impact and for Residual Frequency.

SCG's presentation of RSE for the incremental mitigations shows a high value for increasing public awareness programs: *"The proposed public awareness efforts will increase the volume of current efforts and explore new creative ways to saturate the message into targeted audiences."*

AREAS FOR IMPROVEMENT

Risk Frequency Score

The high risk score is largely driven by assigning a high residual frequency value, corresponding to one incident every 1 to 3 years. The RAMP report points out that SoCalGas and SDG&E themselves had not experienced a catastrophic dig-in recently (as of the filing), but they thought it prudent to include data from all gas and liquid pipeline operators in California. The report presents a graph of "significant" pipeline incidents caused by dig-ins for all California gas and liquid pipeline operations for the 20 years covering 1996-2015. Staff is concerned that this data may contain drivers not appropriate for the worst case scenario.

The dataset chosen for significant incidents includes not only incidents that resulted in fatality or serious injury, but also includes incidents that caused $50,000 of damage or more. It is very likely that most of these incidents did not result in fatalities or injuries, but instead merely met the $50,000 damage criterion. The recovery and repair of an underground gas main can often reach $50,000 cost to the utility itself, without being catastrophic. The worst case scenario envisions that fatalities or serious injury, and substantial property damage would occur. The data set should be filtered for only those incidents that meet all the scenario parameters, which would likely result in a lower frequency.

In addition, the data set also includes incidents from pipelines carrying hazardous liquids, which may produce different results than gas pipeline incidents. The data should be examined to determine if the liquid pipeline incidents are suitable cases for use in the risk scenario.

Staff also notes that SoCalGas reports 2,800 pipeline damage incidents in 2015, none of which had catastrophic results. Assuming in the worst case that the next incident would be catastrophic, the SoCalGas incident rate would be 1 in 2,801 per year. Staff recommends that SoCalGas review its own data for the last 20 years, or for as many years that records are available, to determine its own incident rate for catastrophic dig-in incidents that meet the criteria of the scenario.

The absence of catastrophic incidents for SoCalGas and SDG&E suggests that their damage prevention programs are currently effective, and staff's review of the dataset used to determine residual frequency suggests the kind of incidents chosen have produced a frequency rating that may be too high. If incident data from other operators in California is to be factored in to the frequency analyses, then the circumstances causing those incidents should be carefully evaluated to ensure they are appropriate. The performance of zero catastrophic incidents with over 700,000 excavation tickets processed by SoCalGas per year also supports a lower residual frequency value for this risk.

Current Mitigation Effectiveness

Gas pipeline operators are required under the Federal Gas Safety Code, CFR Title 49 Part 192, to provide Public Awareness (PA) messages about the toll-free "Call before you dig" notification alert service, so that third-party excavators are made aware that they must call the service to notify underground facility operators, and must receive confirmation that the operators have marked the locations, before they dig. SoCalGas presents some data about the use of the one-call program and its effectiveness at preventing excavation damage (of any kind). The utility reports it received 700,000 dig alert notification tickets in 2015. The total number of dig-ins for 2015 was 2,800, 60% of which were caused by excavators who did not call the service. The other 40% of dig-ins were caused by excavators who correctly called before they dug, but produced a dig-in anyway.

From this data the utilities determined that third-party excavators who are aware of the one-call program now would be 2.25 times more likely to cause a dig-in if current PA programs were discontinued, resulting in a 51.6 percent increase in total dig-ins. SoCalGas then calculates the RSE for their current controls based on that increase. The full calculation is not presented in the RAMP report or in the workpapers.

Additional data which could assist in determining current effectiveness of damage preventions programs would be to trend SoCalGas and SDG&E dig-ins per 1000 miles of main per year, and segregate high-pressure dig-ins from medium-pressure dig-ins and service line dig-ins, against total cost of the damage prevention programs per year.

Incremental Mitigation RSE

Staff is concerned about the rationale used to determine the expected risk reductions for the proposed incremental mitigations. It appears that the utilities relied solely on SME opinion. Also, in the workpapers provided per CUE's data request to document the RSE calculations, a number of the data columns are hidden, so that the figures used cannot be reviewed without unprotecting the worksheet.

Mitigation Alternatives

Both utilities briefly discussed alternative mitigations but no quantitative information was presented that illustrates why these were rejected.

CONCLUSION

Staff concludes that while SCG has met most of the Commission's requirements, an expanded discussion of alternative mitigations should include estimates of risk reduction and RSE. Also, staff is concerned that SDG&E may have overlooked the significant risk reduction that SoCalGas has identified for Incremental Public Awareness.

The lack of RSE figures for the alternatives highlights the need for a more robust, quantitative approach to risk assessment and risk management. A dynamic segmentation analysis[12] which objectively assigns probability of failure and cost of failure, to each risk would provide more deterministic data for decision making.

[12] Pipeline Risk Assessment: The Definitive Approach and Its Role in Risk Management. 2015. W. Kent Muhlbauer, author.

4.2 SCG-2 EMPLOYEE, CONTRACTOR, CUSTOMER, AND PUBLIC SAFETY

SUMMARY

In this chapter SoCalGas outlined a very broad set of risk drivers and related baseline and proposed mitigations. This chapter focuses on employee conduct related safety issues with ancillary reliability or other enterprise impacts as well as an impact on general safety.

The worst case scenario that frames this risk is that *"Employees and/or contractors did not follow a policy or procedure that results in fatalities –whether an employee, contractor, customer, or a member of the public. This could also have operational and regulatory impacts, and litigation and financial costs could also stem from this type of occurrence."*

For the 11 control categories of mitigations there were a total of 84 Operations and Maintenance (O&M) projects and programs comprised of 62 baseline and 22 proposed mitigation programs/projects. For six of the control categories there were nine Capital Expenditure (Capex) mitigation programs, six baseline and three proposed mitigation programs/projects. While some programs/projects address a single risk driver, many of the mitigations impact more than one risk driver. SoCalGas highlights five potential indicators or drivers of employee, contractor, customer and public risk:[13]

- Deviation from policies or procedures, fundamental safety principles, or general safety rules, or other legal or regulatory safety requirements.
- Motor vehicle laws or safe driving practices are not followed.
- Workplace hazards posed to employees.
- Gas hazards are not identified or untimely response to identified gas hazards.
- Effective corrective actions to prevent a reoccurrence are not instituted.

The 2015 GRC funding for the baseline mitigation projects is $134.5 million comprised of $6.2 million O&M and $128.4mm Capex spending. The proposed GRC mitigation funding forecast for O&M ranges from $15.6 million to $19 million with Capex ranging from $160.8 million to $194.6 million.[14]

[13] In SDG&E's chapter for this same crosscutting risk, they shared 3 of these risk drivers and noted two others: A) Lack of, or improper use of personal protection and safety equipment, B) Damages to gas pipelines, electric infrastructure and facilities. The differences are attributed to SDG&E's additional electric hazards.
[14] GRC figures per Chapter SCG-2 Table 3 and Table 4 and for illustrative purposes.

STRENGTHS

In this chapter SoCalGas clearly outlined the risk and risk drivers. Staff found that SoCalGas adequately described the controls in general terms within the chapter and that the additional details within the workpapers to the chapter were helpful to get a better understanding of the breadth of programs/projects for controlling the risk.[15]

For the majority of the risk drivers, the risk scenario and the proposed mitigation measure were clear and provided a reasonable basis for understanding the intent of the measures and how they might be able to reduce the impact or frequency of the incidents.

SoCalGas outlined plans for enhancing existing mitigations and new mitigation programs/projects to stabilize or reduce risks going forward. Because the risk environment is constantly changing, often times there are new programs/projects needed to counter increasing risks in order to stabilize the frequency or impact incidents rather than reduce the risk.

AREAS FOR IMPROVEMENT

In this chapter, SoCalGas presented a chart that showed the RSE for the baseline and proposed mitigations using the California Occupational Safety and Health Administration (OSHA) and Controllable Motor Vehicle Incidents (CMVI) reportable incident rates. Use of additional statistics and metrics was limited.

While the CMVI is more easily correlated with the driver training and vehicular equipment upgrade programs and projects, the correlation between the risk and risk mitigations for the operational incidents was unclear. There were many other mitigation programs and projects that affect customers and the public that might tangentially benefit from mitigation programs, but no customer or public incidents were used to develop the RSE and the implication is that the operational RSEs for the Baseline and the proposed mitigations would apply to all the non-vehicular programs/projects.

[15] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Employee, Contractor, Customer, and Public Safety (Chapter SCG-c-WP)

Staff recognizes that it would be difficult to capture customer and public incident rates associated with SoCalGas operations and this should be clearly explained for the programs/projects designed to impact customer and public risks.

At this stage of RAMP development the use of OSHA and CMVI may be state of the art for SoCalGas. These types of performance metrics are good for benchmarking performance. However, there are significant limitations with relying solely on OSHA and CMVI reportables as key performance indicators for justifying programs/projects.

For example, using these types of metrics could create perverse incentives to under report work place and vehicular incidents. It has been found that when OSHA/CMVI type of reportable incidents are used for performance metrics to provide incentive based compensation or to justify program/project funding, that this incentivizes management to discourage reporting of incidents.

SoCalGas should further develop metrics for gauging the performance of safety programs/projects for all control categories, including those that are customer or public facing. This will help future RAMP reports to differentiate programs/projects that work effectively for each of employees and contractors.

Staff found several proposed risk mitigations where the correlation between the mitigation and the risk was not clear. SoCalGas should provide additional information, or provide a different scenario that more clearly aligns with the risk being mitigated.

Lastly, even though SoCalGas is following their self-described method for calculating the RSE, however, based on the assumptions and inputs as presented it was not easy to grasp how the 62 baseline and 22 proposed programs/projects produce the results presented in the SoCalGas RSE graphs.

With the development and use of appropriate performance metrics more directly correlating the mitigation with the risk, the RSE's score will become more meaningful and provide greater value in evaluating baseline, enhanced baseline and new programs/projects.

In addition, the assumptions considered only two metrics to measure all the program mitigations, while it was clear from the descriptions that many of the programs/projects would have little if any bearing on the outcome of an OSHA or CVMI reportable incident.

Staff acknowledge that the underlying table of charts and the calculations are complex, however the underlying tables that showed the source of figures was sparsely explained and

difficult to follow. Staff believes that as SoCalGas builds on this experience preparing RAMP reports and as the process matures, the explanations and supporting data will get better and be easier to understand.

Chapter Specifics:

Below outlines whether the chapter met the required RAMP criteria and objectives:

Risk specific information

Describe the Risk

SoCalGas did a good job identifying the risk drivers associated with this risk and the current baseline of mitigations that address those drivers.

Risk Classification

The classification of this risk as cross cutting was very appropriate. The risk score followed the 7x7 matrix and the level of the consequence scores for the Health, Safety and Environment, Operational & Reliability, Regulatory, Legal and Compliance, and Financial appeared reasonable. The Residual Frequency score appeared reasonable.

Potential Drivers

Good outline of potential drivers and easy to follow and make logical connections with the risk mitigations. The drivers that could impact the risk include employees deviating from safety rules, policies and procedures as well as operational and regulatory requirements. Work place hazards that increase the risks to employees include unsafe customer premises, work environments, hazardous chemicals and gases, condition of equipment and infrastructure. Misidentified or unidentified gas hazards include pipeline or infrastructure damage, leaks, and external environmental influences. Lastly, as a subset of deviating from accepted operating policy and procedures includes the failure to implement corrective actions on infrastructure, tools, and employee conduct which if instituted would prevent or correct a situation from reoccurrence.

For instance, mandatory employee skills training not only improves employee safety, it also has downstream impacts and improved customer and public safety. When employees perform the work safely and competently fewer system failures should result which improves customer and public safety.

Potential Consequences

SoCalGas used the Risk Bow Tie analysis to clearly illustrate how the potential consequences logically related to the risk drivers.

Risk Score

Reasonable Worst Case

The worst case is based on an employee(s) and/or contractor(s) failing to follow a policy or procedure that results in fatalities. It is likely that virtually all situations with negative consequences have been contemplated and encapsulated within the company policies and procedures.

Risk Scoring

SoCalGas gave this cross-cutting amalgam of risks a score of 233,365 which places this at the higher end of scored risks. This received its high overall score because of the high residual frequency score of 5 (frequent), and combined with the health, safety and environmental score of 6 (severe). The health, safety and environmental score of 6 means that even with the current baseline of mitigations, incidents potentially result in life-threatening injuries or a fatality.

The Operational and Reliability (O&R) risk was rated 4, which appears to be due to the likelihood that an incident could affect 10,000 or more customers. In its chapter for like risks, San Diego Gas & Electric's (SDG&E) also gave this risk a 4 rating.[16]

The SoCalGas' Regulatory, Legal and Compliance (RL&C) risk was rated 3 because the incidents would likely lead to an OHSA violation and fine. In SDG&E's chapter for like risks the Regulatory, Legal and Compliance risk was rated a 4, which appears largely due to the type of outcome from employee involved asset failure, e.g. wildfire from electric lines down, that could lead to more significant impacts, investigations and litigation.

The Financial risk for SoCalGas was rated 4, yet SDG&E's was rated a 3. SoCalGas needs to provide more explanation why its financial risk is higher than its sister company's given the higher risk profile of SDG&E's wildfire risks.

[16] Staff include a comparison to SDG&E because they have parallel risks, but different operational environments and issues. These differences in operations and how they impact their risk scores should be explored.

The Frequency Score and its Impact on the Overall Score

For SoCalGas the frequency score of 5 is significant because it indicates the incident rate is frequent enough for consequences to be realized (e.g. once every 1-3 years). Whereas SDG&E, for the same risks, rated their frequency risk at level 4 which is once every 3-10 years. Both companies based their frequency risk on the estimate of incidents on the core risk drivers noted in the chapter. Because of the differences in their operations the difference in their frequency score could be justified. More information based on the actual historical incident frequency could help determine whether the frequency scores are appropriate. The difference in overall risk score between SoCalGas (233.365) and SDG&E (73,796) is due to the difference in their respective frequency score.

Staff noted that the RSE scores provided for baseline and proposed mitigation programs/projects did not significantly reduce the risks below the initial score. The supplemental workpapers showed new RSE scores of 221,697 for operational risks, and 224,264 for vehicular risks, which are slightly down from 233,365.

When the worst case scenarios were applied for O&M and vehicular risks a proportional change between worst case and baseline average was applied to the frequency that drove the risk scores up to 334,341 and 330,640 respectively. It was not clear if the classic definition of frequency were used that the increase in incidents based on the worst case would have raised frequency up to the next level on the frequency scale. The result of going up one level on the frequency scale would be a change of the raw risk score to 1,278,193.

The relative proportion that was used to raise the score was based solely on the subject matter experts (SMEs) determination that incidents would increase based on the worst performing peer utility with the greatest incident rate in 2015 for both OSHA and CMVI reportables.

Staff noted one issue with the methodology is that a 5-year trailing average was compared to the single worst performing peer from 2015. It seems that incident rates fluctuate significantly from year to year (see Figures 2 and 3 below) so comparing the worst case incident from one year to a 5 year average would seem to skew the result. Perhaps taking the worst 5 year average of peer utilities versus the 5 year average incident rate of the company would be a more realistic gauge of potential performance.

Baseline Mitigation Plan

The primary focus on mitigation across all these sub populations is on monitoring, tracking, training and tools. Monitoring includes observing, testing, auditing, improving communication protocols, and automated systems. Tracking includes record keeping, logging worksite, reporting incidents, and customer information. Training includes additional focus on driving and technical skills, situational awareness, and health and wellness. Tools include testing tools, analytics, and personal safety equipment.

Alternative Mitigation Plans and Their Relative RSE, if any

SoCalGas identified two alternates. There were no RSE estimates provided to help evaluate the value of the alternatives, and though it appears that the underlying data from which to calculate such RSEs has not been developed within SoCalGas this type of data is necessary to provide a fuller evaluation of the alternatives.

1) Increase the frequency of refresher training – many of the mitigation programs/projects involved training at periodic intervals so this alternative would affect those training programs by increasing the frequency. The alternative was dismissed because the current level of annual review has been effective in gradually reducing the amount of OSHA recordable incidents. Across-the-board increased frequency in training would increase costs, but there was no expectation of incremental increase in benefit. However, proposed mitigation programs in the defensive driving mitigation include expansion to more employees. The wellness and fitness proposed mitigations increased the number of hours of training with the expectation to reduce on the job injuries.

2) Modernize training techniques – including computer based automated feedback type simulation training. Noting that web-based training has the potential to reach a wider audience in a more flexible manner, with economies of scale SoCalGas still opted to continue primary training on a face–to-face basis. Many reasons were provided that would support their choice to keep it the primary means of training at this time. But no RSE was calculated to provide the objective measurement.

Proposed Mitigation Plans

SoCalGas outlined 11 current mitigations making up their baseline mitigation plan, and proposed 27 enhancements to existing or new activities. In some cases, doing more of a good

thing should result in reduced frequency and/or impact of safety incidents. SoCalGas went into some depth explaining the nature of the mitigation enhancements and new activities.

The chapter states, *"The Employee, Contractor, Customer, and Public Safety risk covers the risk of conditions and practices which may result in severe harm to employee, contractor, customer, and/or public safety such as driving, customer premises, and appliance conditions, as well as non-adherence to company safety policies, procedures, and programs."*[17] Because this risk is such a broad and cross-cutting risk, it may be difficult to fathom how each proposed mitigation enhancement or new activity relates to the stated risk.

Improved Analysis of Contractor Construction Inspection Information

The main focus on improving the tracking of quarterly performance review meetings is unclear. The intent to improve tracking over time to identify issues and trends comprehensively through a coordinated data base seems reasonable. It is not clear where the data comes from, whether it is gathered by the company or provided by the contractor.

It would seem that the company should already maintain a detailed pipeline construction inspection database that could be utilized for contractor sourced pipeline construction data. An additional concern is implied by the statement that this "data needs to be tracked over time". What has the company been doing to track this data in the past?

If this mitigation is merely to upgrade systems of hardware and software to be more efficient at parsing the data, more information is necessary in order to better understand how this enhancement is going to reduce the stated risk.

Contractor Safety Performance Screening and Monitoring

This enhancement appears to be in line with the purpose to ensure adherence to the stated risk above. The establishment of a program to evaluate and monitor contractor safety performance of existing and potential contractors seems like a reasonable way to work toward the reduction of the stated risk. However, it is unclear whether or not the company has been using some means of monitoring performance and has decided to scrap that and go a different route, or whether the company doesn't currently monitor contractor safety performance nor evaluate the historical safety performance of prospective contractors.

[17] http://www.sdge.com/sites/default/files/regulatory/SCG-_RAMP_Employee_Contractor_Customer_and_Public%20Safety_FINAL.pdf, Page SoCalGas 2-1.

Program to update customer contact information for premises access

It is unclear how much safety will be enhanced by obtaining this additional customer contact information, or if this is a nice to have feature without much actual impact on safety consequences. It is also unclear how much risk reduction would be realized and how it would be calculated.

Emergency Responder website with external access features and security

It is unclear how this new activity would impact safety, since this is a voluntarily accessed website there is no clear data shared in the RAMP report that indicates this would gain traction with first responders such that they would actually use the website.

The way this is described it sounds like a passive way to disseminate information, but it is unclear how effective it will be to reduce the stated risks. There is value in securely sharing maps, pipeline information, PAPA brochures, etc. to help FRs locate gas lines.

When briefings are conducted live there is the opportunity for two way communication and feedback to ensure effective complete communication. Additionally, the Company would know whether certain units in the first responder corps were absent and seek them out to complete the communication. A passive website doesn't ensure that every first responder that should get the message actually got the message.

High-frequency radio system for emergency communications

This enhancement appears to be in line with the purpose to address the stated risk above. The radio system as proposed appears to fit with the emergency response effort that could directly impact safety during emergencies or critical operating situations. However, in the description it was not clear who besides the company already has the ability to use this radio frequency and whether this is a universal standard that will be adopted by all other field and emergency first responders. Additional clarity is needed on how widely this high-frequency radio system has been adopted, or whether an industry requirement to standardize to this high-frequency radio system exists.

Drop test tool for low flow measurements

This enhancement may be a more efficient method of testing pipelines before turning on the gas service, but it doesn't sound like it is more effective. If this is for efficiency reasons then

it would seem to have the potential to reduce costs over time. It is not clear how more accurate the Low Flow Meter would be, and what that impact would be on the stated risk. Additionally, it appears this has already been deployed in late 2016.

Upgrade Nomex coveralls and fresh air equipment

This enhancement appears to be in line with the purpose to ensure adherence to the stated risk above. Acquiring the approved Self-Contained Breathing Apparatus (SCBA) and related gear appears necessary due to the obsolescence of existing equipment and gear. It is unclear what happened to the funding that was provided for the normal replacement of the old style of equipment since it would be a normal expense item. It would be helpful to understand whether and to what extent legacy costs offset the cost of the new equipment.

Increased costs for inspection of above-ground pipe and facilities

From a RAMP perspective it is not clear how much of this relates to safety and how much too regulatory compliance and whether there is a real reduction in risk by complying with increased regulations. Logically, there should not be a significant increase in fatalities and injuries to employees, customers and the public from now having to test MSAs for leaks differently. The safety impacts are not clearly defined either, so more information on how this impacts safety could improve the understanding of how this addresses the stated risks above.

