# 2025 Risk Assessment Mitigation Phase

# (Chapter SDG&E-Risk-1)

# Excavation Damage

## May 15, 2025

## TABLE OF CONTENTS


I. INTRODUCTION ..... 1

A. Risk Definition and Overview ..... 1

B. Risk Scope ..... 6

C. Data Sources Used in Quantifying Risk Estimates ..... 6

II. RISK ASSESSMENT ..... 6

A. Risk Selection ..... 6

B. Risk Bow Tie ..... 7

C. Potential Risk Event Drivers/Triggers ..... 8

D. Potential Consequences of Risk Event (CoRE) ..... 9

E. Evolution of Its Drivers and Consequences ..... 9

F. Summary of Tranches ..... 10

III. PRE MITIGATION RISK VALUE ..... 11

A. Risk Value Methodology ..... 11

IV. 2024-2031 CONTROL & MITIGATION PLAN ..... 13

A. Control Programs ..... 14

B. Changes from 2024 Controls ..... 18

C. Mitigation Programs ..... 18

D. Climate Change Adaptation ..... 19

E. Foundational Programs ..... 19

F. Estimates of Costs, Units, and Cost-Benefit Ratios (CBRs) ..... 19

V. ALTERNATIVE MITIGATIONS ..... 21

A. Alternative 1: MP Standby for Repeat Offenders ..... 21

B. Alternative 2: Installation of non-required EFV's ..... 22

VI. HISTORICAL GRAPHICS ..... 22

Attachment A: Controls and Mitigations with Required Compliance Drivers

Attachment B: Excavation Damage - Reference Material for Quantitative Analyses

Attachment C: Excavation Damage - Summary of Elements of Bow Tie

Attachment D: Application of Tranching Methodology

# I. INTRODUCTION

The purpose of this chapter is to present San Diego Gas & Electric Company's (SDG&E or Company) risk control and mitigation plan for Excavation Damage. This chapter contains the information and analysis for this risk that meet the requirements of the California Public Utilities Commission's (Commission or CPUC) Risk-Based Decision-Making Framework (RDF),[1] including the requirements adopted in Decision (D.) 22-12-027 (Phase 2 Decision)[2] and D.24-05-064 (Phase 3 Decision).[3] Excavation Damage is included in the 2025 RAMP Report based on a safety risk assessment, further informed by its reliability and financial consequence attributes, consistent with RDF guidance. This risk chapter describes the basis for selection of Excavation Damage, the controls and/or mitigations put forth to reduce the likelihood or consequence of this risk, a discussion of alternative mitigations considered but not selected, and a graphic to show historical progress. This chapter presents cost and unit forecasts for the risk mitigating activities, but it does not request funding. Any funding requests for this risk will be made through the Company's Test Year (TY) 2028 General Rate Case (GRC) application. Finally, this chapter describes the methods applied to estimate the risk's monetized, pre-mitigated risk, the estimated risk-reduction benefits of each included control and mitigation, and the calculation of Cost-Benefit Ratios (CBRs) for each control and mitigation consistent with the method and process prescribed in the RDF.

## A. Risk Definition and Overview

### 1. Risk Definition

For the purposes of this RAMP Report, SDG&E's Excavation Damage is defined as the risk of a dig-in on the natural gas system that is either classified as high or medium pressure, including appurtenance piping, caused by excavation activities, which result in serious injuries, fatalities and/or damages to the infrastructure.

---

1 As discussed in Volume 1, Chapter RAMP-1, the RDF Framework broadly refers to the recent modifications to the Commission's Rate Case Plan adopted in Rulemaking (R.) 13-11-006, Safety Model Assessment Proceeding A.15-05-002 et al. (cons.), and R.20-07-013 (the Risk OIR), including D.24-05-064, Appendix A.

2 D.22-12-027 is the "Phase II Decision Adopting Modifications to the Risk-Based Decision-Making Framework Adopted in Decision 18-12-014 and Directing Environmental and Social Justice Pilots" (December 21, 2022).

3 D.24-05-064 is the "Phase III Decision" (June 6, 2024).

Certain controls and mitigations presented in this chapter are subject to compliance mandates beyond RDF reporting requirements, such as those from the CPUC's General Order (GO) 112-F and PHMSA including but not limited to subparts of Rule 49 Code of Federal Regulations (CFR). A list of compliance requirements applicable to Excavation Damage is provided in Attachment A. Certain mitigation programs have value beyond the estimated risk reduction calculated under the RDF, such as enhancing operations, alignment with sustainability goals and improving customer service.

**2. Risk Overview**

SDG&E operates and manages a natural gas system of over 15,400 miles of Distribution pipe and 219 miles of Transmission pipe within its 4,100 square mile service territory. Pipe mileage can be further segregated into general operating pressure categories of Medium Pressure (MP), which operates at or less than 60 psig, and High Pressure (HP), which operates above 60 psig. SDG&E's large piping network and large service territory have exposure to potential dig-in related incidents. This risk highlights the consequence and likelihood of dig-in damage that cause a release of natural gas, damage property, or personal injury.

