



**Risk Assessment Mitigation Phase
(RAMP-E)**

**A Discussion of the Use of Risk Spend
Efficiency**

November 27, 2019



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I. INTRODUCTION

Over the last five years the California Public Utilities Commission (the CPUC or Commission), its Safety and Enforcement Division (SED), the Investor Owned Utilities (IOUs), and intervenors have been collaborating on developing and implementing into the regulatory process a reliable and more quantitative process to better understand how utilities mitigate risks. One of the concepts adopted to provide more information is the Risk Spend Efficiency (RSE).

In theory, RSEs are a mechanism that can help IOUs and the Commission understand risks and mitigations better and compare mitigations in addressing risks. Conceptually, RSEs could be a useful tool to assist in decision-making, but even when they were first suggested to the Commission, RSEs had critical shortcomings – shortcomings that continue with their most recent iteration. Because of these continuing deficiencies (and newer ones that have been discovered as RSEs have evolved and expanded), RSEs remain a data point for utilities to consider, but not the deciding factor for mitigation selection – a fact that is recognized by SED, the IOUs, and even the Commission in Decision (D.) 18-12-014, the Safety Model Assessment Proceeding (S-MAP) Settlement Agreement Decision (SA Decision).

San Diego Gas & Electric Company (SDG&E or Company) supports tools to prioritize and optimize their activities that mitigate risks. As such, the Company agrees with the concept of an RSE. In implementing RSEs, however, the Company has found that they are not as effective at prioritizing work as some have expected. As demonstrated in this Chapter, there are challenges with RSEs, including considerable subjectivity, that limit their extensive use at this stage.

The purpose of this 2019 RAMP Report Chapter is to:

- Discuss the background of RSEs and their evolution since 2015;
- Explain why RSEs, as currently constructed, should not be used to prioritize or select investments; and
- Suggest actions that could be taken to strengthen the RSE concept.

This Chapter is structured as follows:

- RSE History

- Shortcomings of RSEs
- Conclusion and Potential Next Steps

II. RSE HISTORY

A. First Presentation of RSEs

The concept of RSE was first publicly discussed in a Commission proceeding in an August 3, 2015 workshop. The basic formula proposed for determining an RSE was:

$$\text{Risk Spend Efficiency for a Mitigation} = \frac{\text{Risk Score Pre-Mitigation} - \text{Risk Score Post Mitigation}}{\text{Cost to Implement the Mitigation}}$$

Southern California Edison Company (SCE) proposed the use of RSEs with purportedly two long-term goals:

- Develop a multi-year spending plan based on the most effective mitigation.¹
- Use RSEs to measure the effectiveness of mitigations.²

But, even in this initial foray into the development of RSEs, SCE recognized a number of shortcomings and challenges, including:

- Data on incidents and assets is not always available, or not compiled in a manner that facilitates analysis;
- Industry data and informed judgment will be needed as utility data is developed;
- Further analysis is needed to isolate risk drivers;
- Models for forecasting asset condition and asset failures are necessary;
- Risk evaluation, mitigation evaluation, and prioritization methodologies need to evolve; and

¹ Southern California Edison Company, *SMAP Workshop* (August 3, 2015) at 2, available at <https://www.cpuc.ca.gov/General.aspx?id=9099>.

² *Id.*

- RSEs were an input into the decision-making process, but any prioritization approach had to consider non-risk related inputs (including funding, compliance requirements, ongoing projects, resources, and operational constraints).³

As discussed below, these challenges and others persist.

B. Treatment of RSEs Since Creation

The Commission has required each utility to include RSEs in their RAMP filings since 2016.⁴ All four IOUs have completed their first RAMP filings incorporating RSEs. In each of these filings, and in the feedback of SED and others, the persistent challenges with RSEs have been noted.

SoCalGas and SDG&E

In their 2016 RAMP filing, Southern California Gas Company (SoCalGas) and SDG&E developed estimates and ranges for RSEs.⁵ In that first presentation of RSEs, they were calculated by dividing Annual Risk Reduction (as the number developed through SoCalGas' and SDG&E's risk scoring processes) by Total Mitigation Cost (the forecasted 3-year capital expenditure plus the annual Operating and Maintenance (O&M) expenses), multiplied by the number of years for which benefits from the risk reduction are expected.⁶

SED reviewed SoCalGas' and SDG&E's filing and concluded that "[t]he concept of [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

³ *Id.* at 5.