Data Analytics and field investigations based upon Advanced Meter information

In theory, this type of systematic analytical approach appears to fit the profile of an activity that could have a beneficial safety impact. Proactively identifying anomalies and preventing potentially unsafe conditions or situations should reduce the frequency of events that result in injury or death. However, it is unclear whether this is a current program or a new activity, or an existing program that is being modified and enhanced with new functionality. If this is an existing program that is in place then it is unclear how much future risk reductions would be expected to result above the current baseline.

Increased inspections (NGAT) associated with energy efficiency programs

It is unclear whether the increased inspection energy efficiency programs have been funded through the energy efficiency program, or whether this is something that is separate and distinct from the carrying out of EE programs. It is unclear whether this is a separate inspection function that is an unintended outflow of increased EE program activity or whether a different

kind of EE program has been deployed that does not include funding for increased inspection activity. It is also unclear how predictable the EE program work is that the Company can reliably anticipate the amount of inspection work that will be required. More transparency into the EE program work forecast appears necessary to support the overall increase in risk from that work that would need mitigation.

RSE Applied to this Risk, and the RSE Results

SoCalGas provided the backup data, through a data request from CUE, that it used to calculate the RSEs summarized in the RAMP report. First, this information should be part of the RAMP report in either an addendum or appendix that is readily available to support the asserted figures. The worksheets provided need to be more clearly explained to better understand the calculations and rationale for the assumptions and the input variables used in the RSE calculation.

Secondly, the basis for these estimates is largely a product of Subject Matter Expert interpretation and possibly opinion. What the following two charts tell us is that though SoCalGas says they have an average improvement in their reportable incident rates from 2007 to 2015 the most recent periods from 2011 to 2015 show significant variability between years and based on the mean of the incident rates from 2011 through 2015, for both OSHA and CMVI reportables, there is no obvious and clear trend of incremental improvement in the respective incident rates.

Because the number of incidents is very low to begin with a handful of incidents in a given year could dramatically swing the incident rate. Though the additional mitigations may turn out to actually reduce the incident rate on average as well as provide a measurable reduction in risk it is difficult to base that on the information provided.

In addition, without the additional information provided in response to CUE's data request, which broke down the amount of spending for vehicular mitigations versus OHSA mitigations, evaluating the RSE and its validity could not be done based on the summary information provided in the RAMP.

Table 2: OSHA and CMVI Reportables Used to Calculate RSE

	OSHA	Variation from Avg.		CMVI	Variation from Avg.
2011	3.50	3.3%	2011	2.79	17.3%
2012	3.63	-0.2%	2012	3.21	4.8%
2013	3.52	2.9%	2013	4.05	-20.1%
2014	3.66	-1.0%	2014	3.21	4.8%
2015	3.81	-5.1%	2015	3.61	-6.9%
5 Year Average	3.62			3.38	

Figure 1: OSHA Reportables Showing the Variation Potential from Year-to-Year

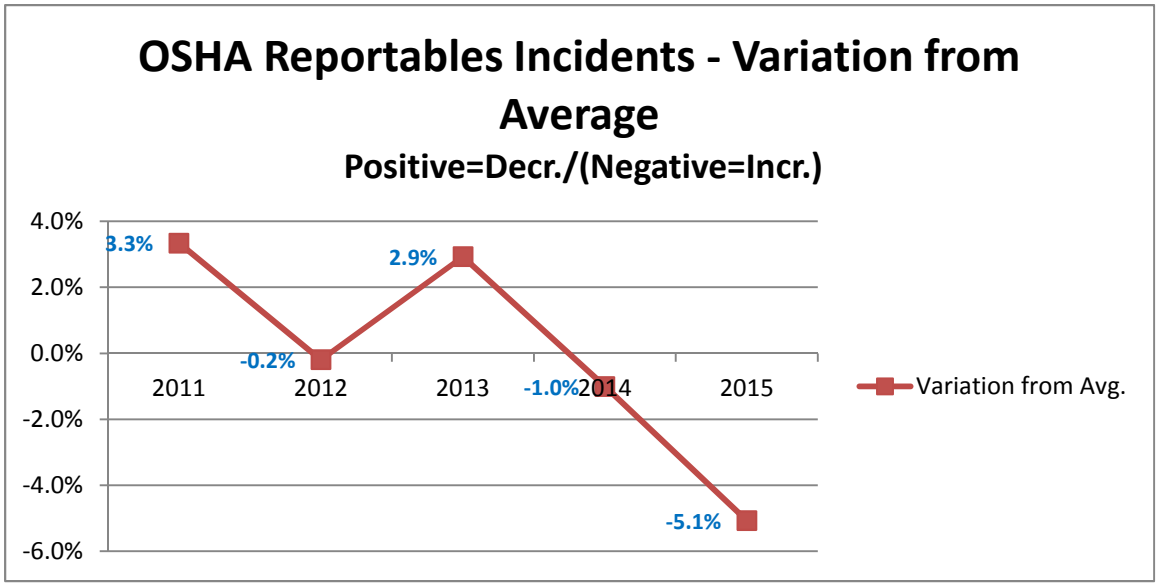
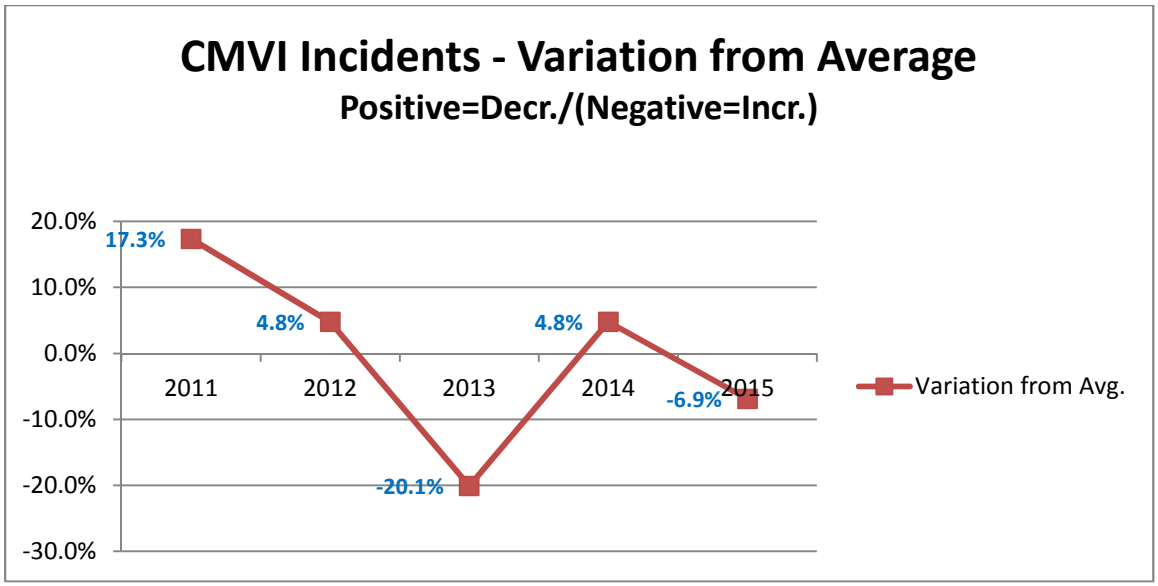


Figure 2: CMVI Reportables Showing the Variation Potential from Year-to-Year



CONCLUSION

In this chapter SoCalGas clearly outlined the risk and risk drivers. Staff found that SoCalGas adequately described the controls in general terms within the chapter and that the additional details within the workpapers provided to satisfy requests for data were helpful to get a better understanding of the breadth of programs/projects for controlling the risk.[18] SoCalGas outlined plans for enhancing existing mitigations and new mitigation programs/projects to stabilize or reduce risks going forward.

As noted by SoCalGas in its explanation of the limitations of RSE in this RAMP, Staff agrees that more work needs to be done to improve the correlation of the RSE to the baseline risks and the proposed risk mitigations in order for the RSE to be used as intended. In addition, in this chapter the assumptions used to calculate the RSE only considered two metrics to measure all the program mitigations where it was clear from the descriptions many of the programs or projects would have little if any bearing on the outcome of an OSHA or CVMI reportable incident.

[18] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Employee, Contractor, Customer, and Public Safety (Chapter SCG-c-WP)

SoCalGas also needs to do a better job clarifying the risk mitigations that are measure by the RSE and at the same time do a better job identifying metrics which correlate with the performance of the respective risk mitigation.

For the majority of the risk drivers the risk scenario and the proposed mitigation measure was clear and provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents. Yet for several mitigations more needs to be done to show the correlation between the mitigation and the risk.

Lastly, even though SoCalGas is following its described method for calculating the Risk Spend Efficiency, based on the assumptions and inputs as presented it was not easy to grasp how the 62 baseline and 22 proposed programs/projects produce the results presented in the SoCalGas RSE graphs. Granted the underlying table of charts and the calculations are complex, however the underlying tables that showed the source of figures was sparsely explained and difficult to follow. Staff believes that as SoCalGas builds on this experience preparing RAMP reports, and the process matures the explanations and supporting data will get better and be easier to understand.

4.3 SCG-3 AND SDG&E-7 - CYBER SECURITY

SUMMARY

The Sempra Utilities combined their analysis of Cyber Security risks and mitigations for both SDG&E and SoCalGas into a single chapter, duplicated in the context of each utility's RAMP filing. Aside from the specifics of existing controls and proposed mitigations, and their projected budgets, the risk analysis of adverse cyber events for both utilities is nearly identical. Due to concerns about the confidential nature of cyber security protections and the potential impacts on customer data, business enterprise platforms and utility operations, the utilities describe their Cyber Security strategies in very general terms. This, unfortunately, hinders a complete evaluation of the status of existing controls and proposed mitigations, and/or alternatives.

Somewhat more information about expected mitigation spending may be found in the workpapers provided in response to data requests from the Coalition of Utility Employees (CUE). These spreadsheets indicate slightly revised figures from the RAMP chapter tables, due

in part to rounding of line items. Still, becomes apparent is that the utilities' proposed baseline expansions will largely be from increased employee positions and labors costs on the O&M side.

Capital expenses for proposed mitigations indicate a shift – especially for SoCal Gas – to higher-cost projects that would emphasize Protection and Detection more so than in the past, in the form of revamp Intrusion Protection Systems (IPS), security controls on servers, authentication tools, and a greater emphasis on protective capability infrastructure installations.

Network security monitoring and new logging and monitoring infrastructure would contribute to improved detection capabilities under SCG's proposed mitigations.

While the utilities did provide a Risk-Spend Efficiency calculation – slightly differing for each utility – the vagueness of its proposed mitigations does not really substantiate the analysis.

There is no doubt that the risks of adverse cyber events are real and potentially may have serious consequences. In seeking funding for a substantive increase in funding for mitigations above current expenditures in the GRC, the utilities will need to provide more details to the Commission and intervenors – even if their related testimony must be filed under a claim of confidentiality and non-disclosure. For SoCal Gas, in particular, moving from current capital spending of about $6.3 million in 2016 to as much as $83.6 million over the 2017-2019 period – with the bulk of that for Capital projects rather than O&M – will require a more detailed justification and expectation of impacts than is presented here.

STRENGTHS

The utilities clearly define the risk to be mitigated as *"a major cyber security incident that cause disruptions to electric or gas operations (e.g. SCADA system) or results in damage or disruption to company operations, reputation or disclosure of sensitive data."*

Although the non-safety components of the risk score for potential consequence are actually higher that for the Health, Safety & Environmental component, assessing the HSE score at 4 on the 7-point scale, and assigning a residual frequency score of 4 (with total RRS of 44,548) appears to be an appropriate assessment of likelihood and consequence.

The chapter provides a comprehensive listing of Potential Consequences, which further illustrates the safety impacts (i.e., injuries to employees or the public; destruction of equipment;

extended outages which result in social disruptions) in the context of operational consequences, data theft, or reputations consequences.

"[A] cyber incident within a control system responsible for delivering energy into the service area could disrupt energy flow systems, causing widespread outages or infrastructure malfunction, resulting in the potential for injuries," the utilities explained. Additionally, local impacts could affect individuals' health by disrupting medical or safety-related equipment.

In short, while safety is not the only attribute of concern, it is significant enough to warrant inclusion in the RAMP risk analysis.

The utilities base their assessment of both risks and responses to cyber security issues on the NIST Cyber Security framework, which was developed jointly by industry and the federal government following Presidential Executive Order No. 13636. This framework represents a logical set of functions:

- Identify
- Detect
- Protect
- Respond
- Recover

The chapter provides a helpful chart of "Threat Descriptions" that were devised as part of the NIST SP 800-30 framework, illustrating Sources of the Threat, Motivations, and Threat Actions, all of which help inform the proposed mitigations.

In using these functions for both categorizing mitigation activities and assessing potential benefits, the utilities show a stronger weighting toward those elements that relate to Recovery than to Identify and Protect elements. This seems a logical weighting.

AREAS FOR IMPROVEMENT

The utilities are understandably vague about their anti-cyber incursion strategies, describing in terms of an "address all risk drivers" approach without detail, signaling only that the proposed mitigations beyond current controls are essentially "more of the same."

This vagueness of description makes it very difficult to evaluate what appears to be a substantial increase in proposed spending for unspecified mitigations.

While current spending levels are quite modest, in the $6.2 million to $6.8 million range for each utility, there appears to be a much high expectation of marginal investments needed for SoCal Gas than for SDG&E which should be explained more thoroughly.

In addition, SDG&E's system requirements fall mainly to O&M (IT and systems), whereas SoCal Gas foresees fairly heavy capital expenditures in the forecast period. There is no description or understanding of what types of projects or programs are driving these projections – they would need to be detailed in the GRC.

The Executive Summary for the chapter provides a little more useful (if general) description of types of initiatives that are associated with each of the functions of the framework. For example, under Identify:

- Implement a system of recordkeeping dedicated to compliance records to better support regulatory auditing;
- Automate distribution of threat intelligence

Somewhat less descriptive is the entry for Detect:

- Leverage emerging technologies to improve detection of insider threats.

Again, there is no arguing that these represent common-sense approaches. The problem for evaluation is that they are so unspecific that the Commission may have difficulty in assigning a value to such activities, or to even understand how they are changing or increasing under "enhanced" mitigation proposals.

Some of the descriptions actually identify specific programs or projects for which the utilities will seek funding in the GRC. For example:

- Perimeter Tap Infrastructure Redesign –to "improve performance and visibility of network traffic to limit impacts of incidents"
- Incident Response - an "out-of-band communication capability to coordinate and support incident response"

In the forthcoming GRC, these mitigations deserve a more thorough explanation and specific project funding details in testimony workpapers, such that decision makers can understand why they are worth funding, without giving away confidential technical details.

RSE for Incremental Mitigations

While the chapter portrays positive RSEs for both SDG&E (ranging from 1.9 to 3.2) and SoCal gas (1.9 – 3.5) there is nothing at all that provides a basis for the scoring outcome. Will mitigations prevent more incidents (hard to say, as there is no data about current incident levels) or reduce consequences (again, no data to base a comparison).

The two alternatives might basically be characterized as "address all risks more aggressively" or "defer implementation" or focus on a more narrow set of mitigations. Perhaps a logical set of options, but the section is so lacking in analysis or information that it provides little help for a comparison of benefits compared to the (unspecified) differences in costs of those options.

CONCLUSION

The Scoping Memo for OII R.16-10-015 and 16-10-016 clearly states that the RAMP reports must address the efficiency of risk mitigation funding, proposed spending, and the level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle. SDG&E has not fully addressed this requirement, nor have they presented an adequate discussion of alternatives, which would include consideration of risk reduction impact and RSE for the alternatives.

Staff recognizes that this RAMP filing is the first of its kind and that it has been difficult to quantify risk reductions in a manner that will support RSE calculations. Staff recommends that SDG&E and the other utilities make a determined effort to gather the data necessary to make more quantitative predictions of risk reduction in future filings.

4.4 SCG-4 AND SDG&E-10 HIGH PRESSURE PIPELINE

SUMMARY

The information presented in the chapters on high-pressure pipeline failure is identical for SoCalGas and SDG&E, with some exceptions as will be noted. When the material is the same for both companies, staff will refer to the Sempra Utilities as the author.

In these chapters the Sempra Utilities outlined a reasonable set of risk drivers, current mitigations (controls) and proposed incremental mitigations. The RAMP report focused on the

extensive measures already in place due to Federal and State safety regulations including the CPUC-mandated Pipeline Safety Enhancement Program (PSEP).

Proposed mitigations would expand on existing measures related to the Transmission Integrity Management Program (TIMP), increase pipeline right-of-way patrols and maintenance, and also include expanded leak survey activities and automated shut-off valve installations that are mandatory under CPUC GO-112F and PUC 957. One of the contributors to catastrophic pipeline failures in recent California history is excavation damage by third-parties. Recent examples are the dig-ins on PG&E transmission lines in Fresno and Bakersfield that resulted in fatalities. The utilities chose to separate Third-Party Dig-Ins as its own risk chapter since the drivers and mitigations are quite different from those considered here.

Both companies used the same reasonable worst-case scenario to support calculation of a risk score: *"A natural gas high pressure pipeline failure in a populated residential area resulting in fatalities, injuries, and property damage. The incident resulted in reliability concerns in the surrounding gas network threatening curtailments and loss of core customers."*

The scenario was evaluated by subject matter experts (SME) and scored according to a standard 7x7 Risk Evaluation Framework. The frequency component of the score was rated a 3 on the 1-to-7 scale (occurs once every 10 to 30 years), even though a catastrophic failure has not occurred on the utilities' high-pressure pipelines. The basis for the frequency rating is that since federal data from the Pipeline and Hazardous Material Safety Administration (PHMSA) for all California operators show a total of 10 fatalities caused by high-pressure pipeline failures in the last twenty years, there should be some accounting for that possibility on their system.

The risk score for both SoCalGas and SDG&E was 36,950, ranking this risk 4th-highest and 10th highest, respectively. SDG&E's risks include electric operations as well as gas. It should be noted that Third-Party Dig-Ins as a distinct category has a risk score of 233,365 for both companies, making it the number one risk for SoCalGas and number two for SDG&E (see chapter 3.1 above).

STRENGTHS

Workpapers for the chapter list numerous baseline capital projects and O&M expenses related to this risk. The total 2015 GRC cost for these controls is given in the RAMP report as

$108.5 million. SoCalGas proposes incremental mitigations, including new regulatory compliance measures, for a total proposed GRC cost range of $386 to $651 million. Similarly, the baseline cost for SDG&E in 2015 is $1.8 million while the proposed GRC cost range is $2.5 - $2.8 million. These are significant increases in risk mitigation costs.

Most of the mitigations impact more than one risk driver. The RAMP highlights six general areas or groupings of these activities:

1. Maintenance: Patrolling, Leak Survey, Pressure Limiting and Regulator Station Inspections and Maintenance, Valve Maintenance
2. Qualifications of Pipeline Personnel (Training)
3. Requirements for Corrosion Control: Corrosion Control, Monitoring and Remedial Measures
4. Operations: Odorization, Emergency Preparedness, Continual Surveillance
5. Pipeline Integrity: Threat Evaluation, Risk Analysis, Pipeline Assessments and P&M
6. PSEP: Pressure Testing and Replacement, and Valve Automation and Replacement

AREAS FOR IMPROVEMENT

The utilities presented RSE results for the baseline controls but did not present RSE values for the proposed incremental mitigations. In response to a data request for the incremental RSE, the utilities replied that RSE related to the projected increase will remain nearly the same. A primary goal of the RAMP process is to show the efficiency of proposed additional spending to guide parties in the subsequent GRC proceeding. If the RSE will remain nearly the same, that result should be shown in the RAMP report.

SoCal Gas and SDG&E briefly discussed two possible mitigation alternatives without giving detailed comparisons of the costs or expected risk reduction to illustrate why the alternatives were rejected.

Analysis of Chapter Specifics:

Below outlines whether the chapter met the required RAMP criteria and objectives:

Risk specific information

Describe the Risk: In chapters SCG-4 and SDG&E-10, SEMPRA did a good job identifying the risk drivers associated with this risk and the current baseline of mitigations that address those drivers.

Risk Classification: The classification of this risk as a gas operational risk was appropriate.
Potential Drivers: The utilities provide a good outline of potential drivers that is easy to follow and makes logical connections with the risk mitigations. The drivers that could impact the risk include: corrosion, stress-corrosion cracking, manufacturing defects, and construction & fabrication flaws, outside forces, incorrect operation, equipment failures, and third-party damage. The selection of risk drivers is taken from the list of pipeline threats specified by the U.S. Department of Transportation Pipeline and Hazardous Materials and Safety Administration (PHMSA), based on the American Society of Mechanical Engineers standard ASME B31.8S. The utilities chose to evaluate the third-party damage risk in separate chapters.

Potential Consequence: SoCalGas used a Risk Bow Tie graphic to illustrate the potential consequences and logically relate them to the risk drivers.

Risk Score

Reasonable Worst Case: The worst case scenario was clearly defined as: *A natural gas high pressure pipeline failure in a populated residential area resulting in fatalities, injuries, and property damage. The incident resulted in reliability concerns in the surrounding gas network threatening curtailments and loss of core customers.*

The Risk Score: the Sempra Utilities gave this risk a score of 36,950 which places it 4th highest for SoCalGas and 10th highest for SDG&E. The score is based on a low residual frequency score of 3 (infrequent), combined with scores of 5 (extensive) and 6 (severe) for the impact categories. The health, safety and environmental score of 6 means that even with the current baseline of mitigations, incidents that occur are likely to result in life-threatening injuries or fatalities.

The Frequency Score and its Impact on the Overall Risk Score: The frequency score of 3 (one incident in every 10 to 30 years) was chosen by subject matter experts to take into account the absence of catastrophic failure on the pipelines but also the occurrence of catastrophic high-pressure pipeline failures for other California gas companies during recent years. PHMSA data shows 10 fatalities resulted from this kind of failure in California during the years 1996-2015. Staff agrees that the combination of utility-specific data and California data produces a reasonably conservative score.

Assuming that the utilities continue to have a zero incident rate, the logical means to reduce the frequency score would be that the overall California incident rate had reduced enough to justify a lower score. But that rate depends on other operators and cannot be influenced by any mitigation programs. How will the utilities demonstrate risk reduction in the future? Is further mitigation necessary if the rate is already zero?

Unless SMEs can determine that a whole number change has been made to the frequency score, the risk score would remain the same in a future risk ranking exercise so there would be no apparent risk reduction achieved from the current residual risk level.

Baseline Mitigation Plan

The primary focus for current mitigation is on continuing compliance with State and Federal pipeline safety rules, for the most part embodied in the Code of Federal Regulations (CFR) Title 49, Part 192. This safety code includes numerous regulations that aim to prevent pipeline failure. Part 192 includes rules for construction and testing, corrosion monitoring and control, pressure regulation, maximum operating pressure, damage prevention, leak surveys, patrolling, pipeline integrity management, and operator qualification.

The utilities groups these activities into general categories: Maintenance; Qualifications (Training); Corrosion Control; Operations; and Pipeline Integrity. To that list is added the CPUC-specific Pipeline Safety Enhancement Program (PSEP). The Pipeline Integrity category for high-pressure pipelines encompasses the Transmission Integrity Management Program (TIMP) requirement under Part 192.

Alternative Mitigation Plans and Their Relative RSE, if any

The same two alternative mitigations are described for SoCalGas and SDG&E. No RSE estimates were provided to help evaluate the value of the alternatives. Staff assumes that the underlying data from which to calculate such RSEs have not been developed at this time.

1) Acceleration of TIMP

SoCalGas and SDG&E mention that TIMP activities could be expanded into non-HCA (High Consequence Area) pipeline segments. This alternative was briefly dismissed due to conflicts with scheduling and resources, without detailing what those conflicts would be or the costs needed to overcome them. The point of considering alternatives in the RAMP is to present

the expected costs necessary to implement the mitigations and compare the resulting RSE to other options on a quantitative basis.

2) Acceleration of PSEP

The utilities also mentioned increasing the pace of PSEP work, which would reach the goal of enhanced pipeline safety sooner, reducing the time that potential risks continue. This alternative was briefly dismissed on the basis of more capital requirements but the actual amounts are not presented. The utilities further concluded that the current pace of PSEP is preferred because it balances affordability, risk reduction, and financial constraints with available resources. Was a study of those elements actually performed? If so, including it in the RAMP would improve the case for these estimates.

Proposed Mitigation Plans

SoCalGas proposes enhancements to some of the current mitigation categories including PSEP, while SDG&E proposes the same activities without PSEP. The activities are:

- HCA Class Location Identification and Remediation (Operations)
- Right-of-Way and Access Road Maintenance (Maintenance)
- Increased Leak Survey Mileage required by GO-112F (Operations)
- PSEP Valve Automation (SCG only) (PSEP)

The RAMP report describes these activities in some detail but does not specify how much enhancement is proposed. The workpapers provide some clues to the extent of the proposed enhancements by showing costs for each activity. A more complete report would detail the miles of pipe replacement, the miles of Right-of-Way to be remediated, the number of valves to be replaced, etc.

HCA Class Location

SoCalGas proposes to increase Operations spending in each of the three years in the next GRC from $1.25 million in 2015 to as much as $12.6 million in 2019 to enhance HCA Class Location activities. SDG&E's RAMP report also proposes to enhance this activity, but their workpapers do not include a line item for this cost. Staff notes there is a large increase in the overall operations category in the SDG&E RAMP report from a current baseline of $510,000 to $1.3 million for the next GRC.

Right-of-Way and Access Road Maintenance

SoCalGas' spending varied from $1 to $2 million a year during 2011-2015 for this activity. The workpapers show plans to spend an increased, and more consistent, $5 million per year in the next GRC cycle. SDG&E's workpapers propose a "review of right of way and other conflicts and resolve such matters" activity at the enhanced level of $32,000 per year; but as described in the RAMP report the enhanced mitigation is the same activity that SoCalGas proposes for $5 million a year. Staff believes the RAMP description of this activity for SDG&E's plan is overstated.

Leak Surveys

CPUC General Order 112-F is a recently updated regulation that adds Class 1 and Class 2 locations (less populated, rural areas) to the sections of transmission pipeline that must be leak surveyed. The RAMP report states that both utilities expect to add 1,800 miles of pipeline to the currently surveyed 800 miles. Staff assumes that there was a copy/paste error in the SDG&E figures since SDG&E total pipeline mileage is actually much less than SoCalGas'.

For SoCalGas, the spending for leak surveys has steadily increased since 2011 and the proposed GRC spending continues that moderate upward trend. For 2015, the SoCalGas cost was $467,000 while the proposed annual cost range is $470,000-$520,000 as shown in the workpapers.

PSEP Valve Automation

PSEP includes a Valve Enhancement Program to enhance system safety by installing and upgrading valve infrastructure to support the automatic and remote isolation and depressurization of the transmission pipeline system in 30 minutes or less in the event of a pipeline rupture.

The proposed program is an enhancement in the sense that although it is required by CPUC orders, it appears there will be more installations during the next GRC period than previously and/or the work was not previously funded under a GRC. The workpapers provide some insight into the scale of these activities from the proposed spending amounts. Staff believes it would be useful to provide details such as the number of valves to be installed and proportion of the transmission pipeline that will be remediated by this enhancement.

RSE Applied to this Risk, and the RSE Results

The RAMP report presents RSE figures for the current controls but not for the proposed incremental mitigations. In response to a data request, the utilities state that there are limited new or expanded activities in the proposed plan so that RSE cannot be determined; and that the RSE will remain about the same. How did they conclude the RSE will be the same without performing the RSE calculation?

One of the expectations of the RAMP process is to provide guidance on the amount of risk reduction expected for the proposed increased cost of mitigation programs. Significant cost increases are indicated for the next GRC. The proposed mitigation costs will be due to new regulatory requirements so that these mitigations will be required by code regardless of risk spending efficiency. Nevertheless, the purpose of the RAMP is to show the expected benefits for the requested money.

The Sempra Utilities provided figures for the Risk Spend Efficiency of current controls by grouping them into broad categories of related activities. This grouping was done in order to attribute costs, which could only be roughly estimated by category because of current accounting methods. The categories for RSE proposes are: Compliance Activities; Integrity Management; Technical Training; and PSEP. However, all four of these categories are related to compliance with safety regulations.

For each of these four categories, the utilities reviewed PHMSA data for significant pipeline failure incident rates per million persons, by State. The PHMSA data was sorted for risk drivers appropriate to each category. Staff notes that it was necessary to review the workpapers to fully understand the choice of data and the analysis behind the RSE calculations. It would be helpful to provide this information in the body of the RAMP report.

Notes on Integrity Management

For Integrity Management (TIMP), the Sempra Utilities reviewed PHMSA data for significant failures caused by the risk drivers of corrosion, material defects or weld flaws. Those drivers are appropriate for mitigation by TIMP. From this data, the rate for the worst-performing state (Louisiana, in this case) was selected as a yardstick to measure the risk

reduction achieved by current Controls. If current controls cease, the SCG and SDG&E incident rates would degrade to at least that of the worst-performing state.

From the PHMSA data set of significant pipeline failures per million persons, SoCalGas and SDG&E have an incident rate of zero, while Louisiana's rate is 1.12. The difference in rates was divided by SoCalGas' or SDG&E's pipeline incident rate from all causes, and modified by the proportion of remediated assets under the TIMP program to determine the residual risk multiplier. The SCG multiplier is 9.7, so the risk score is presumed to increase by 9.7 times should current controls cease. The risk score was then multiplied for the seven-year duration of the TIMP program and divided by the total project cost range over seven years to determine the RSE range for the current Integrity Management mitigations. The RSE range result of 4.3 to 5.2 ranks this category 3rd most effective out of the four considered by SoCalGas. Similar calculations were done for SDG&E.

Staff is concerned that the utilities chose to compare their pipeline incident rate to that of Louisiana for the TIMP risk category. Their assumption is that if current controls were not continued, their incident rate would increase at least to that of Louisiana. However, gas pipeline operators in Louisiana must also follow the same Federal regulations for pipeline safety. The actual degradation of incident rate could be far greater than Louisiana's rate so the RSE would actually be much more efficient.

But the circumstances that produce a higher incident rate for the selected drivers in Louisiana may not be comparable to those in Southern California. The damp climate in Louisiana may produce more corrosive conditions for steel in the ground even though operators there must comply with the same level of corrosion protection required under Part 192. Then the Sempra Utilities' incident rates may not degrade as far as the level of Louisiana. Perhaps a better standard for comparison would be pipeline failure rates from areas where no regulations are observed at all and where soil conditions are similar to southern California.

CONCLUSION

In this chapter Sempra Utilities clearly outlined the risk and risk drivers. Staff found that the utilities adequately described the controls in general terms within the chapter and that the additional details within the workpapers provided to satisfy requests for data were helpful to get

a better understanding of the breadth of programs/projects for controlling the risk. They outlined plans for enhancing existing mitigations to further reduce risks going forward.

However, the utilities did not present RSE figures for the proposed mitigations for either company. The choices made for some of the benchmark performance data, such as comparison of corrosion-caused failures to that of a state with very different soil conditions like Louisiana, raise questions about the validity of the comparisons.

4.5 SDG&E-1 Wildfire Risk Mitigation

SUMMARY

This chapter addresses the risk of wildfire caused by utility assets owned by SDG&E. Wildfires in 2003 and 2007 burned almost 650,000 acres within SDG&E's service territory, destroyed over 5400 electric facilities, damaged 180 electric facilities and resulted in 21 fatalities. More recently, in 2014 there were 14 wildfires that resulted in 26,000 acres burned and over $60 million in damages.

SDG&E has described the worst case scenario as follows – *"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."*

SDG&E has initially proposed a combined Capital and O&M total mitigation spending that appears to approach $400 million per year. The risk score for wildfires was calculated by SDG&E to be 2,551,888, making it the utility's highest scored risk category.

In its submittal, SDG&E identifies 10 drivers of safety risk:

- Downed conductor
- General equipment failure
- Water-related failure of electric equipment
- Contact by foreign object
- Failure of third-party attachments
- Vegetation contact
- Not observing operational procedures
- Lack of internal or external coordinated response
- Extreme force of nature events
- Climate change adaptation impacts

Eight mitigation categories are proposed in this chapter and can be classified as prevention (distribution system hardening, inspection, and repair, aviation protection, vegetation management, advanced protection, incremental distribution system hardening, inspection & repair programs including Cleveland National Forest, and transmission hardening, inspection and repair programs), and response (advanced detection, rapid response).

STRENGTHS

Staff found that SDG&E adequately described the controls when compared to its annual Fire Prevention Plan (FPP), although not as detailed. Given the resources to develop the annual FPP and the operational importance of the FPP to SDG&E's wildfire responsibilities, future RAMP submittals on wildfire would benefit by mirroring the FPP controls in terms of mitigation measures and how they fit within the larger operational context.

In an earlier chapter on probabilistic modeling, SDG&E describes its use of a Wildfire Risk Reduction Model (WRRM) that it developed to assess the safety risks associated with equipment failures that lead to ignitions. This modeling effort utilized a variety of different sources of data along with geospatial analysis to identify:

- Likelihood of failure at each pole based on equipment and equipment characteristics.
- Likelihood of ignition from a failure based on vegetation and weather conditions.
- Estimated fire spread given initial conditions of fuel and weather.
- Damage to property was estimated using land parcel data.
- A risk score was calculated based on the factors related to failure, ignition, fire spread and potential damage.
- Improvements to each distribution pole were then incorporated into the model and risk reduction determined.
- Locations and poles with the largest risk reductions were determined to identify largest risk reductions per dollars spent.

SDG&E states that from 70 to 90 million fire simulations were run across SDG&E service territory. Future uses of WRRM will include other risk reduction considerations such as fire suppression activities and vegetation clearances around structures. Impacts from climate change could also be modeled to look at potential future trends in wildfire risk.

Modeling such as that used by SDG&E for wildfires may also be applicable for other electric safety risks, particularly physical integrity and public safety.

AREAS FOR IMPROVEMENT

Staff recommends that this particular safety risk be more closely linked with the SDG&E Fire Prevention Plan (FPP). That document, in complying with Ordering Paragraphs 2,4, and 5 of Commission Decision 12-01-032 (the "*Fire Safety Order*") and Standard 1E of General Order (GO) 166, focuses on a comprehensive and integrated assessment of the risk of fire posed by SDG&E's overhead electric system. In that document, SDG&E's organizational and operational activities are comprehensively described and broken down into five categories –

1) Minimizing sources of ignition,
2) Operational practices for reducing the risk of ignition,
3) Mitigating the threat of fire: awareness and readiness,
4) Fire suppression and recovery and
5) Community outreach and public awareness.

The Fire Prevention Plan is founded upon the goal of minimizing the probability that the various components of its sixty-nine kilovolt transmission and twelve kilovolt distribution system might become the original or contributing source of ignition for a fire. These programs include gathering and analyzing the data from SDG&E's extensive weather network. 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, which in turn facilitates the immediate organization and implementation of the SDG&E response appropriate to the threat.

For future RAMP filings, it would be appropriate that the RAMP workpapers and Risk Mitigation Plan for wildfires more directly relate to and be reflective of the most recent FPP and the anticipated next three FPPs. The workpapers in particular should be a vehicle for describing in detail the technical analysis that is used by SDG&E upon which it based its' FPP and GRC proposals. Since the FPP describes program and operational initiatives within the context of SDG&E's corporate safety goals, the wildfire risk mitigation plan should identify FPP components and how identified tasks and costs relate to proposed activities described in the FPP.

Similarly, in the future the utility should submit working papers that provide the technical information behind what options were considered, how choices were made and expected outcomes. RAMP working papers need to describe current activities, new mitigation options, current risk score and alternative risk scores based on chosen mitigation, and why utility believes it has chosen the optimal strategy for mitigating safety risk.

Chapter Specifics:

Below outlines whether the chapter met the required RAMP criteria and objectives:

Risk Specific Information

Describe the Risk

In the wildfire chapter (SDG&E-1), the utility sufficiently identifies the risk drivers and the current baseline of mitigations.

Risk Classification

The classification of this risk as electric is accurate.

Potential Drivers

Thorough descriptions of potential drivers were presented in the chapter.

Potential Consequences

There was sufficient listing of potential consequences. However, SDG&E should consider adding firefighting costs as a consequence.

Risk Scoring

Reasonable Worst Case: The description of the worst case scenario is generic but sufficient. Given that past wildfires have led to thousands of acres of damage, lost property, and fatalities it would be difficult to conceive of a scenario that is worse than some of the wildfires previously experienced in that region of the state.

The Frequency Score and its Impact on the Overall Score: The frequency score of 5 is reflective of San Diego's recent wildfire history where large wildfires have occurred in the eastern portion of their service territory in 2003 and 2007 and wildfires closer to the coast in 2014. Frequency of wildfires is expected to occur every 1 to 3 years, resulting in a residual frequency of 5. In the future, climate change may impact the frequency and size of wildfires.

Baseline Mitigation Plan

While the description of the baseline mitigation plan goes through its list of current mitigation efforts of; 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 detection programs, it is prefer that it the future this section in particular is directly aligned with the FPP. The 2016 FPP more thoroughly describes SDG&E efforts to minimize sources of ignition, operational practices for reducing risk, mitigating the threat of fire and fire suppression and recovery. Since these activities are all funded through the GRC, the RAMP should provide the financial details of those activities described in the FPP, including program budget, schedule, and key performance indicators.

Alternative Mitigation Plans and Their Relative RSE, if any

Two alternatives were presented in this chapter, 1) extensive use of falling conductor protection (FCP and undergrounding of overhead electric service. There was no calculation of risk spend effici3ncy for these alternatives. In particular, for the FCP alternative, SDG&E proposed replacing its current FPP with the exclusive use of FCP. It is not clear why extending the installation of FCPs to more locations on circuits in Fire Threat Zone initially would not be a cost effective mitigation for reducing riskwith collateral benefits of improving worker and public safety. It would be appropriate to further vet this alternative to determine if there is a point of diminishing returns in terms of installation of FCPs on SDG&E's distribution system in the fire threat zone. Another factor not explored in this chapter is how FCP installation will take place from 2017 – 2019 and how it will be determined what locations and in what order installation will occur during this period

Proposed Mitigation Plans

SDG&E's baseline mitigation consisted of six mitigations. It is proposing the same mitigations but with expanded scope and associated funding. In both the baseline and proposed mitigations, closer alignment to the FPP would better enable review and understanding of how SDG&E plans to implement these mitigations and impact fire safety.

There is a significant increase in funding associated with the six mitigation programs proposed by SDG&E. Overall, taking into account the difference between the highest proposed total mitigation spend of $1.25 billion compared to the baseline mitigation costs of $138 million,

there would be an almost 1000% increase in spending, averaging $400 million per year for wildfire mitigation. Total proposed mitigation capital costs from 2017 to 2019 range from $934 to $1,214 million.

For the GRC, staff recommends that the utility prepare a working paper for each of the six mitigation programs to describe how it differs from the current baseline, specific tasks, budgets, schedule, and key performance indicators associated with each program. These working papers should be able to describe in detail how the program relates to the FPP and how an increased program scope and investments will impact safety risks.

RSE Applied to this Risk, and the RSE Results

The Risk Spend Efficiency (RSE) as specified in D.16-08-018 is an attempt to look at the cost effectiveness of proposed mitigation programs by explicitly including a calculation of risk reduction and a ranking of mitigations based on risk reduction per dollar spent. Since this review is intended to evaluate the safety implications of the proposed RAMP Risk Mitigation Plan, RSE could provide some insight into how effective the proposed mitigation should be expected in reducing risk.

One observation from reviewing this section is that the RSE analysis examined nine mitigation programs rather than the six programs specified in its tables. The three additional programs, aviation protection and advanced detection, and advanced protection were included in the RSE analysis and it is difficult to align the proposed GRC costs with the RSE because of this detachment between the mitigation programs defined in the Cost Tables and the mitigations programs specified in the RSE. Similarly, the descriptions of the mitigation in Section 8 on RSE were more specific than the descriptions in Section 5 on the baseline risk mitigation plan and Section 6 on the proposed mitigation plan.

This disconnect also continues in the RSE mitigation descriptions such as in the section on Advanced Protection where it states that “SDG&E expects to install on 10% of their circuits” advanced protection which staff assumes is related to hardware that is not described in the utility’s submittal. This section also separates inspection, repair, maintenance and replacement programs into to subcategories, distribution and transmission. Since it is assumed that transmission programs are not under the jurisdiction of the CPUC and will not be included in the GRC, the RSE should clearly differentiate between the non-CPUC jurisdictional costs associated

with systems reliability and the CPUC jurisdictional safety programs. The inclusion of non-CPUC jurisdictional programs into the GRC analysis could lead to unnecessarily conflating the safety and reliability risks.

While the RSE analysis demonstrates cost-effectiveness to the level that the risk and cost estimates will allow, there is not enough transparency in the calculations, so it is unclear the estimated impact on safety. The use of RSE calculations could identify the alternatives with the greatest risk reduction per dollar spent; though they do not necessarily identify the mitigations that will have the greatest impact on safety.

CONCLUSION

This chapter begins to provide insight into how SDG&E plans to mitigate fire safety risks associated with wildfires from 2017 to 2020. As a first attempt at meeting CPUC requirements it does enable regulators and intervenors a better understanding of how investments funded through the GRC will support wildfire mitigation programs.

In addition, as specifically called out in the Scoping memo, based on the RAMP filing, staff is currently unable to completely assess whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed wildfire mitigation spending have been adequately analyzed and discussed. This area might benefit from further exploration in a workshop.

What is clear from this first effort is that there needs to be a hierarchy of documents that support the RAMP effort in order to provide a comprehensive grasp of the utility's efforts and how GRC funds and mitigation programs will ensure a safe and reliable electric grid.

This hierarchy should begin with the utility's Fire Prevention Plan, with enough specificity to allow reviewers to understand what activities and investments will occur under a mitigation program. This plan should then feed into separate workpapers for each program that detail how GRC will fund risk mitigation activities that improve and impact key safety performance indicators during the three year period. These working papers should have enough detail to enable a thorough technical review of the proposed risk mitigation. Finally the RAMP Risk Mitigation Plan should summarize what is contained in the working papers while directly relating to the FPP.

5 ANALYSIS OF OTHER RISKS

5.1 SCG-5 AND SDG&E-9 WORKPLACE VIOLENCE

SUMMARY

The review of both SoCalGas and SDG&E chapters on workplace violence were combined. Workplace violence is characterized as a violent incident associated with the workplace and is a crosscutting risk based on employee conduct. Unfortunately, the worst case for the companies involves: *"An active shooter at a well-populated company facility that takes action, which results in injuries and fatalities."*

The violence includes emotional, physical and psychological harm to an employee or third party. The potential drivers listed are human error, process failure, and system failure as well as circumstances that could contribute to workplace violence.[19] The SoCalGas and SDG&E mitigation efforts focus on two main approaches each with two types of controls. Being prepared is the first approach utilizing 1) training, and 2) planning, situational awareness and incident management. The second approach is to limit access through 1) physical security systems, and 2) contract security personnel. The current baseline mitigations have been developed over many years and many performance metrics should be available for measuring program efficacy.