⁴ California Public Utilities Commission, *Safety and Enforcement Division Evaluation Report on the Risk Evaluation Models and Risk-based Decision Frameworks in A.15-05-002, et al.* (March 21, 2016) at 78-79.

⁵ Investigation (I.) 16-10-015/-016 (cons.), Risk Assessment and Mitigation Phase Report of San Diego Gas & Electric Company and Southern California Gas Company (November 30, 2016) at A-9.

⁶ *Id.*



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.”⁷ SED also recognized that, “This is admittedly an evolving area.”⁸

Pacific Gas & Electric Company (PG&E)

In its 2017 RAMP filing, for RSE calculations, PG&E used a different formula to calculate RSEs for mitigations. PG&E essentially calculated RSEs for broader mitigation *plans*, incorporating a number of mitigations under one umbrella RSE. PG&E noted in their filing that the concept of RSEs was one of many factors that should be taken into consideration in determining where to make investments.⁹

In their review of PG&E’s RSE methodology, SED agreed that RSEs were not the only factor for consideration in selecting mitigations.¹⁰ For example, SED acknowledged that “resource constraints, compliance constraints, or operational constraints” could lead to selection of mitigations with lower RSEs.¹¹ In addition, SED referenced PG&E’s self-assessment regarding the use of RSEs: “[I]mprovements in the quality and availability of data and a deeper understanding of risk tolerance are needed before risks and the effectiveness of mitigations truly can be compared.”¹² SED pointed out how mitigation isolation could be a “pitfall” and “suboptimal from an aggregate risk portfolio standpoint.”¹³

⁷ California Public Utilities Commission, *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* (March 8, 2017) at 6.

⁸ *Id.*

⁹ I.17-11-003, 2017 Risk Assessment and Mitigation Phase Report of Pacific Gas and Electric Company (November 30, 2017) at A-14.

¹⁰ California Public Utilities Commission, *Risk and Safety Aspects of Risk Assessment and Mitigation Phase Report of Pacific Gas & Electric Company Investigation 17-11-003* (March 30, 2018) at 35.

¹¹ *Id.* at 17.

¹² *Id.* at 25.

¹³ *Id.* at 18.



SCE

In its 2018 RAMP filing, SCE used an approach similar to PG&E, but instead calculated the difference between the Multi-Attribute Risk Scores (MARS) before and after a mitigation.¹⁴ SED included in their review several comments regarding SCE’s filing. An important comment was that SCE’s “[R]isk reduction analysis including RSEs would be most appropriate for decision-makers to be able to assess programs based on SCE’s internal standards based on safety risks and costs.”¹⁵ SED continued to recognize that RSEs remain one element of the risk/mitigation analysis – not the entire analysis.

S-MAP

In the SA Decision, the Commission reconfirmed that the utilities will provide RSE calculations in the RAMP for all mitigations and alternatives.¹⁶ The Settlement Agreement adopted in the SA Decision increases the quantitative aspects of RSEs and standardizes to some extent the process for developing RSEs between the utilities. However, many shortcomings of RSEs are not alleviated by the Settlement Agreement, and the process included therein has created new challenges with RSEs. Thus, while the process underlying the creation of RSEs became more quantitative, the value of RSEs still should not be overstated.

II. SHORTCOMINGS OF RSEs

In their current iteration, RSEs have a significant number of limitations keeping them from being entirely reliable or valuable as a decision-making tool. Below (in no particular order) several of these shortcomings are described.

Lack of data: The foundation of the RSE process is the availability of broad, accurate data for every risk and mitigation. Without such data, RSEs become drastically devalued by

¹⁴ I.18-11-006, Southern California Edison Company’s 2018 Risk Assessment and Mitigation Phase Report (November 15, 2018) at 2-13.

¹⁵ California Public Utilities Commission, *A Regulatory Review of the Southern California Edison’s Risk Assessment Mitigation Phase Report for the Test Case 2021 General Rate Case Investigation 18-11-006* (May 15, 2019) at 48.

¹⁶ D.18-12-014 at 22-23.



uncertainty. To properly calculate an RSE, as required by the Settlement Agreement, there must be an accurate measure of the frequency and consequences of a risk, the effects of a mitigation on both the frequency and consequence of a risk, and the cost required to implement the mitigation.