The plans for improving mitigations include security enhancements to infrastructure and security guards posted at company facilities where each improve access control, intrusion detection, and interdiction capabilities, to deter, detect, delay, or help prevent undesirable events at company facilities. Physical security system upgrades, including, improvements with access control, intrusion detection systems, and interdiction capabilities. Employ contract security (security guards) to secure and physically protect assets and people.

The preparedness activities within the planning, awareness, and incident management category include enhancing services to manage the Workplace Violence Mitigation Team,

[19] The companies noted that extremist ideologies, personal conflicts, and mental health issues could contribute to increase frequency or impact of workplace violence incidents. Most workplace violence involves assault, verbal and psychological abuse. Rarely are there fatal incidents that involve active shooters which grab the headlines.

training, investigations, employee awareness, new hire screening processes, employee assistance and wellness programs, and corporate security's risk management program.

This risk had a total score of 23,107 largely based on the low frequency score of 3 (once every 10-30 years).

Mitigations

The Companies propose to maintain the existing baseline mitigation activities and complete similar security projects to increase protection, e.g. installing or updating access control and detection capabilities at facilities that have employees. Two expanded activities: 1) to add security guards to new locations, 2) SDG&E must comply with Senate Bill (SB) 3, effective January 1, 2017, which increases minimum wage costs of existing mitigations.

In addition, the companies propose to upgrade the systems used in the Planning, Awareness and Incident Management categories. This system is approximately ten years old, the upgrade will facilitate:

Case Management: Due to the increased number of requests for information from state and federal regulatory entities create a greater need for system upgrades. New functionality is needed for querying of data different levels of detail. The companies are still exploring whether existing systems used by Sempra for other purposes may provide suitable incident/case management services to meet this increased need.

Social Media Monitoring: Increase social media monitoring for emergency notifications, incident updates, threat identification, customer communications, and to identify the misuse of branding.

Risk management: Federal and state mandates and requests for information require workplace violence risk management (E.g. to identify and prioritize threats, vulnerabilities, and consequences). The mitigation proposes to hire another FTE to handle increase in this workload and to assist with security planning and mitigation development.

Corporate Security Agent: Due to increase in Corporate Security services, regulatory requirements (e.g. RAMP), detailed security planning and reporting. SDG&E's has two agents. SoCalGas' has four agents. The mitigation proposes to hire more agents.

STRENGTHS

The companies did a good job outlining the current risk mitigation programs/projects within the 2 main approaches: 1) Physical security systems and contract security; 2) Planning, awareness and incident management; a) Workplace Violence Mitigation Team (WVMT), b) Training, c) Investigations, d) Employee awareness, e) New hire screening, f) Employee assistance and wellness programs, g) Incident case management system, and h) Risk management program.

AREAS FOR IMPROVEMENT

These are some areas in which additional information or a more detailed description might help clarify the RAMP filing for this risk.

Analysis of Alternative Mitigations

1) First Alternative: Training Changes:

Outsource training or develop computer-based training. These two options sound like completely different alternatives which would have different approaches and affect different aspects of operations. The companies need to separate these alternatives and do a better job explaining the positives and negatives of each. The potential intersection of these 2 choices appears to be the elimination of company instructors. This was not adequately explored in chapter to determine whether either or both could be cost effective given that the results of the alternatives are not known.

2) Physical Security Tradeoffs:

Use either Physical security systems (cameras, fences, etc.) or guards as alternatives to each other. Some company locations would only have security guards while others would only have security systems. The potential benefit to this alternative is a reduction of costs; however, it was stated that this would also increase the risk exposure. It wasn't clear whether the company explored various combinations and the mix of manned and/or security systems at company sites based on the probability of risk events in order to optimize the risk profile. It appears that these two choices are not mutually exclusive, and may be complementary with some mix of implementation that optimizes the risk reduction.

Risk Spend Efficiency:

The companies acknowledged in the RAMP report that their RSE development is in its infancy and Staff agrees that this area needs additional work in this chapter.

The risk mitigation plans seem to focus on almost entirely on the violent incidents (e.g. robbery, indecent exposure, workplace violence, and assault) that are comparable to Federal nationwide statistics. The use of United States Labor Department nationwide crime statistics may be poorly correlated to SDG&E and SoCalGas demographics. However, SDG&E and SoCalGas state that "(t)his proxy seems reasonable because it enables the comparison of the Utilities' workplace experience over time to the national experience." Staff believes a better comparison and counterfactual would be to the experience of other employees at other peer utilities to get a better RSE and bench mark. If the companies can show that the company experience can be correlated to the nationwide statistics, then that would provide a more plausible counterfactual. It maybe that a local correlation in crime statistics in the service territory would be a better gauge to measure performance and develop the RSE, but only if the like crime incident rates are matched to like incident types experienced at the companies. Otherwise that conflates apples to orange comparisons.

The company statistics need greater transparency and break down into the different types of incidents and related causes. The different incidents should be matched to the associated mitigation activities and programs and the counterfactual should match the incident type (e.g. robbery statistics versus robbery statistics, et al). There are likely to be significant cross over and more than one incident type will match to a mitigation and vice-a-versa and a transparent method of grouping should be used.

It appears the companies want to contrast and create a counterfactual from which to estimate the Risk Spend Efficiency (RSE). However, in this case the counterfactual completely ignores that across the nation federal, state and local jurisdictions expend significant amounts of resources on risk mitigation activities to reduce violent crime with varying degrees of success (probation, prisons, policing, courts, rehabilitation, counseling, violence intervention programs and juvenile offender programs).

That all those mitigation activities may have an impact, but their impact in relation to the companies has not been factored into the equation and the RSE. Therefore, the use of federal crime statistics should be qualified when used as a counterfactual to allow the companies to also take into consideration and show the level of mitigations being used to come up with an apt comparison for RSE. Therefore, the RSEs calculated based on estimates of potential benefit from increased spending for SDG&E and SoCalGas mitigation activities is very difficult to understand given the ambient crime level in the local communities in which it operates. Maybe there is a point where it is impossible to reduce the risk no matter how much resources are applied to risk mitigation, given the inherent nature of mankind, and if that is determined to be the case, then that baseline should be acknowledge.

There is a marked difference in incident rates between the two companies as well as funding levels for different mitigation programs and each utility should develop its own RSE and not combine together. Staff noted that SDG&E spends about $1,800 per employee and SoCalGas spends about $400 per employee for baseline mitigation programs. Intuitively, there appears to be causal relationships between incident levels and with the type of work and demographics of each's workforce and type of utility service as well as the amount spent per employee. More needs to be done to develop counterfactual scenarios that provide a realistic basis to calculate an RSE separately for each utility.

There could also be a situation where one utility has significantly reduced its incident rate that there may be diminished benefit from mitigation activities that have little impact on risk reduction (SDG&E has a significantly lower workplace incident rate 0.9% in 2014, which is also about half the national average shown in the chapter workpapers).

CONCLUSION

After review of this chapter staff determined that given the level of maturity of the RAMP process and reporting framework developed to-date, that in general SDG&E has met the requirements for this chapter except as noted below.

In this chapter the joint utilities clearly outlined the risk and risk drivers. Staff found that though the utilities adequately described the controls in general terms within the chapter, that

additional details provided to satisfy requests for data, were necessary to get a better understanding of the breadth of programs/projects for controlling the risk.[20]

The joint utilities noted the current limitations of RSE in this RAMP, in this chapter on Workplace Violence Staff found that the RSE was not intuitively matched to the risks and that the various risk drivers and consequences did not match well with counterfactual offered to rate the RSE of the existing and proposed mitigation programs.

Because this risk has many potential factors that could impact the risk drivers and potential consequences the future RAMP needs to break down the incident types and match them to their mitigation activities to show the causal link between risk mitigation and reduced risk. SoCalGas needs to do more work to improve the correlation of the RSE to the baseline risks and the proposed risk mitigations in order for the RSE to be used as intended. The underlying data used for calculations should be replicable and consistent with verifiable sources.

5.2 SCG-6 PHYSICAL SECURITY OF PHYSICAL GAS INFRASTRUCTURE

SUMMARY

This chapter on security risks to gas pipeline facilities follows a standard outline, addressing most of the Commission's requirements. Physical security includes fences, gates, and cameras. Contract security involves third-party security guards. SoCalGas proposes to continue current mitigations and calculates that incremental proposals offer lower RSE compared to the current controls. Alternatives are briefly discussed but no RSE is presented for the alternatives.

SoCalGas describes this as an Operational Gas risk. The reasonable worst case scenario is: *"A terrorist group uses explosives to rupture major transmission lines, which results in a fire. Employees and members of the public may sustain injuries. This also may result in severe disruption to the gas supply with potentially widespread curtailments of both core and noncore customers."*

[20] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Employee, Contractor, Customer, and Public Safety (Chapter SDG&E-3-WP)

The risk drivers are: intentional damage, human error, process failure, and system failure. SoCalGas followed their standard 7x7 Risk Evaluation Framework to determine a risk score of 23,107. This risk is ranked 6th among SoCalGas' risks.

Current control categories include: Physical Security, Contract Security, Operational Resiliency, Planning Awareness, and Incident Management. Incremental mitigations are proposed for Operational Resiliency and Physical Security.

STRENGTHS

SoCalGas has presented good information on the current controls in place for reduction of risk to physical security of pipelines and related facilities. Incremental mitigations are proposed and RSE is presented for both current and incremental measures. However, the absence of RSE for the alternatives highlights the need for a more robust method of risk assessment and decision making.

SoCalGas presented RSEs for the current controls and the incremental mitigations. The group of current controls has a much higher RSE (13.2) than the two groups of incremental proposals (2.8, 1.8).

Two alternatives are briefly mentioned: 1) use of outside training resources rather than in-house security agents to train employees on security of facilities. 2) Using only physical (fences, cameras) security, or guards, rather than a combination of both as is proposed. No RSE is presented for comparison with the proposed mitigations.

AREAS FOR IMPROVMENT

The purpose of the RAMP is to provide guidance on the quantity of risk reduction expected to be achieved for the level of funding that will be requested in the next GRC. That information should be included in the discussion of alternative mitigations to provide clarity on why the alternatives were not chosen.

CONCLUSION

Based on our review of this chapter, staff believes that SoCalGas has met the requirements for this chapter and can be the foundation for more detailed RAMP reports and working papers in the future that provide more detail on proposed budgets, schedules and key

performance indicators. Current descriptions give an overview of what can be anticipated in the GRC and with further improvements can significantly further transparency and accountability in GRC proceedings.

The dynamic segmentation approach (previously described in Section 4.1) would provide a clearer means of performing cost-benefit analysis because it assigns a probability of failure, and a potential cost (loss) of that failure, to each uniquely performing segment of the facilities or operations. The costs can then be tabulated and ranked to identify the highest risks, by their potential costs. Proposed mitigations can be considered based on the cost to perform the mitigation compared to the potential cost of the unmitigated risk.

5.3 SCG-7 Workforce Planning

SUMMARY

This chapter outlines planning workforce resources, knowledge transfer programs, training (HR based), technical skills training, and succession planning. The primary worst case envisioned by SoCalGas involves *"An employee performs work that she/he has had minimal experience performing and causes a service disruption, which results in injuries to one or more individuals – whether an employee, contractor, customer or member of the public. A regulatory investigation is opened and/or adverse litigation is initiated."*

SoCalGas includes various sources to illustrate the potential risk drivers and potential risk mitigations. Of the 5 categories of mitigations there were a total of 52 mitigation activities listed in workpapers comprised of 33 baseline technical training, 10 enhancements to baseline across all 5 categories and 9 proposed mitigation programs/projects mostly in technical training.

This particular risk has a low risk score of 5,774 and was included in the RAMP report due to the safety impact score of 4. The baseline project's mitigation spending of $4.7 million increases in the forecast by 49% to $7.1 million, which is the midpoint of the proposed range of O&M spending. The capex costs were identified and included in SCG-2 as part of the training initiatives. SoCalGas did a good job highlighting the potential indicators or drivers of employee attrition that leads to potential consequences. A large part of the expansion of programs involves hiring more people to manage and implement expanded training.

Three alternatives were considered and rejected:

1) To consider not implementing work for planning software and instead maintain the manual workforce planning process. Basically, status quo, do nothing. From a safety stand point this may be viable if the same results could be obtained from manual versus automated planning process.

2) Changes to Knowledge Management:

- Outsourcing knowledge management resources was proffered and dismissed because SoCalGas is concerned that institutional knowledge in critical areas will be lost. It is unclear whether they are out sourcing the training coordinators or the trainers themselves. If the organizers of the training function are outsourced then it would seem there would be little risk of losing institutional knowledge. However, if this means the expert trainers are outsourced then it may be a significant risk of losing key institutional knowledge. There is no discernable reason why appropriately administered expert workforce planning contractors would not be able to understand how SoCalGas' internal processes work and what knowledge is required for SoCalGas to function where they direct an organize the internal expert trainers.

- Maintain the status quo of succession planning process which does not identify the critical roles for knowledge transfer. This alternative seems like a non sequitur and it is confusing why it was included as something they would consider as an alternative.

- Expand "Communities of Practice" for transferring critical knowledge based on detailed workforce planning data that would help determine the appropriate number of learning communities to establish over time.

3) Accelerated Leadership Training Sessions - increasing leadership training sessions should expedite developing leadership skills more widely in the company. SoCalGas dismissed because it would require detailed workforce planning data to specify which trainings to focus on and this data is not available at this time. As a precursor, implementation of new technology to capture and analyze critical roles and trainings is required, which is part of the proposed mitigation activities.

STRENGTHS

SoCalGas adequately described the general nature of the controls within the chapter and were helpful to get a better understanding of the breadth of programs/projects for controlling the risk.[21] The majority of the risk mitigation activities was clearly described and provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents.

The additional workpapers (Chapter SCG-7-WP) listed the programs showing greater detail along with historical and estimated future spending ranges helped show the breadth of programs and projects. These schedules may help correlate the RAMP to the GRC.

Given that this risk scored very low, SoCalGas provided sufficient detail to show the risk mitigation activities tie in with the stated safety risks.

AREAS FOR IMPROVEMENT

Risk Spend Efficiency:

- SoCalGas could do a better job finding comparison metrics which have a causal relationship with the potential improvements. See recommendations for RSEs in chapter SCG-4. It is difficult to imagine that a well-managed company with sound safety performance would stop applying resources to at least maintain the current level of performance. Suggesting that other organizations, peers or populations with poor performance provide a feasible counterfactual benchmark only would make sense if there were noted causal relationships between the counterfactual and the company's situation (the level of resources applied and the type of mitigation activities they use within the environment their systems operate).

- Properly trained field personnel impact incidents, but the report implies that the efforts in workforce planning have been a key driver of the current incident rate of 0.0142 incidents/mm people, which seems unreasonable. There are multiple organizational factors that go into reducing the incident rate and maintaining it at those low levels.

[21] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Employee, Contractor, Customer, and Public Safety (Chapter SCG-c-WP)

SoCalGas does not provide any improvement estimates about what it would cost for the alternative incremental improvements.

The Job Proficiency Curve was confusing:

The use of a proficiency curve based solely on term of service appears to overstate the impact of time on the job and ignores the myriad factors that contribute to proficiency. There is a minimum level of performance for any task, and one must assume that there is an expectation for safety and safe performance for all tasks. That different skills are required for entry level tasks than skills for the most complex tasks, yet for workers performing the respective tasks a minimum level of proficiency is required, as well the work performed safely. A better example(s) should be used in the upcoming GRC to support other causal factors associated with safety performance such as the relationship between training and safety proficiency. Staff are concerned that only years of service are being conflated with job proficiency, which then is conflated with safety.

Absorbing New Employees

- Because SoCalGas has a history of absorbing significant numbers of workers. The potential attritions and turnover appears to be consistent with the recent past. SoCalGas needs to explain why it will have difficulty absorbing employees at the same rate as it has done recently.
- The statistics purported to show the excessive mobility of college educated Millennials, for example, appears to conflate to leaving the company in search of opportunity, though staff interprets the article as talking about changing jobs, not changing companies. These are college educated individuals who appear skewed toward the management track; exactly the type of individual SoCalGas indicate is needed to fill its management ranks. Additionally, recent articles in the media indicate that Millennials are less likely to move around than prior generations.[22]

CONCLUSION

After review of this chapter Staff determine that given the level of maturity of the RAMP process and reporting framework developed to-date, that in general SoCalGas met the requirements for this chapter.

[22] https://www.wsj.com/articles/millennials-are-less-mobile-than-young-people-have-been-in-decades-1487017646

5.4 SCG-8 RECORDS MANAGEMENT

SUMMARY

This chapter outlines records management from the perspective that it involves 4 categories of controls; 1) records management policies and procedures, 2) training, 3) operations compliance and oversight, and 4) information systems management. The conceivable worst case is described as: "*Employees, relying on inadequate records, mismark the location of a natural gas pipeline, which ultimately leads to a pipeline failure. This results in severe injuries and disruption of service for an extended period. This also results in a legal consequences including regulatory investigation with financial impacts.*"

SoCalGas includes various sources to illustrate the potential risk drivers and risk mitigations. The four control categories had a total of 10 O&M mitigation activities listed in workpapers. This particular risk has a relatively low risk score of 4,734 and was included in the RAMP report due to the safety impact score of 5 on the 7x7 matrix. The low risk scores in the other categories contributed to the overall lower risk score. The greatest increase in Capital Expense spending is forecast for upgrading the information management systems. The training category shows the largest percentage increase in O&M spending but in nominal dollars the operational, compliance and oversight category would double to $10.8 million.

SoCalGas highlighted the potential drivers that lead to inadequate record keeping. Other potential consequences could be considered that may help frame the risk in the future, such as, the impact of bad records on asset integrity programs, and improper risk assessment from the lack of data and measurable performance metrics.[23] A key mitigation that helps reduce risk is the ability to prevent and detect issues within the asset infrastructure, record management and record keeping are seen as key functions in that effort. The largest expenditures are forecast in

[23] The theme of the RAMP has been that there is incomplete data available to make risk spend efficiency calculations for many existing and alternative mitigation programs. That work is ongoing to update the data systems in use to measure performance of risk mitigation activities. A sound record management system should provide a basis for obtaining, retaining, managing and analyzing the key operational and administrative metrics that could be used for evaluating RSE, and efficacy of mitigation activities going forward.

information management systems, and the most activities are controlled by administration for record management support, records storage and audits of policy and procedure.

STRENGTHS

SoCalGas adequately described the general nature of the controls within the chapter and the supplemental workpapers were helpful to get a better understanding of the breadth of programs/projects presented for controlling the record keeping risk.[24]

The majority of the risk mitigation activities provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents. The additional workpapers (Chapter SCG-8-WP) listed the programs showing greater detail along with historical and estimated future spending ranges.[25] These schedules may help correlate the RAMP to the GRC.

AREAS FOR IMPROVEMENT

Risk Spend Efficiency (RSE)

Staff found the RSE assumptions and premises to be confusing. The RSE supplemental workpaper details for this chapter were difficult to follow, and inclusion of SDG&E costs was not adequately explained and the figures did not tie between supporting workpapers. The cost estimated in the RSE supporting schedule stated they were combined SDG&E and SoCalGas figures, but the chapter only outlined SoCalGas' Records Management risks, so it was unclear what purpose combining both company's estimated GRC costs served. The SDG&E Chapter 13 on records management indicated that some of their gas records management costs were embedded in SCG's systems but that was not made clear in the SCG chapter.

The RSE premise used for the RSE calculations, based on the counterfactual abandonment of systems and personnel, was confusing and hard to follow. It also appeared to be using incorrect inputs and assumptions that may have resulted in an overstated RSE than reasonable. The change in risk the frequency was calculated using the assumed 600%

[24] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Records Management (Chapter SCG-8-WP)
[25] Ibid.

degradation in risk that would result from abandoning its current efforts for records management that increases the risk score from 4,734 to 33,324.

The RSE appears to be calculated backwards and as a result would overstate the RSE. The following appears to be the issue:

- SoCalGas assumed that the future GRC spending levels would equate to future mitigation costs, though if we are going backward from today, it would seem appropriate to use the spending used to get them to the current state of risk (that equates to the current risk score of 4,734). The trailing 5 years spending would seem like the best figure to use.
- SoCalGas assumed the degraded risk would be an instantaneous increase of 28,589 risk points from 4,734 to 33.324 and persist over 5 years. Where one could argue that the state of risk degrades ratably over the life of the projected 5 years. The ratable change is 5,718 risk points per year (5,718 times 5 = 28,589 total change plus the starting score of 4,734 to get to 33,324 risk score at the end of 5 years).
- The mitigation funding over the trailing 5 years to achieve the current baseline risk score of 4,734 (including Capex and O&M) comes to $96mm.[26] Using RSE formula results in a 0.3 RSE score for maintaining the baseline mitigation.

The other premise is that the incremental increase in spending from baseline would improve the frequency occurrence of incidents by 55%. The problem with this is that the number and type of incidents has not been identified. Looking at the three potential consequences of risk (bodily harm, penalties/fines, and erosion on public confidence) it would appear at the least, these would equate to OSHA reportable incidents in some shape or form.

Because OSHA reportable incidents is the primary metric of safety performance permeating this RAMP filing, it appears that many risk mitigations are acting on the mitigation and reduction of this metric. If this particular incremental risk mitigation activity can change the frequency of risk by 55% it would seem that based on all the other risk spending taking place that this would be a huge bargain. Yet, based on this RAMP filing we know that SoCalGas has a very small OSHA incident rate and that there are diminishing returns to each incremental investment in mitigation activities.

[26] One could argue that the records management function is more than information management systems and that this has been evolving for many more than 5 years and that it did not start at zero 5 years ago and all of a sudden improve. Just as it is as unlikely that the risk would degrade by 600% if the information systems spending for records management ceased today and the status quo using existing systems remained.

Staff is concerned that the benefit achieved from this incremental spending is overstating its potential benefit. As a result the RSE calculation would provide a higher RSE value than may be warranted.

Alternative Mitigations

First, maintaining current practices and policy was discussed. SoCalGas noted that current records management controls are strong. They did not really justify why maintaining the existing processes and mitigations, which are strong, was not a viable cost effective option. Especially given the extremely low incident rates noted in other chapters. The implication was that they had already defined areas for improvement, but that "Maintaining the status quo may hinder these projects from moving forward." This really isn't how the RAMP was intended to work.

Second, centralize the IT record keeping applications rather than manage IT systems for each operational asset group. The arguments provided against this alternative are: 1) the company thinks that each operational asset group should create a system that they think fits their specific needs, 2) inputting records can take considerable time and resources and there is a concern that accuracy and completeness will not be maintained. 3) the effort of inputting documents will disrupt the flow of the existing record keeping organization.

Given the similarity between the gas operation assets within the two major operational asset groups (gas transportation and distribution systems) it appears that there would be significant overlap in the systems needs and data used to manage these assets. The arguments ring hollow and it is not clear why a central system would replace, rather than integrate the systems already in use, such as the GIS, and existing data tables.

SoCalGas fails to identify the benefits of centralizing its systems. Some benefits that seem universal might be standardized policies, procedures and training across the company for records management, economies of scale utilizing common hardware and software, and fewer personnel to manage one system instead of two or three.

The company does not clearly and convincingly articulate the downsides. For instance, one downside was, "inputting records can take considerable time and resources" which seems incongruous.

First, those same records would need to be input into any system in use. Secondly, if they were already input into an existing IT system, then it would seem that those electronic database records should be expeditiously mapped and transferred to a new system's database format if necessary.

Without the specificity describing the challenges, the obstacles to creating and maintaining a centralized IT record keeping and management system do not appear insurmountable.

The costs of centralizing systems were not articulated and it is difficult to compare how they may stack up against the spending proposed for the current proposed systems.

CONCLUSION

After review of this chapter Staff determine that given the level of maturity of the RAMP process and reporting framework developed to-date, that in general SCG met the requirements for this chapter, except as noted.

5.5 SCG-9 AND SDG&E-14 – CLIMATE CHANGE ADAPTION

SUMMARY

Climate Change Adaptation is a long-term strategy for dealing with the expected drivers and potential consequences of significant changes to weather patterns and ecological conditions posed climate change. How those changes play out will vary over time and according to geographic location, but it is prudent for utility managers to begin to assess and plan for expected changes that could impact operations, energy demand and safety. The Sempra utilities, SDG&E and SoCal Gas, have begun this process, and their filings in this RAMP indicate an initial level of mitigation activity that could well increase over the course of the next several decades.

The companies provided differing worst-case scenarios for this risk category. For SoCal Gas: "*An extreme rain event hits the SoCalGas territory after several years of drought resulting in high risk areas giving way to land/mudslides and flooding in low-lying areas. There are damages to access roads and multiple exposures of high pressure pipelines along with one of the pipelines failing. Multiple-year projects are required involving extensive permitting and repairs to restore the infrastructure with millions of dollars in costs.*"

In Contrast SDG&E's worst-case is related to Wildfires*: "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."*

While the underlying assessment of risk drivers, identified threats and consequences are similar for each of the utilities – indeed the residual risk scoring outcome for both utilities is identical – each utility has a distinguishable set of adaptation actions and strategies which, at least at this point, are leading to vary different proposals for potential mitigations and expected costs.

The proposed mitigations for SDG&E appear to be focused on planning and forecasting, such as continuing meteorological support and working in collaboration with climate advisory groups, academics and consultants. The gas utility is projecting increased geological hazard analysis, strain gauge installation for improved system monitoring, and a larger investment in capital expenditures related to improving slope stability and erosion control.

From what could be characterized as minimal baseline controls, devoted to existing activities, SoCal Gas, in particular, projects an approximately eight-fold increase in annual spending for adaptation mitigations from only $700,000 for control activities in 2015 to as much as $14 - $19 million for capital and O&M spending in the 2017-2019 period.

However, what is presented in the Adaptation chapters in this RAMP is evidently only part of the story with regard to utility approaches to the risks posed by climate change.

For one thing, what are commonly called mitigation activities specific to climate change (efforts to reduce greenhouse gas emissions as a way to potentially avoid the worst climate impacts) are not addressed in this analysis. The utilities correctly note that Adaptation is "the adjustment in natural or human systems in response to actual or expected climate changes".[27]

Also, potential consequences of changed conditions attributable to failure to adapt, including catastrophic damage to pipelines, are addressed separately in the RAMP analysis.

[27] This is based on using the United Nations Intergovernmental Panel on Climate Change (IPCC) definition.

But of particular concern is that the SDG&E adaptation chapter failed to discuss some of the utility's existing efforts to assess vulnerability to utility substations located in coastal areas that might be subject to sea-level rise as a result of climate change. Especially useful in terms of thinking about future mitigation projects is the South Bay substation relocation project approved by the Commission (in D.13-10-005 and amended in D.15-01-006).

Perhaps the utility felt that because there is no pending GRC project ask along these lines, it was not relevant to the current RAMP, but clearly it should be incumbent upon utility planners to beginning thinking and preparing for future consequences – which could appear sooner than currently anticipated. For both utilities, it might be wise to refine the expected timeline for planning for Climate Change impacts from 50-100 years, to a 20-50 year horizon.

STRENGTHS

The SoCal Gas risk assessment for climate change adaptation evidences a notable shift in thinking about the vulnerabilities to gas transmission and distribution systems. When threat assessment focuses only on extreme weather events (severe storms, wind storms, etc.) it would appear that gas systems might be relatively more resilient because much of the infrastructure is underground. However, beginning in 2015, the company began assessing vulnerabilities to its high-pressure systems "because a failure or rupture due to a climate-change related risk may potentially result in a catastrophic event" compared to a failure on medium pressure pipelines.

This led to assessment of three geographic areas of SoCal Gas territory – the San Joaquin Valley, the Cajon Pass corridor, and the Coastal valley area – with particular eye toward their histories of drought, subsidence, landslides and mudslides. In its current assessment of identified risks, the above-ground weather impacts and wildfire threats are supplemented by these threats:

- Flooding due to sea level rise
- Subsidence due to drought/groundwater depletion
- Effectiveness of cathodic protection may diminish
- Landslides and mudslides
- Exposure of underground pipelines
- Levee failures

This analysis was a factor in SoCal Gas articulating a clear "reasonable worst case scenario" for use in developing a residual risk score. Given recent weather-related events, this scenario may not be a distant future threat, but something the utilities must take into consideration in the near term.

AREAS FOR IMPROVEMENT

The SDG&E analysis of Safety impacts rests heavily on the potential for increased wildfires, although it also alludes to "long-term power outages…fast moving flood-waters, and extreme heat."

The Chapter does include a table of "vulnerabilities" that are mapped to other RAMP chapters. These do acknowledge the areas of Wildfires, Electric Infrastructure Integrity, Catastrophic Damage to Pipelines (both medium pressure and high pressure), as well as Employee, Contractor and Public Safety.

With SDG&E's proposed mitigations focused on continued meteorology support and its Climate Advisory Group, the utility seems to be exhibiting a too restrictive categorization of the interactivity of risks associated with Climate Change. As part of its ongoing participation in the department of Energy's Partnership for Energy Sector Climate Resilience, SDG&E may want to draw on the experience of other utilities that are beginning to view the climate challenges in a more holistic manner.

RSE for Mitigations

Neither SDG&E nor SCG provided a risk-spend efficiency calculation for Climate Change Adaptation mitigations, "because there is no linkage to adaptive or corrective actions which would have a measurable effect on the probability of their predicted safety consequences."

In the short-term (at least for this GRC cycle) that may be the case, but as noted above, the future may be nearer than the utilities believe.

Alternative Mitigations

SDG&E's cursory showing related to mitigation alternatives is essentially a binary choice: 1. add more expertise through hiring a climatologist, or 2. Continue the status quo.

If nothing else, this appears to exhibit a lack of imagination, especially given the utility's statement that, "Preparing SDG&E for climate change, which in turn helps to keep customers and the public safe, is of utmost importance and has significant value."

It is hoped that future GRCs do more to put that principle into practice with a better thought-out strategy.

The SCG mitigation alternative is singularly focused on use of satellite data – whether to 1. Use publicly available data, or 2. Reduce satellite monitoring with increased use of Strain Gauges. Neither was considered effective to provide predictive capacity for pipeline failures or adequately assess land movement.

CONCLUSION

The Scoping Memo for OII R.16-10-015 and 16-10-016 clearly states that the RAMP reports must address the efficiency of risk mitigation funding, proposed spending, and the level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle. SDG&E and SCG have not fully addressed this requirement, nor have they presented an adequate discussion of alternatives, which would include consideration of risk reduction impact and RSE for the alternatives.

Staff recognizes that this RAMP filing is the first of its kind and that it has been difficult to quantify risk reductions in a manner that will support RSE calculations. Staff recommends that utilities make a determined effort to gather the data necessary to make more quantitative predictions of risk reduction in future filings.

5.6 SCG-10 Catastrophic Damage involving Medium-Pressure Pipeline Failure

SUMMARY

This chapter concerning the risk of medium-pressure (60 psi and less) catastrophic pipeline failures for SoCalGas follows a standard outline, addressing many of the Commission's RAMP requirements. Medium-pressure pipeline is primarily found in gas distribution networks. Staff noted some gaps in the areas of alternatives and Risk Spend Efficiency (RSE).

The worst-case scenario is described as: *"A medium pressure pipeline failure due to a control device malfunction, which results in uncontrolled gas release causing injuries to employees and the public. This also results in over 1,000 customers without gas supply for at least 24 hours."*

The risk drivers and risk score are well documented. Current controls are discussed in detail, as well as proposed incremental mitigations. RSE is presented for groups of the current controls and for incremental mitigations. Two alternative mitigations are briefly presented, but without estimates of risk reduction or RSE.

STRENGTHS

SoCalGas classified the risk as an Operational Gas Risk and calculated a Risk Score of 2,344 using the SEMPRA 7x7 Risk Evaluation Framework (REF) and based on Subject Matter Expert (SME) evaluation of the chosen reasonable worst case scenario. This scenario was: *"A medium pressure pipeline failure due to a control device malfunction, which results in uncontrolled gas release causing injuries to employees and the public. This also results in over 1,000 customers without gas supply for at least 24 hours."*

A satisfactory list of risk drivers was presented and discussed. Current controls are based on regulatory compliance activities and are expected to continue. RSE's are calculated for both current controls and incremental mitigations. The incremental program is to modify SoCalGas' "DIMP DREAMS" program to target a population of 2,200 miles of unprotected steel mains that have historical records of three or more leak repairs in the last 10 years and accelerate replacement of priority pipe to 150 miles per year, three times more than the current rate.

AREA FOR IMPROVEMENT

The assumption behind the RSE calculation for the proposed incremental mitigation of unprotected steel pipe anticipates that if the mitigation is not carried out, the incidence of failures (due to corrosion, or material and weld defects) would degrade to at least that of the worst-performing state (Nevada), modified by the proportion of pipeline that would be mitigated. It is an unusual premise since other risk chapters, like SCG-4, do not make a similar assumption for future risk degradation, but rather use this logic only for cessation of current controls.

Further, there is no discussion of the reasoning that current levels of failure would necessarily degrade further on pipe that has been unprotected for many years.

Other than comparison with the worst-performing state, what evidence suggests that failures in this category will increase by such a rate? Has data analysis shown an increasing trend of failures for the 8,000 miles of unprotected pipe which would indicate the rate could degrade to that of Nevada or worse?

Staff suggests that a better way to determine potential risk reduction is by dynamic segmentation analysis of the pipeline systems, which support assignment of the probability of failure to each unique segment along with a cost of failure, to determine the potential cost of the risk if not mitigated. Then all risks can be ranked by their potential cost, and mitigations can be chosen which are effective in avoiding those costs. RSE would then be the cost of failure divided by the cost of mitigation.

SoCalGas uses a "true-up" multiplier to allow comparison of the risk reduction and RSE with the same risk category for San Diego Gas and Electric. A multiplier of 6x is used to account for the roughly six times more miles of pipe in SoCalGas's distribution system than in SDG&E's. Staff is concerned that while it is helpful to be able to compare from one risk to another, such comparison cannot be made across all the risks in the RAMP report unless all of them have been equated in a similar fashion.

Two alternative mitigations are presented and discussed in some detail. The first alternative was to greatly accelerate the replacement of all 8000 miles of unprotected steel pipe within 20 years, or 400 miles per year. SoCalGas estimates this program would cost over $600 million per year but ignores that much of this pipeline has not experienced a history of leaks. SoCalGas concludes that such a program would not be cost effective in general terms, but does not present an RSE for this alternative. The second alternative mitigation would replace certain vintage steel pipelines that are currently under cathodic protection, but may be at greater risk of failure related to construction and other practices that were in effect when the pipeline was originally built. SoCalGas considers the pros and cons of this program in general but does not present an RSE to permit comparison with other alternatives.

It seems likely to Staff that the alternatives considered would not provide high RSE, but the goal of the RAMP process is to support review of proposed mitigations on a quantitative basis, so that RSE should be presented for these alternatives.

CONCLUSION

The Scoping Memo for OII R.16-10-015 and 16-10-016 issued on 1/11/17 states that the RAMP reports must address the efficiency of risk mitigation funding, proposed spending, and the level of mitigation planned for SDG&E's and SoCalGas' next GRC cycle.

Staff suggests that a more rigorous approach to risk assessment, for example by dynamic segmentation analysis, would lead to supportable figures for potential risk reduction. Staff concludes that while SoCalGas has met many of the Commission's requirements, an expanded discussion of alternative mitigations should include estimates of risk reduction and RSE, and more effort to present the relative effectiveness of mitigations across all risks is needed.

5.7 SCG-11 Catastrophic Event Related to Storage Well Integrity

SUMMARY

This chapter on storage well risk follows a standard outline, addressing most of the Commission's requirements. Consideration of this risk is especially appropriate in light of the recent Aliso Canyon storage well release. This risk is ranked low because of the expected low frequency of this kind of event, the Aliso Canyon incident notwithstanding.

The reasonable worst case for analysis is: *"An uncontrolled release of gas that occurs over an extended period of time due to a storage well structural integrity issue that requires complex well control operations and results in numerous reports of public impacts, supply issues and extensive customer impacts. The release of gas into the atmosphere results in an environmental impact and increased regulatory oversight in the form of new regulations and requirements."*

RSE is presented for both current controls and incremental mitigations. However, the two alternatives are discussed briefly with no RSE guidance provided.

STRENGTHS

SoCalGas describes this risk as an Operational Gas Risk involving compression and storage assets. The risk drivers include: aging infrastructure, internal/external corrosion, forces of nature, human error, and record keeping. SCG determined the risk score of 1,826 by using their risk register process with Subject Matter Experts (SME) and the 7x7 Risk Evaluation Framework, which rates this risk as 11th highest on SCG's list.

Current controls include on-going maintenance work and Capital improvements as well as implementation of an existing SIMP (Storage Integrity Management Program). Incremental mitigations are proposed to expand and accelerate the SIMP.

Two alternatives are briefly discussed. 1: spread out the SIMP assessment baseline over a six-year rather than the proposed four- year timeline. 2: Abandon more of the existing wells and replace them with new ones, without first inspecting the condition of existing wells.

AREAS FOR IMPROVEMENT

No risk reduction or RSE is presented for the alternatives. The RSE for the incremental mitigations is 10 times less than for the current controls, while the proposed GRC spending range of $309 to $406 million is several times that of the current GRC baseline of $47 million. The incremental RSE cannot be compared on an absolute scale to the other risks, so interested parties cannot determine if the level of proposed spending should be funded in the next GRC in preference to other risk category mitigations.

No incident rate or other quantitative measurement of probability of failure was used in the RSE calculation but risk reduction was solely based on SME determination that the frequency score would be adjusted should the mitigations take place.

CONCLUSION

The difficulty in making comparisons between mitigations for the various risks highlights the need to adopt a more robust method to quantify risks on an absolute scale. While SoCalGas has presented some proposed mitigations and RSE, staff suggests that a better way to determine potential risk reduction is by dynamic segmentation analysis of the storage systems, which supports assignment of the probability of failure to each component along with a cost of failure.

From those figures, one can determine the potential cost (i.e. estimated loss) if the risk is not mitigated. Then all risks can be ranked by their potential cost, and mitigations can be chosen which are effective in avoiding those costs. RSE would then be the cost of failure divided by the cost of mitigation.

5.8 SDG&E-3 Employee, Contractor, Customer, and Public Safety

SUMMARY

In this chapter SDG&E outlined a very broad set of risk drivers and related baseline and proposed mitigations. In this chapter SDG&E focuses on employee conduct related safety issues, several ancillary reliability or other enterprise impacts as well as an impact on general safety. Of the 8 categories of mitigations there were a total of 48 projects and programs comprised of 19 baseline, 23 enhanced baseline and 6 proposed mitigation programs/projects.

While some programs/projects address a single risk driver, many of the mitigations impact more than one risk driver. SDG&E did a good job highlighting 5 potential indicators or drivers of employee, contractor, customer and public risk; these are shared with SoCalGas.

SDG&E explained that because this risk encompasses a wide range of activities and that the potential mitigations are extensive; it conducted a threshold assessment from which to identify mitigations to address within this risk.

The threshold criteria used to identify the core activities affecting this risk appear reasonable. The primary focus of the mitigations across this risk are on: maintaining the Health & Safety risk organization, safety and skills training (employee, contractor and first responders), monitoring safety behaviors, analyzing key performance indicators, plant and equipment maintenance, field work inspection, customer communications both to and from, and nexuses with public safety.

STRENGTHS

Staff found that SDG&E adequately described the general nature of the controls within the chapter and that the additional details within the workpapers were helpful to get a better understanding of the breadth of programs/projects for controlling risk.[28]

For the majority of the risk drivers the risk scenario and the proposed mitigation measure was clear and provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents.

The additional workpapers per CUE's data request listed the programs in slightly greater detail along with historical and estimated future spending ranges helped show the breadth of programs and projects. These schedules may help correlate the RAMP to the GRC.

AREAS FOR IMPROVEMENT

Providing Sufficient Detail to Describe the Risk Mitigation Plans

SDG&E provided a sparse outline of its plans for enhancing existing mitigations and new mitigation programs/projects to stabilize or reduce risks going forward. SDG&E noted 23 baseline enhancements and 6 proposed mitigations. The corresponding RAMP chapter discussed three topical areas. More detail in the RAMP chapter on the programs/projects and their features would help correlate it to the workpapers, and should help with a more in depth understanding of the potential impact on risk reduction.

The Frequency Score and its Impact on the Overall Score

The frequency score of 4 indicates the incident rate is once every 3-10 years. SDG&E stated that their substantial controls mitigate the realization of this risk. Staff noted that SoCalGas' rated their frequency risk at 5 (once every 1-3 years); the RAMP does not provide explicit reasons for the significant difference between the two companies. More information supporting the historical incident rates could help provide the support for the frequency score.

[28] Provided to CUE per their data request http://www.sdge.com/sites/default/files/regulatory/Cost%20Workpapers.zip, 2016 Risk Assessment Mitigation Phase Investigation 16-10-016 Workpapers to Employee, Contractor, Customer, and Public Safety (Chapter SCG-c-WP)

Risk Spend Efficiency

Though SDG&E is following the prescribed method for calculating the Risk Spend Efficiency, based on the assumptions and inputs as presented it was not easy to grasp how the 19 baseline, 23 baseline plus enhancements, and 6 proposed programs/projects produce the results presented in the RSE graphs.

In this chapter SDG&E presented a chart that showed the RSE for the baseline and proposed mitigations using the California Occupational Safety and Health Administration (OSHA) and Controllable Motor Vehicle Incidents (CMVI) reportable incident rates. While the CMVI is more easily correlated with the driver training and vehicular equipment upgrade programs and projects, the correlation between the risk and risk mitigations were not so clear for the operational incidents.

There were many other mitigation programs and projects that affect customers and the public that might tangentially benefit from mitigation programs; however no customer or public incidents were used to develop the RSE.

Staff recognizes that it would be difficult to capture customer and public incident rates associated with SDG&E operations and this may be an area where it is more difficult to find metrics designed to measure customer and public risks.

Reasonable Worst Case Used for the Risk Spend Efficiency

The basis for the estimates of anticipated improvement from implementing proposed mitigations is largely a product of Subject Matter Expert (SME) interpretation and possibly opinion. Staff has the same concerns in this chapter's calculation of RSE as noted in SoCalGas' SCG-2 (see 4.2, above). That because there are significant variations in the year-over-year incident rates for both the operational and vehicular incidents, using a single data point from one-year to establish worst case may skew the RSE.