The problem is that for the majority of risks and mitigations, such data is scant or incomplete. For example, the Commission requires the Company to inspect the system annually, but there has been little data as to how many incidents were avoided through such annual inspections. Nevertheless, if an anomaly is observed during an inspection the Company would respond as needed. While the Company may capture additional information during an inspection, the data may not always be useful for risk reduction analysis. Therefore, the risk reduction benefit associated with annual inspections cannot be accurately determined at this time. All of the IOUs and SED have acknowledged the challenge with this dearth of data.¹⁷ As SED noted, as recently as last year, “improvements in the quality and availability of data and a deeper understanding of risk tolerance are needed before risks and the effectiveness of mitigations truly can be compared.”¹⁸ Without current and accurate data the value of RSEs is limited.¹⁹

Another challenge commonly experienced with data is determining which data is most appropriate. Although utility specific data is best, it is not always available. The Company explains within specific RAMP chapters when data came from other sources. But when data is pulled from other sources, it can invite a host of questions. Most notably, how comparable a situation was to the one that the data was pulled from. For example, for an asset-based risk, the nationally-relied upon data could be based on a utility which had not invested as much in the safety of its infrastructure. But, at the same time, the utility’s infrastructure may be less likely to experience risk events for other reasons, such as population densities, environment, or other

¹⁷ See I.16-10-015/-016 (cons.), I.17-11-003 and I.18-11-006.

¹⁸ California Public Utilities Commission, *Risk and Safety Aspects of Risk Assessment and Mitigation Phase Report of Pacific Gas & Electric Company Investigation 17-11-003* (March 30, 2018) at 25.

¹⁹ Another issue, not addressed here, is the associated cost of collecting data, which presents its own difficulties and constraints.



factors. It is difficult to balance all of these factors properly. For example, in evaluating the risk reduction benefits of certain mitigations, such as mitigating service damages within a sewer lateral, the Company relied on national PHMSA data to determine the incident rate since there was limited Company data available for such incidents. A mitigation focused on relocating services from within sewer laterals to remove the likelihood of damage addresses identified threats of low frequency, but potentially high consequence events. Although there is limited internal data to support that incidents related to this threat have occurred, the Company relied on nationally available data to determine the potential consequence of this threat.

Frequency of Incidents: Related to the previous point, the lack of the availability of data is difficult to overcome in some instances because of the infrequency of incidents for many risks. This is particularly the case with “tail” risks. Tail risks are those risks which occur very infrequently, finding themselves on the very extreme end of a probability curve (*i.e.*, the “tail”). Understanding the reduction in risk associated with infrequent catastrophic incidents is difficult to determine because of the frequency of events. For example, Florida Power & Light (FP&L) invested billions of dollars in “hardening” their electric system against hurricane risk starting in 2004. A significant hurricane did not impact their system until 2016. Accurately determining the benefit of FP&L’s investments (*i.e.*, the risk reduction) took over 12 years.

Reliance on Subject Matter Experts (SMEs): The lack of available data and frequency of tail risks leads to a reliance on SMEs to assess how much a risk will be reduced by the implementation of a mitigation and requires SMEs to calibrate that the available data is appropriate and applicable to our operations. As SED has acknowledged, the RSE is a product of SME input.²⁰ As a result, it is subject to the potential issues that can occur with uncalibrated SME input.

Changes Occur: Conditions change over time. Consequences and frequencies of events, priorities for the Commission and utilities, and other important factors in decision-making can change, even within a rate case cycle. As a result, predictive RSEs can be of limited value and

²⁰ California Public Utilities Commission, *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* (March 8, 2017) at 16.

fairly speculative. One of the clearest examples of this is when calculating RSEs for vegetation management mitigations. In such calculations, one cannot reasonably take into account changes in growth rates, costs or even fluctuations in weather. Vegetation can change in an area; unpredicted weather patterns can change the biological and geographical landscape. RSEs can therefore vary widely from forecast to reality. The Commission appears to recognize this, as evidenced by its acknowledgement that utilities require flexibility to adapt to changing conditions and in addressing risk.

Changing Methodologies and Tools: Comparing past and future RSEs, even from one cycle to the next, is generally of limited value. Changes will occur in methodologies and tools over time. This is recognized in D.18-12-014, which notes that utilities' multi-attribute value functions (MAVFs) will evolve over time.^{21,22} This evolution can take many forms. It can result from simply refining data, but also wholesale changes to the structure of the Company's Risk Quantification Framework. The Company is already aware that intervenors encourage the IOUs to incorporate additional attributes into the MAVF, such as an environmental attribute and a customer satisfaction attribute. Although such attributes may be, to some extent, built into the current three attributes, adding new attributes will undoubtedly affect RSEs for many if not all mitigations. RSEs are thus of limited value in that they cannot effectively be compared between cycles.

Non-RSE Factors: Perhaps one of the most critical shortcomings of RSEs is that there is much they do not capture. The methodologies for determining RSEs do not take into consideration all the factors that go into the decision to select a mitigation. For example, if a utility intends to replace a bare wire conductor with insulated conductor, the RSE calculation will consider the risk reduction achieved by installing the new conductor and the cost of the new conductor. While factors such as resource availability, permitting requirements, and changing climate conditions are not considered within the RSE calculation, these factors are certainly taken into consideration for decision-making purposes. Similarly, certain human factor benefits,

²¹ D.18-12-014 at 54.

²² The Company at times refers to its MAVF herein as the Risk Quantification Framework.



such as those related to training and communicating with the public, are not easily captured as part of the RSE calculation. For example, the human benefits related to improved training and tools to allow the use of a newer laptop technology to enhance data collection was not captured in the RSE, which contributed to a low score resulting for this mitigation. This deficiency in RSEs has been recognized in essentially every RAMP filing and the SED report discussion therein.²³

RSEs Cannot Be Compared Across Utilities: RSEs cannot be compared in any meaningful way across utilities. Although the Commission and Intervenors have in the past expressed a desire to be able to compare RSEs across utilities for similar risks/mitigations, that is not possible at this time.²⁴ Each of the utilities will use different formulas and methodologies in calculating RSEs. Each utility might use different attributes, different weights and scaling, and even different frequency and consequence valuations. SED acknowledged this in reference to PG&E's RAMP where it noted that the calculations and methodologies in calculating RSEs are complex and require significant effort to interpret.²⁵ Although the Settlement Agreement standardized certain processes and aspects of the creation of RSEs, the differences still confound any meaningful comparison.

Lack of Common View of Risk Tolerance: As noted by PG&E in their 2017 RAMP filing, a deeper understanding of the implications of differing risk tolerances is required before comparability can truly be achieved.²⁶ For example, SED, an intervenor, and a utility might have different views regarding the number of fire incidents that should be able to occur on a particular system. Some might say they want zero incidents while others may say there should be no incidents that burn beyond three-square feet. These varying tolerances lead to different

²³ See I.16-10-015/-016 (cons.), I.17-11-003 and I.18-11-006.

²⁴ D.16-08-018 at 164.

²⁵ California Public Utilities Commission, *Risk and Safety Aspects of Risk Assessment and Mitigation Phase Report of Pacific Gas & Electric Company Investigation 17-11-003* (March 30, 2018) at 23 and 139-140.

²⁶ I.17-11-003, 2017 Risk Assessment and Mitigation Phase Report of Pacific Gas and Electric Company (November 30, 2017) at A-6.

mitigations and RSEs. In addition, certain outcomes can be a higher priority because of their cause, even if the RSE cannot reflect that type of preference. The Company attempted to capture some of this in the alternative methodology discussed in Chapter RAMP-D, which can emphasize a need to reduce more significant events compared to more frequent risk events.

Mitigation Synergy not Recognized: As the MAVF for creation of RSEs currently stands, it is incapable of correctly showing the value of RSEs when mitigations are combined or broken up. Some mitigations work best when combined with one or more mitigations. Because RSEs have to be presented as standalone scores, the value of combining RSEs cannot be captured. Similarly, some mitigations apply across multiple risks. The RSE calculation methodology as it currently stands does not allow for a recognition of such benefits. Although combining the benefits across all risks impacted improves accuracy, this would significantly add to the complexity of the analysis and presentation of the mitigation benefits. For example, the replacement of live front equipment mitigation impacts both the Electric Infrastructure Integrity (EII) risk and the Employee Safety risk. However, the Company elected to assess the mitigation benefit as part of the EII risk to minimize double counting of benefits throughout this 2019 RAMP Report.²⁷ Thus, the risk reduction within the Employee Safety risk is underestimated, since the mitigation was assessed against the EII risk. This is another instance of RSEs not being able to capture the entire picture when it comes to the costs and benefits of mitigations or controls.