Secondly, it is unclear that degradation in operational and vehicular safety performance would only reach the worst performing peer's level if all resources used for these safety mitigation programs/projects were cut off. Presumably, that peer is applying some level of resources to mitigate safety risks due to the regulatory and compliance nature of the industry.

There exists the rebuttable presumption that that worst performing peer is spending the minimum necessary to comply with all regulatory and legal requirements, and that SDG&E too is trying to minimize resources applied to get the maximum safety result.

CONCLUSION

After review of this chapter Staff determine that given the level of maturity of the RAMP process and reporting framework developed to-date, that in general SDG&E has met the requirements for this chapter except as noted. See Section 4.2 conclusions for SoCal Gas for additional recommendations that may also apply to SDG&E for this risk.

5.9 SDG&E-4 DER Safety and Operational Concerns

SUMMARY

This chapter on examines risks associated with distributed energy resources (DER) such as solar rooftop systems, battery storage devices, electric vehicles, wind turbines and other small devices that operate in parallel with SDG&E's distribution system.

Safety concerns related to increased DER penetration of the SDG&E distribution system related to potential risks to utility personnel. If DERs are energizing the system without utility knowledge, particularly if the utility has de-energized the system from the substation for operation and maintenance purposes, there is the potential of injury or fatalities.

This risk is specifically related to the proper functioning of DER invertors to cease operations upon the loss of a power signal from the utility, known as anti-islanding. The mitigation proposed by the utility assumes that inverters are not reliable in terms of its anti-islanding capability.

SDG&E has identified the worst case scenario as follows – *"First responders and/or Company employees respond to a circuit believed to be de-energized, DER isolation fails to work, and DER energizes/back-feeds the circuit, which could result in a life-threatening injury or fatality to a first responder/employee. This could also result in moderate affects to a critical location or customer (as well as potential customer privacy implications) and/or adverse financial consequences."*

The baseline risk mitigation includes 1) power quality studies of DER interconnections, 2) improved modeling tools and 3) interconnection compliance. The proposed risk mitigation adds an increased outreach program to first responders and anti-islanding test program, increase power quality studies, reduces the modeling effort and shifts interconnection compliance to non-GRC costs.

Alternatives include first responder training rather than an outreach program and relying on the status quo condition of relying on UL certification as verification of the anti-islanding functionality of inverters.

SDG&E has given this a risk score of 73,139 and proposed GRC funding of $1.2-$2.1 million.

STRENGTHS

This chapter provided a satisfactory description of the potential risks and how they were scored. The potential consequences were well thought and addressed how DERs could pose a safety risk to utility personnel.

AREAS FOR IMPROVEMENT

It is not clear from the description in the chapter why the utility suspects invertor performance, whether it is based on experience to date with DER in the SDG&E service territory or whether other utilities with high penetration of DER are facing similar issues. If inverters are performing sufficiently, particularly with regard to anti-islanding, then the proposed risk mitigation plan may not be called for and the current baseline is sufficient at this time. For the GRC proceeding, it should be clear why the proposed plan is necessary, with data on invertor performance in the SDG&E service territory and in the electric industry in general. This chapter did not mention smart invertor, the role they have in current or future DER installations, and whether they have better performance in terms of anti-islanding.

This chapter does not give a full explanation of how interconnection compliance would become a non-GRC cost, going from $1,000 in O&M baseline GRC to $760,000 - $960,000 in non-GRC costs in the proposed mitigation.

CONCLUSION

It is not clear from this submittal whether the additional measures in the proposed risk mitigation plan are warranted. The proposed alternative of relying on UL certification coupled with the baseline risk mitigation may be sufficient unless there is evidence that invertor anti-islanding capabilities are lacking and a significant risk to utility personnel working on the distribution system.

5.10 SDG&E-5 RELIABILITY PLANNING & MITIGATION

SUMMARY

This chapter on the risk of safety impacts due to major loss of electric service due to a transmission outage throughout the SDG&E service territory. SDG&E has given this a risk score of 44,458 and proposed total non-GRC and GRC mitigation funding of $211 to $499 million, with the GRC costs proposed to be $11-$13 million.

At a recent electric utility conference in San Diego, one of the opening keynote speakers was Scott Drury, President of San Diego Gas & Electric. He noted that SDG&E has been recognized as the most reliable utility in the western US for 11 straight years and that 60% of its distribution system is underground. Therefore, it is curious that given its industry leading performance in reliability that SDG&E would consider this a significant safety risk.

In addition, this risk deals solely with risks associated with a transmission outage, and does not consider distribution-level outages.

SDG&E has described the worst case scenario for this risk as follows – *"Similar to the September 2011 Southwest Blackout, the loss of multiple transmission assets due to a significant event. Potential consequences include life threatening injuries or few fatalities. The operational impacts affect critical customers and entire metropolitan areas leading to severe and long-term consequences to the environment. Blackouts may involve regulatory compliance violations, litigation, and financial consequences."*

For proposed mitigations, the only measure relevant to the Commission is the modernization of the utility's primary command center. An alternative is to modernize both the primary and backup command centers. Modernization of control centers has multiple benefits and ideally should pay for themselves through improved efficiency, reliability, and performance.

STRENGTHS

This chapter provides a satisfactory description of risk drivers; it lists six potential drivers including generation constraints, reliability events and natural causes. It is also very clear in describing the specific conditions of blackout that it seeks to mitigate with this risk mitigation plan.

AREAS FOR IMPROVEMENT

In its risk scoring it provides the maximum score of 6 (severe) for health, safety and risk yet its explanation for this ranking is not persuasive and it is not clear that it takes into consideration emergency response measures that would be in effect in case of a large scale transmission outage.

The majority of proposed mitigation is non-GRC related since it is solely focused on transmission outages. The one exception is the proposal to modernize the utility's command centers. For the GRC, the utility should provide more rationale as to why both the primary and backup command centers shouldn't be modernized concurrently to ensure better resiliency in case of a transmission blackout, and how modernizing only the primary command center does not compromise safety and resiliency.

The cost split for the modernization of the primary command center between GRC and non-GRC, with GRC funding making up 85% and needs clearer justification. Particularly if this measure provides significant mitigation to a transmission outage, it may be justified for this measure to be primarily funding through non-GRC sources.

CONCLUSION

Based on our review of this chapter, staff believes that SDG&E has met the requirements for this chapter and can be the foundation for more detailed RAMP reports and working papers in the future that provide more detail on proposed budgets, schedules and key performance indicators. Current descriptions give an overview of what can be anticipated in the GRC and with further improvements can significantly further transparency and accountability in GRC proceedings.

5.11 SDG&E-6 FAIL TO BLACKSTART

SUMMARY

This program is proposing a total mitigation cost of $19 to 22 million, with the GRC funding in the range of $12.7 - $14 million, and has been given a risk score of 44,548. This mitigation plan addresses the safety risk inherent with an inability to restore electric services to customers following a complete blackout or shut down condition due to lack of an interconnection and only available option is a generation Blackstart Resource.

SDG&E has two Blackstart facilities, one at the Miramar Energy Facility (MEF) and another at the Orange Grove Energy facility. There are also several similar facilities in the service territory that are owned by NRG.

SDG&E has described the worst case scenario for this risk as follows – *"Service territory suffers complete blackout, Palomar Energy Center is unavailable. Restoration process fails. Due to prolonged effects of blackout, impacts to community including fatalities, environmental impacts, and financial implications."*

The proposed risk mitigation plan is a significant expansion of 2015 O&M activities of $80K. The baseline plan consists of two measures; 1) maintenance, certification and testing of existing facilities (GRC funding $20K), and 2) annual Blackstart plan review and training (non-GRC funding of $60K). The proposed plan consist of five measures consisting of

- South Grid Blackstart Project
- Modernization of Grid Control Centers
- Substation Backup Power Enhancements
- Maintenance, Certification and Testing of Existing Facilities
- Blackstart Training and Procedure Development

The risk spend efficiency (RSE) score is low for these mitigation measures. Some of the costs are split between GRC and non-GRC. The rationale for the cost allocation between GRC and non-GRC needs to be explained better. Some of the proposed mitigation also benefits other risks, such as the modernization of grid control centers.

The utility provides two alternatives, modernization of both primary and backup grid control centers and diesel generators at major substations instead of fuel cells.

STRENGTHS

This chapter provides a satisfactory description of the risk, the risk drivers and potential consequences. The explanation of impact scores also was satisfactory in identifying the varied consequences of a failure to Blackstart.

AREAS FOR IMPROVEMENT

This chapter could be strengthened with better supporting explanations and workpapers for each proposed mitigation. Particularly because cost splitting for the mitigations between GRC and non-GRC funding how and why the cost are split needs to be adequately explained to be able to properly evaluate the impact of risk mitigation on the GRC. Another uncertainty is inadequate explanation why fuel cells are chosen over diesel generators for backup power. Traditionally, fuel cells are more expensive and are not widely used for backup power generation.

One of the alternatives is to modernize both the primary and backup control centers. Given the importance of these facilities to utility operations the pros and cons of this alternative were not sufficient for staff to understand merits for rejecting this option. SDG&E needs to provide sufficient reasoning and support for the alternatives, and more fully explore the benefits and costs. Also, without performing some sort of RSE it is difficult for evaluators to compare the risk mitigation activities.

CONCLUSION

SDG&E has laid out a strong case as to why it needs to modernize its control center by outlining the risk of failing to blackstart.. The proposed risk mitigations are require a significant increase in funding. For the GRC, it may be worthwhile for the utility to prepare workpapers for each proposed mitigation that details the proposed activity's tasks, budgets, schedules and key performance indicators. From these papers, staff would be better able to conduct technical analysis on the viable of the proposed activities, how costs are determined, potential safety impacts, and the viability of the proposed mitigation and alternatives.

5.12 SDG&E -8 AVIATION INCIDENT

SUMMARY

This risk is an aviation incident by SDG&E contractors, subcontractors or other third parties who may enter SDG&E's service territory that results in damage to electric transmission, distribution and/or gas transmission facilities.

SDG&E has described the worst case scenario as: *"SDG&E helicopter has mechanical failure which leads to aviation crash that results in employee injuries or fatalities and fire."*

The baseline risk mitigation plan is consistent with aviation industry and Federal Aviation Administration standards. Much of the proposed risk mitigation plan is a continuation of the baseline plan that was started in 2015. However the proposed plan includes the addition of a twin-engine helicopter purchase with associated pilot training and aviation safety training program and creation of an aviation advisor, SDG&E has given this a risk score of 23,108 and proposed total mitigation cost of $8-$11.5 million.

STRENGTHS

This chapter gave a satisfactory overview of how SDG&E uses aviation services and the current baseline measures. A thorough listing of operational risk drivers gives a full portrait of the many opportunities for safety events and their potential consequences. The baseline risk mitigation plan of 1) aviation safety management system, 2) job site observation program, 3) service provider audit program and 4) best practices training is a notable program that meets aviation industry standards.

AREAS FOR IMPROVEMENT

The proposed risk mitigation plan takes a baseline plan that costs $80 K to a safety program that costs $8 to $11 million without a clear justification or demonstration of significantly improved safety performance. It is not clear from this chapter whether SDG&E currently owns any aircraft or if aviation work is contracted out to third parties. It was also not clear whether the purchase of the twin engine helicopter noted above would reduce risk and if so by how much. Regardless whether the aircraft are purchased, leased, or whether those services are contracted out the same risks apply. Therefore, it is unclear whether the mitigation activities

that focus on safety can be isolated and examined independently of the asset acquisitions. Given that the risk spend efficiency is significantly smaller than the baseline and ambiguous benefits, it would be difficult to see the proposed mitigation plan, or it's alternative of buying a single engine helicopter, as a worthwhile investment.

CONCLUSION

The aviation safety management system incorporated by SDG&E in 2015 is consistent with industry standards and federal regulation. The proposed plan may be unwarranted given the success to date of the utility's safety management system and significantly greater cost of the utility's proposed risk mitigation plan.

5.13 SDG&E 11 UNMANNED AIRCRAFT SYSTEM INCIDENT

SUMMARY

SDG&E has described the worst case scenario as follows: *"Collision of UAS with infrastructure, manned aircraft or personnel on the ground that damages electric assets or causes injury or death and outage."*

STRENGTHS

The utility provides a satisfactory description of risk drivers and how risk was scored. Proposed mitigation measures are given appropriate justification.

AREAS FOR IMPROVEMENT

Staff finds that given 1) the limited information on SDG&E's UAS program, 2) lack of any data related to accidents involving UAS technologies with electric utilities, and 3) this operation is in a controlled pilot phase and is regulated by the FAA, it is difficult to evaluate whether the proposed mitigations should be funded based on safety performance.

It would also be worthwhile to determine whether SDG&E's UAS program will provide costs savings and other operational benefits. With the proposed mitigation measures aggregated to produce a cumulative risk spend efficiency, it would be appropriate to provide how the mitigation measures would be applied to SDG&E's current and planned UAS program given that it is being carried out under the auspices of the FAA.

A program plan that includes past history, program goals, a schedule with milestones and description of how UAS will be incorporated into utility operations would better enable an assessment of whether mitigation is warranted due to safety requirements.

RSE for Incremental Mitigations

The risk associated with UAS seemed to rely on collisions between fixed wind aircraft and was not specific to UAS commercial operations. All mitigation measures are aggregated resulting in one RSE result; therefore there is no basis for comparing various proposed measures. Breaking out each mitigation measure individually to better assess how each would impact safety would allow for a better grasp of how mitigation would impact safety risk.

Alternative Mitigations

The two alternatives are first, outsource UAS services to contractors and second, to carry out UAS operations that conform to ICAO and FAA frameworks but without a safety oversight approach, which is the status quo. Given that SDG&E is already developing a UAS program and is working with the FAA to conduct rigorous testing, the first alternative would result in the loss of experience and expertise gained to date in the pilot phase of this program. The second option appears to be more feasible, given that air safety is being addressed through FAA oversight and requirements.

CONCLUSION

This is a new operational capacity for SDG&E resulting from the emergence of unmanned aircraft systems for commercial operations. Given that this is an operation that is still in its pilot phase and it is not clear from the materials submitted how the utility will utilize UAS in its operations, this proposal should be tabled at this time. Further, the CPUC should assess whether this risk is under its jurisdiction, since operation of UAS is regulated for safety by the FAA and has limited impacts related to the electric infrastructure and public safety.

5.14 SDG&E-12 INFRASTRUCTURE INTEGRITY

SUMMARY

This program is proposing a GRC Capex request of between $456 million - $593 million and has been given a risk score of 5,112. Activities associated with this program address the issue of aging infrastructure that could lead to equipment failure with resulting safety impacts primarily focused on overhead, underground and substation asset failure.

The current proposal has activities focused on equipment, specifically transmission, distribution and substation assets, outside the Fire Threat Zone (FTZ).

SDG&E has described the worst case scenario as follows – *"An energized wire down event occurs due to overhead electric infrastructure failure. While energized, the downed wire caused arcing, fires, and damage to structures, causing serious injuries to anyone within the ground vicinity. This event also results in claims, litigation and associated financial impacts."*

The baseline Controls are meant to address: 1) premature overhead failure which includes controls such as its Corrective Maintenance Program including pole replacement, 2) premature underground failure including cable replacement, removal of equipment not meeting current safety standards, 3) premature substation failure including the condition based maintenance program with monitoring devices for asset health assessment, and 4) System modernization.

Proposed risk mitigation expanding the baseline programs. For example, the proposed Premature Overhead Failure mitigation includes a Wire Correction Program which consists of

1) Utilizing a probabilistic risk model - expanding the premature overhead failure effort to replace or protect the assets most prone to failure based on analytic data analysis applied to non-FTZ circuits.
2) Deploying Falling Conductor Protection (FCP) in non-FTZ areas where several contiguous spans of three-phase #6 wire exists on the distribution system. This effort would require infrastructure upgrades switches, control and communications hardware.

This effort is aimed to address the top 25% of projected wire down risks over a ten years.

Other proposed risk mitigations is

- Pole loading program to assess and document existing poles and their condition,

- Post-Construction True-Up Quality Assurance and Quality Control program with emphasis on field inspection and documentation of pole loading conditions, improvement in construction standards and work methods, and follow-up for poles with high risk of failure,
- A 4 kV modernization program which continues conversion of 4 KV systems to 12 kV standards,
- Modernization of substations including elimination of 12/4 kV step-down transformers,
- Expand Condition-Based Maintenance to include transmission and substation battery assets,
- A 10-year System Modernization mitigation targeting assets expected to fail or cause potential safety risk within the next 1-10 years, and
- Advanced SCADA Program to increase situational awareness using advanced automation and control.

STRENGTHS

Staff found that SDG&E adequately described the general nature of the controls within the chapter and provided a persuasive case for why these mitigations are needed. There is a broad array of mitigation programs to improve asset integrity that will have safety benefits.

The risk scenario and proposed mitigation measures were described sufficiently to understand the intent of the measure and how it related to risk drivers and potential impact on safety.

AREAS FOR IMPROVEMENT

In the tables listing the baseline and proposed risk mitigation plans, there appears to some mitigation programs that have non-GRC costs, in particular, premature substation failure in the baseline plan where the GRC covers 35% of the costs. The differences between GRC and non-GRC costs could be further explained so that it is clear what current activities are addressing and how the proposed mitigation will differ from current efforts.

Future RAMP risk mitigation plans would be strengthened with an analysis of alternatives that specifies the cost to safety impacts.

This would enable technical review of proposed mitigation against the alternatives as a means for optimizing investment to improve safety.

The RSE also provided and utilized calculations in the detailed RSE worksheet provided per the CUE data request. That analysis was used in the RSE calculation to change the frequency of incidents. These supporting calculations were difficult to follow. In the future greater emphasis should be placed on the supporting documentation to explain how and why some assumptions were made and how they impact the RSE calculation. Without that it is difficult to follow and ultimately place confidence in the resulting RSE scores.

In addition, there were references made in the Wildfire chapter (SDG&E-1) concerning the probability of number of wires down that ultimately lead to ignition and those ignition events that lead to a catastrophic wildfire incident.

It appears that probabilistic analysis of the different segments of assets and the relative risk for each segments has been initiated, but that information if available was not sufficiently shared that could answer questions such as probability of wires down by line segment, and from the number of wires down what is the probability that such a wires down incident would lead to a catastrophic wildfire.

Whether the risk mitigation would focus on those risks and asset segments with a higher probability of failure or risk and what the impact would be in incident frequency. This kind of analysis and information ultimately provides greater insight into the potential change in incident frequency of the mitigation activities and that would drive the RSE.

CONCLUSION

Staff believes that SDG&E has met the requirements for this chapter and could be the foundation for more detailed RAMP reports and supporting workpapers in the future. Staff determined that more detail on the items noted above as well as proposed budgets, schedules and key performance indicators are needed to better understand the value of these risk mitigation activities.

5.15 SDG&E-13 RECORDS MANAGEMENT

SUMMARY

This chapter follows the same outline as the records management chapter for SoCalGas Chapter 8. The risks and control categories are the same. This chapter outlines 4 categories of controls; 1) records management policies and procedures, 2) training, 3) operations compliance and oversight, and 4) information systems management. SDG&E includes various sources to illustrate the potential risk drivers and risk mitigations. The 4 control categories had a total of 11 O&M mitigation activities listed in workpapers (6 baseline programs in administration: 5 enhanced baseline programs; 2 - training and 3 - operations, compliance and oversight: 1 proposed mitigation programs in administration).

This particular risk has a low risk score of 4,734 and was included in the RAMP report due to the safety impact score of 5. The low risk scores in the other categories and a frequency score of 3 helped to keep the overall risk score this low.

The greatest increase in Capital spending is forecast for upgrading the information management systems. The training category shows the largest percentage increase in O&M spending but in nominal dollars the operational, compliance and oversight category had the largest increase of $2.6 million.

SDG&E highlighted the potential drivers that lead to inadequate record keeping. The largest expenditures are forecast in information management systems, and the most activities are controlled by administration for record management support, records storage and audits of policy and procedure.

STRENGTHS

SDG&E adequately described the general nature of the controls within the chapter and the supplemental workpapers were helpful to get a better understanding of the breadth of programs/projects presented for controlling the record keeping risk.

The majority of the risk mitigation activities provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents.

The additional workpapers (Chapter SDG&E-13-WP) listed the programs showing greater detail along with historical and estimated future spending ranges. These schedules may help correlate the RAMP to the GRC.

AREAS FOR IMPROVEMENT

The same issues with Risk Spend Efficiency (RSE) that were found in SCG – 8 Records Management were also found in this chapter. Refer to that chapter.

CONCLUSION

Given the level of maturity of the RAMP process and reporting framework developed to-date, that in general SDG&E met the requirements for this chapter.

5.16 SDG&E-15 Public Safety Events

SUMMARY

This chapter involves the risk associated with public safety and/or property damage related to SDG&E infrastructure, employees or third parties.

SDG&E has described the worst case scenario as follows – *"Trespassers on SDG&E property attempt to steal copper wire. Contact with equipment results in injuries and operational disruptions."*

The risk drivers are 1) failure of security systems, 2) non-compliance with security procedures, and 3) intentional and unintentional acts involving electric infrastructure. Baseline mitigation consists of 1) Physical Security, 2) public awareness program, and 3) design, operations & maintenance. SDG&E has given this a risk score of 2,344 and proposed total mitigation cost of $40 million to $60 million with GRC funding of $12 million-$14 million.

The baseline mitigation and proposed mitigation consists of three measures –

- Physical security
- Communications and outreach
- Design, operations and maintenance

Proposed new mitigations are to add security guards to new locations and comply with SB3. Communications and outreach and design, operations and maintenance are not expected to change from current baseline activates.

The only alternative provided was to add physical security systems rather than security guards.

STRENGTHS

This chapter had a satisfactory description of the baseline mitigation measures.

AREAS FOR IMPROVEMENT

To a certain extent it is not clear how this risk defers from physical security, which did not rank high enough as a risk priority to be included in this risk mitigation plan. If physical security is not a high enough risk, it is unclear why this risk is ranked significantly higher, particularly when the proposed mitigation is one that usually addresses physical security.

Based on the figures provided in Table 4, Baseline Risk Mitigation Plan, a significant amount of this activity is not GRC funded. Specifically, for the physical security mitigation, the total cost is approximately $54 million, but the proposed GRC cost is $12.2 million or 23% of total mitigation costs. It would be informative if there was an explanation of the cost breakdown, what GRC costs are, and how that cost split was determined by the utility.

Additional analysis of alternative mitigations would be helpful.

CONCLUSION

There were a number of issues with this chapter including how costs were divided between GRC and non-GRC sources. This risk seems to have much in common with physical security and it was not clear what the distinction is between public safety and physical security.

5.17 SDG&E-16 Catastrophic Damage Involving a Medium Pressure Gas Pipeline Failure

SUMMARY

This chapter on the risk of medium-pressure (60 psi and less) pipeline failures for San Diego Gas and Electric Company (SDG&E) follows a standard outline, addressing most of the Commission's requirements. Medium-pressure pipeline is found in gas distribution networks. Staff noted some gaps in the areas of alternatives and Risk Spend Efficiency (RSE).

In this chapter the worst case used to frame the risk is: *"A medium pressure pipeline failure due to a control device malfunction, which results in uncontrolled gas release causing injuries to employees and the public, and/or results in over 1,000 customers without gas supply for at least 24 hours."*

The risk drivers and risk score are well documented. Current controls are discussed in detail, as well as proposed incremental mitigations. RSE is presented for groups of the current controls and for incremental mitigations. Two alternative mitigations are briefly presented, but without estimates of risk reduction or RSE.

Staff reviewed this RAMP chapter for compliance with CPUC requirements, and has identified strengths and areas for improvement in the report, as follows.

STRENGTHS

The description and scoring of this Chapter is identical to Chapter SCG-10 for the same risk. SDG&E proposes to continue their current controls, and presents a set of eight different incremental enhancement or facility improvement programs which would be done under the current code-required Distribution Integrity Management Program (DIMP).

Some of these incremental mitigations include doubling the current rate of Aldyl-A pipe replacement, evaluation and replacement of various older pipe fittings, and risk evaluation of Cathodic Protection areas within DIMP segments. Risk Spend Efficiency is provided for three groups of current controls, and for one bundle of the eight incremental mitigations.

AREAS FOR IMPROVEMENT

The assumption behind the RSE calculation for the bundle of proposed incremental mitigations anticipates that if the mitigations are not carried out, the incidence of failures (due to corrosion, material failure, or pipe and weld defects)[29] would degrade to at least that of the worst-performing State (Nevada), prorated for the proportion of pipeline that would be mitigated.

Other risk chapters, like SCG-4, do not make a similar assumption for future risk degradation, but rather use this logic only for cessation of current controls.

SDG&E's current incident rate for this set of risk drivers is zero. What evidence suggests that failures in this category will increase to the rate of Nevada, or worse, if the new mitigation programs are not adopted? And, will the next GRC propose that every one of these programs must be funded, or that none of the risk reduction can be achieved?

SEMPRA has pointed out in the comparable SCG-10 Chapter that the RSE's for SCG's medium-pressure failure risk were "trued up" by six times to provide comparable RSE with the smaller pipeline network of SDG&E, but RSE cannot be compared across all risks in the RAMP report. A more robust risk assessment would provide clear guidance for and ranking of mitigations that have the greatest expected risk reduction efficiency for the utility across all risks.

CONCLUSION

Staff suggests that a better way to determine potential risk reduction is by dynamic segmentation analysis of the pipeline systems, which supports assignment of the probability of failure to each unique segment along with a cost of failure. From those figures, one can determine the potential cost of the risk if not mitigated. Then all risks can be ranked by their potential cost, and mitigations can be chosen which are effective in avoiding those costs. RSE would then be the cost of failure divided by the cost of mitigation.

[29] RSE Calculation Workpapers, in response to CUE data request: SDGE-16-WP-RSE Catastrophic Damage Involving Medium Pressure Pipeline Failure, MS Excel file

5.18 SDG&E-17 WORKFORCE PLANNING

SUMMARY

In this chapter SDG&E characterizes the workforce planning worst case risk as a less-experienced employee fills a position recently vacated by a long-time experienced employee due to retirement and due to lack of experience, the employee performs work that gives rise to serious injuries. SDG&E has a below industry historical attrition rate, but is aged employee pool is growing and if they retire at ages consistent with national averages the attrition rate would increase, which they termed the "retirement bubble".

The four control categories identified for the baseline risks involve a variety of knowledge transfer programs and training; compliance and inspection; employee engagement surveys and action plans; and using outside contractors/labor to fill the void. SDG&E includes various sources to illustrate the potential risk drivers and potential risk mitigations.

Of the four control categories, there were a total of nine mitigation activities listed in workpapers comprised of four baseline technical training and five enhancements to baseline, the mitigation programs were mostly in technical training. This particular risk has a low risk score of 255 and was included in the RAMP report due to the safety impact score. Scores for other attributes were low.

The workforce planning baseline projects mitigation spending of $1.85 million increases to forecast mid-point of $5.34 million for the proposed mitigation activities. There were no capex costs identified as part of the training initiatives.

The proposed mitigation activities include the existing baseline activities and expand the focus to supervisor and leadership training, emphasis on knowledge sharing, contractor training, and technology training.

Alternative Mitigations

Two alternatives were considered and rejected:

1) To consider increasing reliance on contractors and outside labor to fill critical roles. The cost is expected to be higher with the reliance on contractors taking place during peak season. The over reliance on contractors was rejected with the objective to maintain core knowledge in-house.

2) Maintain current mitigations at the status quo may result in SDG&E maintaining the low historic OSHA recordable rates it has achieved through 2015. However, keeping abreast of emerging technologies and onboarding younger replacement employees are expected to continually drive new training and training requirements. Therefore, staying in place and risking potential erosion of skills was rejected.

STRENGTHS

SDG&E adequately described the general nature of the baseline mitigation activities within the chapter. SDG&E provided excellent examples of the potential attrition risks in critical functions and roles. SDG&E did a good job highlighting the potential indicators or drivers of employee attrition that leads to potential consequences. A large part of the baseline programs for gas operations are for skills qualification and compliance training which are a normal part of ensuring the proficient and safe conduct of the workforce. Additionally, monitoring organizational effectiveness through surveys provides feedback on employee engagement and job satisfaction.

The potential risk drivers were outlined in a clear and understandable fashion and appropriately tied to the consequences.

The majority of the risk mitigation activities was clear and provided a reasonable basis for understanding the intent of the measure and how it might be able to reduce the impact or frequency of the incidents.

Given that this risk scored very low, SDG&E provided sufficient detail to show the risk mitigation activities tie in with the stated safety risks.

AREAS FOR IMPROVEMENT

Control Disconnect with Risk

Staff noted that SDG&E identified compliance and inspection as a control category. It is not clear how compliance is a control that mitigates the risk of retiring employees. If anything, it appears that this compliance risk is an associated risk, perhaps because by losing significant numbers of skilled employees the company may have not been able to perform its compliance work. The quality of work could suffer as well as the increased risk of asset failure.

More work is needed to show the connection between the proposed mitigations and expected impact on the identified risk of replacing the retiring skill set needs to effectively comply with requirements.

Risk Spend Efficiency

SDG&E could do a better job finding comparison metrics which have a causal relationship with the potential improvements. See recommendations for RSEs in chapter SCG-4. It is difficult to imagine that a well-managed company with sound safety performance would stop applying resources to at least maintain the regulatory compliance work at the current level of performance. Suggesting that other organizations, peers or populations with poor performance provide a feasible counterfactual benchmark only would make sense if there were noted causal relationships between the counterfactual and the company's situation (the level of resources applied and the type of mitigation activities they use within the environment their systems operate).

Properly trained field personnel impact incidents, but the report implies that the efforts in workforce planning have been a key driver of the current incident rate of 0.00 incidents/mm people, which seems unreasonable. There are multiple organizational factors that go into reducing the incident rate and maintaining it at zero levels. The degradation time frame seems reasonable, but in any case one should at least assume that the same level of resources for mitigation activities would be applied.

SDG&E does not provide any improvement estimates about what it would cost for the alternative incremental improvements.

Job Proficiency Curve was Confusing

The use of a proficiency curve based solely on term of service appears to overstate the impact of time on the job and ignores the myriad factors that contribute to proficiency. There is a minimum level of performance for any task, and one must assume that there is an expectation for safety and safe performance for all tasks. That different skills are required for entry level tasks than skills for the most complex tasks, yet for workers performing the respective tasks a minimum level of proficiency is required, as well the work performed safely. A better example(s) should be used in the upcoming GRC to support other causal factors associated with

safety performance such as the relationship between training and safety proficiency. Staff are concerned that only years of service are being conflated with job proficiency, which then is conflated with safety.

Absorbing New Employees

Because SDG&E has a history of absorbing significant numbers of workers, and the potential attrition and turnover appears to be consistent with the recent past, it is unclear whether this risk is as grave as purported. Therefore, SDG&E needs to do a better job explaining why it will have difficulty absorbing employees at the same rate as it has done recently.

CONCLUSION

After review of this chapter Staff determine that given the level of maturity of the RAMP process and reporting framework developed to-date, that in general the utility met the requirements for this chapter.

###

6 CONCLUSION AND RECOMMENDATIONS

For the majority of the risks drivers identified, the utilities offered a complete – if sometimes cursory and occasionally redundant – narrative describing their various risks, and fulfilled the required elements of the RAMP. In general, they provided clear descriptions of the risk scenarios and the proposed mitigation measures, and they provided a reasonable basis for understanding the intent of the mitigations and how they might be able to reduce the impact or frequency of the incidents. Yet for several mitigations, there needs to be more effort in showing the correlation between the risk and the mitigations proposed.

Possibly the greatest shortcomings of the RAMP filing are in the lack of clearly defined mitigation alternatives, and the lack of risk-reduction analysis and RSE calculations for these alternatives when included. While staff points out concerns about some of the analysis provided by the utilities in describing their risk strategies and potential mitigation plans, the focus of this report is to provide guidance to the utilities as to how they might bolster their information and justifications for their proposed spending plans.

As a general observation, staff agrees that more work needs to be done to improve the correlation of the RSE to the baseline risks and to proposed risk mitigations in order for the RSE to be used as intended. In addition, the utilities in the future need to do a better job clarifying and ranking the risk mitigations that are measured by the RSE and at the same time do a better job identifying metrics which correlate with the performance of the respective risk mitigation. This will help ensure that the utilities meet a specified goal that RAMP filings include "calculations of risk reductions and a ranking of mitigations based on risk reduction per dollar spent," as articulated in D.16-08-018, Ordering Paragraph 30.

This is admittedly an evolving area.

The following should be considered for improvement in the GRC presentation and workpapers:

- In the RSE, use plausible comparisons that connect causal relationships to information provided for making a sound decision on whether the increase in spending would be reasonable and the incident rate reductions possible.

- More thoroughly outline plans for enhancing existing mitigations, and provide more information to sufficiently describe how enhancements differ and improve baseline (Control) activities with an estimate of risk reduction.
- Improve the correlation of the RSE to the baseline risks and the proposed risk mitigations in order for the RSE to be used as intended.
- Address the requirement to provide an RSE for the alternative mitigation programs, and work on presenting reasonable and viable alternatives and provide sufficient explanation of alternatives and their potential for risk reduction.

In addition, based on the RAMP filing, staff is currently unable to completely assess this aspect of the RAMP that was specifically called for in the Scoping Memo: Whether or not the hardening inspection and repair programs which constitute a large percentage of SDG&E's proposed Wildfire mitigation spending have been adequately analyzed and discussed. This area might benefit from further exploration in a workshop.

In several chapters, this report references a concept called "dynamic segmentation" as a possibly useful tool for improving the risk analysis, especially for gas pipelines. A dynamic segmentation analysis[30] which objectively assigns probability of failure and cost of failure, to each risk would provide more deterministic data for decision making. As part of the initial workshop, staff will further describe this approach for discussion.

Because of time constraints and the lack of a Commission approved standard for evaluation, this report does not specifically analyze the "safety culture" aspects of the utilities' presentations. This may be an area that is better explored in a workshop setting, or in testimony in the future GRCs. The utilities have not identified any immediate critical safety situations – at this point.

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[30] Pipeline Risk Assessment: The Definitive Approach and Its Role in Risk Management. 2015. W. Kent Muhlbauer, author.

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UMMARY TOTALS FOR ALL MITIGATION PROJECTS/PROGRAMS IN THE RAMP FILING.

ving table shows mid-point of the total mitigation spending for the forecast ranges of 2019 age of 2017-2019 Capex spending. The 2019 mitigation totals includes GRC as well as any C forecast spending.

ia Gas Company:

1/10/2017) to CPUC Data Request:

Mitigation	Control			Cumulative Capex Range 2017-2019		2017-2019	2019			2019 Range Mid-Pt Forecast O&M + Capex	% Incr. from 2015 to 2019
	2015 Capital	2015 O&M	Control Total	Low	High	Yearly Avg. Capex	% Incr. in Capex from Control to Avg. Capex	O&M Range Avg.	% Incr. O&M 2015 - 2019 Forecast Avg.		
	-	141	141	-	-	-	N/A	147	4%	147	4%
lark	-	21,879	21,879	-	-	-	N/A	24,515	12%	24,515	12%
ness[1]	-	947	947	-	-	-	N/A	1,152	22%	1,152	22%
nd ts	-	-	-	6,165	6,875	2,173	N/A	122	N/A	2,295	N/A
	-	-	-	6,570	8,030	2,433	N/A	-	N/A	2,433	N/A
G-01 TOTAL	**-**	**22,967**	**22,967**	**12,735**	**14,905**	**4,607**	**N/A**	**25,935**	**13%**	**30,541**	**33%**

SCG-02: C1/M1	Policy, procedures, standards, and ESCMP[1]	-	5,299	5,299	-	-	-	N/A	5,235	-1%	5,235	-1%
SCG-02: C2/M2	Employee skills training[1]	-	11,475	11,475	-	-	-	N/A	14,310	25%	14,310	25%
SCG-02: C3/M3	Employee refresher training[1]	1,055	8,845	9,900	2,850	3,483	1,056	0%	11,667	32%	12,722	29%
SCG-02: C4/M4	Contractor management and traffic control[2]	3,065	8,411	11,476	8,274	10,113	3,065	0%	9,211	10%	12,276	7%
SCG-02: C5/M5	QA, job observations, field rides, and job monitoring[1]	58	6,265	6,323	156	192	58	0%	6,666	6%	6,724	6%
SCG-02: C6/M6	Safety communications and first responder liaison[1]	-	3,830	3,830	-	-	-	N/A	4,115	7%	4,115	7%
SCG-02: C7/M7	Environmental services monitoring	-	900	900	-	-	-	N/A	1,087	21%	1,087	21%
SCG-02: C8/M8	Safety, industrial hygiene, wellness, and emergency services/programs[1]	-	7,798	7,798	2,031	2,483	752	N/A	13,071	68%	13,823	77%
SCG-02: C9/M9	PPE and safety equipment	-	2,582	2,582	2,264	2,767	839	N/A	4,547	76%	5,385	109%
SCG-02: C10/M10	Gas facility and pipeline inspections[1,2]	-	54,468	54,468	-	-	-	N/A	84,537	55%	84,537	55%
SCG-02: C11/M11	Safety-related field orders (leaks, appliance check and unusual use, etc.)	-	20,251	20,251	-	-	-	N/A	23,250	15%	23,250	15%
	SCG-02 TOTAL	**4,178**	**130,124**	**134,302**	**15,575**	**19,038**	**5,769**	**38%**	**177,692**	**37%**	**183,461**	**37%**
SCG-03: C1/M1	Identify	-	46	46	-	7,500	1,250	N/A	331	620%	1,581	3337%
SCG-03: C2/M2	Protect	6,368	404	6,772	28,700	41,300	11,667	83%	734	82%	12,401	83%
SCG-03: C3/M3	Detect	-	-	-	9,450	14,900	4,058	N/A	75	N/A	4,133	N/A

SCG-03: C4/M4	Respond	-	14	14	7,000	12,000	3,167	N/A	89	536%	3,256	23155%
SCG-03: C5/M5	Recover	-	-	-	-	6,000	1,000	N/A	-	N/A	1,000	N/A
	SCG-03 TOTAL	**6,368**	**464**	**6,832**	**45,150**	**81,700**	**21,142**	**232%**	**1,229**	**165%**	**22,371**	**227%**
SCG-04: C1/M1	CFR 192 Subpart M - Maintenance[1]	12,885	7,670	20,555	38,925	43,023	13,658	6%	8,093	6%	21,751	6%
SCG-04: C2/M2	CFR 192 Subpart N - Qualifications of Pipeline Personnel[1]	-	396	396	-	-	-	N/A	421	6%	421	6%
SCG-04: C3/M3	CFR 192 Subpart I - Requirements for Corrosion Control	504	325	829	2,921	3,783	1,117	122%	828	155%	1,945	135%
SCG-04: C4/M4	CFR 192 Subpart L - Operations[1]	8,005	3,701	11,706	14,280	15,783	5,011	-37%	19,078	415%	24,089	106%
SCG-04: C5/M5	CFR Part 192 Subpart O - Gas Transmission Pipeline Integrity Management[1]	42,985	31,960	74,945	124,918	187,122	52,007	21%	47,289	48%	99,296	32%
SCG-04: C6/M6	PUC 957 & 958 - PSEP: High Pressure Testing and Replacement, Valve Automation and Replacement	389,715	60,944	450,659	365,250	608,750	162,333	-58%	61,750	1%	224,083	-50%
	SCG-04 TOTAL	**454,094**	**104,996**	**559,090**	**546,294**	**858,461**	**234,126**	**-48%**	**137,459**	**31%**	**371,584**	**-34%**
SCG-05: C1/M1	Physical Security Systems and Contract Security[1]	135	1,888	2,023	2,069	2,884	826	511%	3,770	100%	4,596	127%
SCG-05: C2/M2	Planning, Awareness, and Incident Management[1]	14	422	436	30	33	11	-25%	780	85%	791	81%
	SCG-05 TOTAL	**149**	**2,310**	**2,459**	**2,099**	**2,917**	**836**	**461%**	**4,550**	**97%**	**5,386**	**119%**
SCG-06: C1/M1	Physical Security Systems and Contract Security[1]	4,522	1,674	6,196	11,360	13,848	4,201	-7%	3,592	115%	7,793	26%

SCG-06: C2/M2	Operational Resiliency	432	-	432	12,300	17,700	5,000	1057%	-	N/A	5,000	1057%
SCG-06: C3/M3	Planning, Awareness, and Incident Management[1]	-	505	505	-	-	-	N/A	753	49%	753	49%
	SCG-06 TOTAL	**4,954**	**2,179**	**7,133**	**23,660**	**31,548**	**9,201**	**86%**	**4,345**	**99%**	**13,546**	**90%**
SCG-07: C1/M1	Workforce Planning	-	2,235	2,235	-	-	-	N/A	2,858	28%	2,858	28%
SCG-07: C2/M2	Knowledge Transfer	-	466	466	-	-	-	N/A	1,078	131%	1,078	131%
SCG-07: 3/M3	Training	-	1,898	1,898	-	-	-	N/A	2,908	53%	2,908	53%
SCG-07: C4/M4	Training - Technical non-HR[1,2]	1,055	23,193	24,248	2,850	3,483	1,056	0%	30,372	31%	31,427	30%
SCG-07: C5/M5	Succession Planning	-	149	149	-	-	-	N/A	254	70%	254	70%
	SCG-07 TOTAL[3]	**-**	**4,748**	**4,748**	**-**	**-**	**-**	**N/A**	**7,097**	**49%**	**7,097**	**49%**
SCG-08: C1/M1	Administrative	-	649	649	-	-	-	N/A	757	17%	757	17%
SCG-08: C2/M2	Training[1]	-	44	44	-	-	-	N/A	1,149	2510%	1,149	2510%
SCG-08: C3/M3	Operational Compliance and Oversight[1]	3,850	5,572	9,422	15,520	18,102	5,604	46%	10,812	94%	16,415	74%
SCG-08: C4/M4	Information Management Systems[1]	12,855	5,442	18,297	81,123	99,151	30,046	134%	5,958	9%	36,003	97%
	SCG-08 TOTAL	**16,705**	**11,707**	**28,412**	**96,643**	**117,253**	**35,649**	**113%**	**18,674**	**60%**	**54,323**	**91%**
SCG-09: C1	Land Movement Satellite Monitoring	-	210	210	-	-	-	N/A	-	-100%	-	-100%
SCG-09: M1	Gas Infrastructure Resilience & Vulnerability Report		-	-	-	-	-	N/A	300	N/A	300	N/A
SCG-09: C2/M2	Geological Hazard Engineering Data Analysis and Flood Hazard Dashboard	-	20	20	-	-	-	N/A	1,400	6900%	1,400	6900%

SCG-09: M3	Strain Gauge Installation Projects	-	-	-	1,200	2,100	550	N/A	75	N/A	625	N/A
SCG-09: C3/M4	Storage Field Slope Stability & Erosion Control Projects	470	-	470	12,600	14,400	4,500	857%	-	N/A	4,500	857%
	SCG-09 TOTAL	**470**	**230**	**700**	**13,800**	**16,500**	**5,050**	**974%**	**1,775**	**672%**	**6,825**	**875%**
SCG-10: C1/M1	Maintenance[1]	2,108	14,291	16,399	6,505	8,216	2,454	16%	22,155	55%	24,608	50%
SCG-10: C2/M2	Qualifications of Pipeline Personnel[1]	-	3,095	3,095	-	-	-	N/A	4,259	38%	4,259	38%
SCG-10: C3/M3	Requirements for Corrosion Control	3,636	10,242	13,878	12,898	16,292	4,865	34%	20,256	98%	25,121	81%
SCG-10: C4/M4	Operations[1]	10	1,313	1,323	30	36	11	10%	1,691	29%	1,702	29%
SCG-10: C5/M5	Gas Distribution Pipeline Integrity Management[1]	60,093	14,530	74,623	356,940	468,240	137,530	129%	37,237	156%	174,767	134%
	SCG-10 TOTAL	**65,847**	**43,471**	**109,318**	**376,373**	**492,784**	**144,860**	**120%**	**85,597**	**97%**	**230,457**	**111%**
SCG-11: C1/M1	Maintenance work performed on gas storage wells	-	3,476	3,476	-	-	-	N/A	3,480	0%	3,480	0%
SCG-11: C2/M2	Well abandonments, replacement materials and labor associated with each activity	43,584	-	43,584	117,135	129,465	41,100	-6%	-	N/A	41,100	-6%
SCG-11: M3	SIMP - Well Assessments	-	-	-	159,300	230,100	64,900	N/A	9,900	N/A	74,800	N/A
SCG-11: M4	SIMP - New Integrity and Risk Management Regulations	-	-	-	7,650	11,050	3,117	N/A	16,500	N/A	19,617	N/A
	SCG-11 TOTAL	**43,584**	**3,476**	**47,060**	**284,085**	**370,615**	**109,117**	**150%**	**29,880**	**760%**	**138,997**	**195%**

Notes:

- Control (C) and Mitigation (M).