Non-Asset Mitigations/Controls: Non-Asset mitigations also do not lend themselves well to evaluation by RSEs. Because such mitigations do not clearly lend themselves well to being broken down into discrete data points, trying to force them into a quantitative analysis is challenging. For example, the benefit of training or public awareness efforts for third party dig-ins is challenging to quantify because these non-asset mitigations rely on a variety of sources and indirect measurements related to the risk. There are a substantial number of mitigations that

²⁷ Additional discussion on the Treatment of Risk Mitigating Activities Presented in Risk Chapters is in Section III.B.4 of Chapter RAMP-A.



utilities pursue and implement which are not asset based. Determining how to assess them within an RSE-driven framework continues to be problematic.

RSEs Do Not Reflect Reality of Utility or Commission Priorities: Although there are several shortcomings in the RSEs that are primarily data driven, perhaps one of the most challenging to quantify is related to valuing mitigations that are strongly supported by the Commission and IOUs' strategic efforts and priorities. Certain mitigations are recognized by essentially all interested parties to be important – yet their RSEs would suggest they should be treated as lower priority work. For example, in the high-pressure pipeline incident risk, the valve automation mitigation had a relatively low RSE, yet valve automation was required by the Commission in D.14-06-007. The rankings of RSEs shown in Appendix D-1 contain other examples of these types of mitigations. Because there are so many mitigations like this, it becomes difficult to accept the results of other less unanimously supported mitigations (or any of the RSEs, for that matter).

Cannot be Used to Prioritize: Another shortcoming of RSEs is that they are not particularly effective at their presumed purpose: to rank mitigations. When SCE first proposed the use of RSEs in August 2015, they recognized it would take time to develop them and they were, at best, only one of many factors to be taken into consideration in measuring mitigation effectiveness.²⁸ PG&E and SED went further in concluding that RSEs cannot be used to compare RSEs across risks or across utilities.²⁹ Based on all the shortcomings noted above, the conclusions reached by SED, SCE, and PG&E regarding whether RSEs can be used to simply rank mitigations are correct. There are too many shortcomings and variables to be able to use RSEs in their current format to determine whether an investment should or should not be made relative to another risk.

²⁸ Southern California Edison Company, *SMAP Workshop* (August 3, 2015), available at <https://www.cpuc.ca.gov/General.aspx?id=9099>.

²⁹ D.16-08-018 at 164.



III. CONCLUSION AND POTENTIAL NEXT STEPS

SoCalGas and SDG&E, PG&E and SCE have all included RSE calculations in their respective RAMP Reports; however, as noted in numerous S-MAP Workshop documents and SED briefings, RSEs are flawed and provide imperfect results. While there is a belief that RSEs can be used as an input into investment decision making, neither SED nor the utilities believe RSEs can be used to prioritize investments or that they should be the determining input into decision making.

In conclusion, for RSEs to be of increased value in investment decision making, then RSEs specifically:

1. Must provide insights into mitigation selection but cannot be the only criteria used to prioritize mitigation investments.
2. Need further study and methodological development to address the complexity of deciding which mitigations are best implemented to address a risk.
3. Cannot address all the factors that go into determining which mitigations can be implemented (*e.g.*, resource availability and scheduling/permitting issues cannot be taken into consideration in developing RSEs).
4. Require historic data in addition to SME insights to be of most value.
5. May not provide an optimized portfolio of mitigations.
6. Need a better understanding of each stakeholders' risk tolerance for RSEs to be valuable.
7. Are of limited value when evaluating the effectiveness of non-asset mitigations.
8. Should be the subject of additional investigation in future S-MAPs.

The Company is hopeful that an exploration of how to strengthen RSEs can be included in future S-MAP proceedings. This exploration could include, but not be limited to, a determination of a risk tolerance methodology, RSEs and risk mitigation effectiveness and the access to historic data that goes well beyond subject matter expertise. This will likely mean that RSEs will have limited use for future GRC cycles while the methodology is refined, and data is improved and collected.