- Numbers in risk chapter tables may differ from rounding.

- The purpose of the Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations 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.

[1] Controls/Mitigations for which the mitigation spending overlaps or is duplicative of spending for other Controls/Mitigations.

[2] Controls/Mitigations for which numbers in risk chapter tables may differ due to calculation errors.

[3] Total cost for SCG-07 does not include technical training outside of HR.

[4] Delta calculated as the average of Low and High for the Mitigation Total minus the Control Total.

[5] Non-GRC Control (C) represents Baseline (2015) costs. Non-GRC Mitigation (M) represents Proposed costs for 2017-2019 Capital and 2019 O&M.

Chapter Legend

SCG-01	Catastrophic Damage Involving Third Party Dig-Ins
SCG-02	Employee, Contractor and Public Safety
SCG-03	Cyber Security
SCG-04	Catastrophic Damage Involving High-Pressure Gas Pipeline Failure
SCG-05	Workplace Violence
SCG-06	Physical Security of Critical Gas Infrastructure
SCG-07	Workforce Planning
SCG-08	Records Management
SCG-09	Climate Change Adaptation
SCG-10	Catastrophic Damage Involving Medium-Pressure Pipeline Failure
SCG-11	Catastrophic Event related to Storage Well Integrity

San Diego Gas & Electric Company

SDG&E RESPONSE (01/10/2017) to CPUC Data Request:

Company Risk ID (Chapter)	Control/ Mitigation	2015 Control			2019		Cumulative Capex Range 2017-2019		2017-2019		2019 Range Mid-Pt Forecast O&M + Capex	% Incr. from 2015 to 2019
		Capital	O&M	Control Total	Range Avg. O&M	% Incr. O&M 2015 to 2019 Forecast Avg.	Low	High	Yearly Avg. Capex	% Incr. in Capex from Control to Avg. Capex		
SDGE-01: C1/M1	Inspection, Repair, Maintenance & Replacement Programs[1,2]	102,084	637	102,721	1,438	126%	895,080	1,163,606	343,114	236%	344,552	235%
SDGE-01: C2/M2	Vegetation Management[1]	-	23,100	23,100	27,087	17%	-	-	-	N/A	27,087	17%
SDGE-01: C3/M3	Design & Engineering Approaches[1,2]	3,838	-	3,838	-	N/A	36,144	46,989	13,856	261%	13,856	261%
SDGE-01: C4/M4	Legal & Regulatory[2]	602	743	1,345	662	-11%	1,272	1,653	488	-19%	1,149	-15%
SDGE-01: C5/M5	Rapid Response[1]	-	5,660	5,660	7,306	29%	-	-	-	N/A	7,306	29%
SDGE-01: C6/M6	Monitoring and Detection Programs	834	451	1,285	1,884	318%	1,350	1,755	518	-38%	2,401	87%
	SDGE-01 TOTAL	**107,358**	**30,591**	**137,949**	**38,375**	**25%**	**933,846**	**1,214,003**	**357,975**	**233%**	**396,350**	**187%**
SDGE-02: C1/M1	Training[1]	-	129	129	130	1%	-	-	-	N/A	130	1%
SDGE-02: C2/M2	Locate and Mark Activities[1]	253	2,195	2,448	2,732	24%	739	818	260	3%	2,991	22%
SDGE-02: C3/M3	Public Awareness[1]	-	20	20	20	0%	-	-	-	N/A	20	0%
SDGE-02: M4	Prevention and Improvements	-	-	-	24	N/A	-	-	-	N/A	24	N/A
	SDGE-02 TOTAL	**253**	**2,344**	**2,597**	**2,906**	**24%**	**739**	**818**	**260**	**3%**	**3,165**	**22%**

SDGE-03: C1/M1	Safety Policies & Programs[1]	5,014	34,597	39,611	36,543	6%	20,340	24,408	7,458	49%	44,001	11%
SDGE-3: C2/M2	Mandatory Employee Training, Retraining and Refresher programs[1]	-	16,673	16,673	18,343	10%	-	-	-	N/A	18,343	10%
SDGE-3: C3/M3	Field Observation and Behavior Based Safety Programs	-	650	650	986	52%	-	-	-	N/A	986	52%
SDGE-03: C4/M4	Regular Safety Meetings	-	3,524	3,524	3,877	10%	-	-	-	N/A	3,877	10%
SDGE-03: C5/M5	Ongoing Maintenance Programs	-	2,664	2,664	3,089	16%	-	-	-	N/A	3,089	16%
SDGE-03: C6/M6	Customer Communications and First Responder Training[1]	-	1,973	1,973	7,695	290%	-	-	-	N/A	7,695	290%
SDGE-03: C7/M7	Contractor Safety Program	38,164	741	38,905	818	10%	115,365	138,438	42,301	11%	43,118	11%
SDGE-03: C8/M8	Customer Orders Relative to Public Safety	-	4,958	4,958	5,589	13%	-	-	-	N/A	5,589	13%
	SDGE-03 TOTAL	**43,178**	**65,780**	**108,958**	**76,938**	**17%**	**135,705**	**162,846**	**49,759**	**15%**	**126,697**	**16%**
SDGE-04: C1/M1	Power Quality Studies of DER Interconnections	38	-	38	-	N/A	600	1,200	300	689%	300	689%
SDGE-04: C2/M2	Improved Modeling Tools	1,643	-	1,643	88	N/A	-	-	-	-100%	88	-95%
SDGE-04: M3	Increased Outreach Program	-	-	-	400	N/A	-	-	-	N/A	400	N/A
SDGE-04: C3/M4	Interconnection Compliance	-	1	1	859	85800%	-	-	-	N/A	859	85800%
SDGE-04: M5	Anti-Islanding Program	-	-	-	250	N/A	-	-	-	N/A	250	N/A
	SDGE-04 TOTAL	**1,681**	**1**	**1,682**	**1,597**	**159550%**	**600**	**1,200**	**300**	**-82%**	**1,897**	**13%**
SDGE-05: M1	Upgrades and Installation of New Transmission Facilities	-	-	-	-	N/A	382,560	467,571	141,689	N/A	141,689	N/A

SDGE-05: M2	Modernization of Grid Control Centers[1]	-	-	-	-	N/A	13,898	15,360	4,876	N/A	4,876	N/A
SDGE-05: C1/M3	Advance Readiness	-	1,029	1,029	1,029	0%	-	-	-	N/A	1,029	0%
SDGE-05: C2/M4	Monitoring and Control of Bulk Electric System	4,923	1,575	6,498	1,575	0%	12,141	13,419	4,260	-13%	5,835	-10%
	SDGE-05 TOTAL	**4,923**	**2,604**	**7,527**	**2,604**	**0%**	**408,599**	**496,350**	**150,825**	**2964%**	**153,429**	**1938%**
SDGE-06: M1	South Grid Blackstart Project	-	-	-	-	N/A	1,173	1,297	412	N/A	412	N/A
SDGE-06: M2	Modernization of Grid Control Centers[1]	-	-	-	-	N/A	13,898	15,360	4,876	N/A	4,876	N/A
SDGE-06: M3	Substation Backup Power Enhancements (Fuel Cells)	-	-	-	-	N/A	4,214	5,702	1,653	N/A	1,653	N/A
SDGE-06: C1/M4	Maintenance, Certification, and Testing of Existing Blackstart Facilities	-	20	20	20	0%	-	-	-	N/A	20	0%
SDGE-06: C2/M5	Blackstart Training and Procedure Development	-	60	60	60	0%	-	-	-	N/A	60	0%
	SDGE-06 TOTAL	**-**	**80**	**80**	**80**	**0%**	**19,285**	**22,359**	**6,941**	**N/A**	**7,021**	**8676%**
SDGE-07: C1/M1	Identify	(1)	1,416	1,415	1,336	-6%	-	-	-	N/A	1,336	-6%
SDGE-07: C2/M2	Protect[2]	1,824	2,883	4,707	5,010	74%	3,000	9,000	2,000	10%	7,010	49%
SDGE-07: C3/M3	Detect	2	1,020	1,022	1,456	43%	-	-	-	-100%	1,456	42%
SDGE-07: C4/M4	Respond	-	812	812	1,216	50%	-	-	-	N/A	1,216	50%
SDGE-07: C5/M5	Recover	-	73	73	351	380%	-	-	-	N/A	351	380%
	SDGE-07 TOTAL	**1,825**	**6,204**	**8,029**	**9,368**	**51%**	**3,000**	**9,000**	**2,000**	**10%**	**11,368**	**42%**
SDGE-08: C1/M1	Aviation Safety Management Systems	16	34	50	67	96%	-	-	-	-100%	67	33%

SDGE-08: C2/M2	Job Site Observation Program	-	12	12	13	8%	-	-	-	N/A	13	8%
SDGE-08: C3/M3	Service Provider Audit Program	-	7	7	21	200%	-	-	-	N/A	21	200%
SDGE-08: M4	Purchase a Twin-Engine Helicopter	-	-	-	234	N/A	7,650	11,050	9,350	N/A	9,584	N/A
SDGE-08: C5	"Best Practices" Training	6	4	10	-	-100%	-	-	-	-100%	-	-100%
SDGE-08: M5	Aviation Safety Training	-	-	-	21	N/A	-	-	-	N/A	21	N/A
SDGE-08: M6	Currency and Proficiency Training with New Helicopter	-	-	-	4	N/A	-	-	-	N/A	4	N/A
	SDGE-08 TOTAL	**22**	**57**	**79**	**358**	**528%**	**7,650**	**11,050**	**3,117**	**14067%**	**3,475**	**4298%**
SDGE-09: C1/M1	Physical Security Systems and Contract Security[1]	4,289	4,320	8,609	7,167	66%	14,703	17,670	5,396	26%	12,563	46%
SDGE-09: C2/M2	Planning, Awareness, and Incident Management	252	285	537	622	118%	531	585	186	-26%	808	50%
	SDGE-09 TOTAL	**4,541**	**4,605**	**9,146**	**7,789**	**69%**	**15,234**	**18,255**	**5,582**	**23%**	**13,371**	**46%**
SDGE-10: C1/M1	CFR 192 Subpart M - Maintenance[1]	-	1,161	1,161	1,099	-5%	-	-	-	N/A	1,099	-5%
SDGE-10: C2/M2	CFR 192 Subpart N - Qualifications of Pipeline Personnel[1]	-	102	102	157	54%	-	-	-	N/A	157	54%
SDGE-10: C3/M3	CFR 192 Subpart I - Requirements for Corrosion Control	-	48	48	48	0%	-	-	-	N/A	48	0%
SDGE-10: C4/M4	CFR 192 Subpart L - Operations[1]	412	103	515	103	0%	1,173	1,299	412	0%	515	0%
SDGE-10: C5/M5	CFR Part 192 Subpart O - Gas Transmission Pipeline Integrity Management[2]	7,074	3,876	10,950	5,233	35%	15,184	16,784	5,328	-25%	10,561	-4%

SDGE-10: C6/M6	CPUC 958 - PSEP: High Pressure Testing and Replacement[3]	86,690	4,453	91,143	-	-100%	50,400	61,600	18,667	-78%	18,667	-80%
	SDGE-10 TOTAL	**94,176**	**9,743**	**103,919**	**6,640**	**-32%**	**66,757**	**79,683**	**24,407**	**-74%**	**31,047**	**-70%**
SDGE-11: C1	UAS Weight Limitations	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-11: C2	Pilot in Command Experience and Training Requirements	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-11: C3	UAS Software and Hardware Checked Prior to Flight	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-11: C4	Flights Not Conducted Near Aircraft or People or Within Five Miles of an Airport Without Air Traffic Control Permission	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-11: C5	Complied with State and Federal UAS Regulations	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-11: M1	UAS SMS	-	-	-	66	N/A	-	-	-	N/A	66	N/A
SDGE-11: M2	UAS Training Program for SDG&E Employees	-	-	-	20	N/A	-	-	-	N/A	20	N/A
SDGE-11: M3	Contractor Qualification, Oversight and Audit Program	-	-	-	29	N/A	-	-	-	N/A	29	N/A
SDGE-11: M4	Flight Management Controls	-	-	-	11	N/A	-	-	-	N/A	11	N/A
SDGE-11: M5	Research Best Use Cases for Specific Systems as Technology Advances	-	-	-	12	N/A	-	-	-	N/A	12	N/A
	SDGE-11 TOTAL	**-**	**-**	**-**	**137**	**N/A**	**-**	**-**	**-**	**N/A**	**137**	**N/A**
SDGE-12: C1/M1	Premature Overhead Failure[1]	16,040	1,179	17,219	9,565	711%	177,339	230,544	67,981	324%	77,546	350%

SDGE-12: C2/M2	Premature Underground Failure	33,107	-	33,107	1,472	N/A	215,139	279,681	82,470	149%	83,942	154%
SDGE-12: C3/M3	Premature Substation Failure	4,189	-	4,189	300	N/A	37,545	48,808	14,392	244%	14,692	251%
SDGE-12: C4/M4	System Modernization[1]	571	52	623	784	1407%	26,169	34,020	10,032	1657%	10,815	1636%
	SDGE-12 TOTAL	**53,907**	**1,231**	**55,138**	**12,121**	**885%**	**456,192**	**593,053**	**174,874**	**224%**	**186,995**	**239%**
SDGE-13: C1/M1	Administrative	-	577	577	844	46%	-	-	-	N/A	844	46%
SDGE-13: C2/M2	Training	-	34	34	873	2466%	-	-	-	N/A	873	2466%
SDGE-13: C3/M3	Operational Compliance and Oversight	7,365	5,650	13,015	8,211	45%	22,920	27,504	8,404	14%	16,615	28%
SDGE-13: C4/M4	Information Management Systems[1]	19,561	-	19,561	-	N/A	69,305	83,166	25,412	30%	25,412	30%
	SDGE-13 TOTAL	**26,926**	**6,261**	**33,187**	**9,927**	**59%**	**92,225**	**110,670**	**33,816**	**26%**	**43,742**	**32%**
SDGE-14: C1/M1	Meteorology Support	-	23	23	26	11%	-	-	-	N/A	26	11%
SDGE-14: C2/M2	Climate Advisory Group	-	-	-	-	N/A	-	-	-	N/A	-	N/A
SDGE-14: M3	Consultant Support	-	-	-	150	N/A	-	-	-	N/A	150	N/A
SDGE-14: M4	University Team	-	-	-	263	N/A	-	-	-	N/A	263	N/A
	SDGE-14 TOTAL	**-**	**23**	**23**	**438**	**1804%**	**-**	**-**	**-**	**N/A**	**438**	**1804%**
SDGE-15: C1/M1	Physical Security[1]	18,444	6,596	25,040	8,613	31%	41,092	49,923	15,169	-18%	23,782	-5%
SDGE-15: C2/M2	Communications and Outreach[1]	-	731	731	694	-5%	-	-	-	N/A	694	-5%
SDGE-15: C3/M3	Design, Operations and Maintenance	-	-	-	-	N/A	-	-	-	N/A	-	N/A
	SDGE-15 TOTAL	**18,444**	**7,327**	**25,771**	**9,307**	**27%**	**41,092**	**49,923**	**15,169**	**-18%**	**24,476**	**-5%**
SDGE-16: C1/M1	Maintenance[1]	1,215	5,782	6,997	6,176	7%	2,982	3,294	1,046	-14%	7,222	3%

SDGE-16: C2/M2	Qualifications of Pipeline Personnel[1]	200	500	700	874	75%	1,418	1,732	525	163%	1,399	100%
SDGE-16: C3/M3	Requirements for Corrosion Control	531	1,399	1,930	1,539	10%	6,069	6,707	2,129	301%	3,668	90%
SDGE-16: C4/M4	Operations[1]	496	496	992	496	0%	1,413	1,560	496	0%	991	0%
SDGE-16: C5/M5	Gas Distribution Integrity Management Programs	6,208	17	6,225	261	1435%	64,479	89,161	25,607	312%	25,868	316%
SDGE-16: M6	Improvements	-	-	-	3,349	N/A	129,265	142,871	45,356	N/A	48,705	N/A
	SDGE-16 TOTAL	**8,650**	**8,194**	**16,844**	**12,695**	**55%**	**205,626**	**245,325**	**75,159**	**769%**	**87,853**	**422%**
SDGE-17: C1/M1	Gas Operations[1,2]	-	-	-	319	N/A	-	-	-	N/A	319	N/A
SDGE-17: C2/M2	Customer Service Field & Smart Meter Ops[1]	-	343	343	883	157%	-	-	-	N/A	883	157%
SDGE-17: C3/M3	Kearny[1]	-	21	21	43	105%	-	-	-	N/A	43	105%
SDGE-17: C4/M4	Electric Regional Operations[1]		1,069	1,069	2,741	156%	-	-	-	N/A	2,741	156%
SDGE-17: C5/M5	Electric Grid Operations[1]	-	13	13	21	62%	-	-	-	N/A	21	62%
SDGE-17: C6/M6	Construction Services[1]		5	5	303	5950%	-	-	-	N/A	303	5950%
SDGE-17: C7/M7	Electric Distribution Operations[1]		-	-	35	N/A	-	-	-	N/A	35	N/A
SDGE-17: C8/M8	Electric Transmission & Distribution[1,2]	-	327	327	917	180%	-	-	-	N/A	917	180%
SDGE-17: C9/M9	HR Organizational Effectiveness	-	76	76	77	1%	-	-	-	N/A	77	1%
	SDGE-17 TOTAL	**-**	**1,854**	**1,854**	**5,336**	**188%**	**-**	**-**	**-**	**N/A**	**5,336**	**188%**

Notes:
- Control (C) and Mitigation (M).
- Numbers in risk chapter tables may differ due to rounding.

- The purpose of the Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations 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.

[1] Controls/Mitigations for which the mitigation spending overlaps or is duplicative of spending for other Controls/Mitigations.

[2] Controls/Mitigations for which numbers in risk chapter tables may differ due to calculation errors.

[3] SDG&E does not have PSEP Phase 2A work (i.e., work in less populated areas).

[4] Delta calculated as the average of Low and High for the Mitigation Total minus the Control Total.

[5] Non-GRC Control (C) represents Baseline (2015) costs. Non-GRC Mitigation (M) represents Proposed costs for 2017-2019 Capital and 2019 O&M.

Chapter Legend	
SDGE-01	Wildfires Caused by SDG&E Equipment
SDGE-02	Catastrophic Damage Involving Third Party Dig-Ins
SDGE-03	Employee, Contractor and Public Safety
SDGE-04	Distributed Energy Resources (DERs)
SDGE-05	Major Disturbance to Electrical Service (Blackout)
SDGE-06	Fail to Blackstart
SDGE-07	Cyber Security
SDGE-08	Aviation Incident
SDGE-09	Workplace Violence
SDGE-10	Catastrophic Damage Involving High-Pressure Gas Pipeline Failure
SDGE-11	Unmanned Aircraft System (UAS) Incident
SDGE-12	Electric Infrastructure Integrity
SDGE-13	Records Management
SDGE-14	Climate Change Adaptation
SDGE-15	Public Safety Event - Electric
SDGE-16	Catastrophic Damage Involving Medium-Pressure Pipeline Failure
SDGE-17	Workforce Planning

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