SDG&E has been mitigating dig-in risk to its underground gas infrastructure for decades. Dig-ins are a ubiquitous problem for all industries and utilities with buried infrastructure and are not unique to SDG&E. Excavation activities can vary widely based on project scope and size. Examples include: a homeowner doing landscaping work, a plumber repairing a sewer line, contractor performing excavation work on streets or sidewalks, or a city upgrading its aging municipal water or sewer systems. Excavation damage can range from minor scratches and/or dents on gas piping, to ruptures with an uncontrolled release of natural gas. The release of natural gas may not just occur at the time of the damage. A leak or rupture may also occur after the infrastructure has sustained damage that has accumulated over time. Damage that does not result in a release of gas is less often reported by the responsible party. Unfortunately, SDG&E cannot always assess the pipe for damage and make the appropriate repairs to preserve the integrity of the pipe.

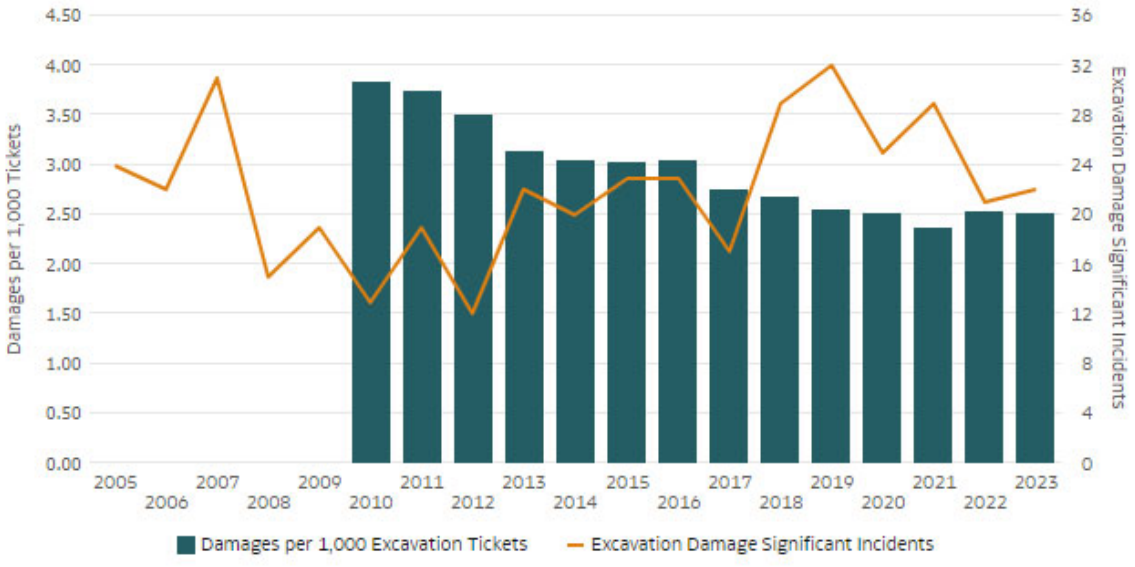
Serious consequences may result if an event occurs because of this risk. For example, if a leak or rupture occurs, ignition of the released gas could lead to an explosion, fire, or both. The nearby public could be seriously injured, and property damage could be extensive. Federal and state agencies acknowledge the threat of dig-in risk and have responded by adopting several

regulations and industry standards and supporting awareness efforts to help prevent dig-ins. For example, the Department of Transportation (DOT) sponsored the "Common Ground Study," completed in 1999. Subsequently, the "Common Ground Study" led to the creation of the Common Ground Alliance (CGA), a member-driven association of 3,200 individuals, organizations, and sponsors in every facet of the underground utility industry. With industry-wide support, CGA created a comprehensive consensus document that details the best practices addressing every stakeholder groups' activity in promoting safe excavation and dig-in prevention.

While these efforts are important and commendable, and the number of dig-ins per 1,000 excavation tickets within the industry has been trending down (Figure 1), excavation damage incidents continue. Excavation tickets are a common metric used throughout the industry to gauge the status of a damage prevention program. Figure 1 represents industry trends for dig-ins on distribution lines. Excavation data for transmission incidents are less frequent and harder to trend. Thus, the DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) collects ticket totals in annual reports for distribution facilities but did not collect ticket information for transmission facilities before 2024.

**Figure 1**

**Excavation Damage: Excavation Tickets & Incidents**




Under California State Law, an excavator planning excavation work is required to contact the Regional Notification Center for their area, also known as Eight-One-One (811) or

Underground Service Alert (USA), at least two (2) full working days prior to commencing construction excavation activities, not including the day of the notification.[4] 811 is the national phone number designated by the Federal Communications Commission (FCC), that connects homeowners or contractors who plan to dig with professionals through a local call center. California has two Regional Notification Centers, DigAlert and USA North, that split California at the Los Angeles/Kern county, and Santa Barbara/San Luis Obispo County lines; USA North serves all counties north of the county lines and DigAlert serves all counties south of the county lines. SDG&E is served exclusively by DigAlert which will be referenced as 811 USA for the remainder of this chapter. Once an excavator makes contact, the Regional Notification Center will issue a USA Ticket notifying local utilities and other operators of the location and areas to be inspected for potential conflicts of underground infrastructure with the pending planned excavation work. Operators are then required to provide an Electronic positive response to indicate that there are no facilities in conflict or to mark their underground facilities via aboveground identifiers (*e.g.*, paint, chalk, flags, whiskers) to designate where underground utilities are approximately positioned, thus enabling excavators, like contractors and homeowners, to recognize the existence of underground utility facilities within the respective digging area. The law also requires excavators to use careful, manual (hand digging) methods to expose subsurface installations prior to using mechanical excavation tools.[5]

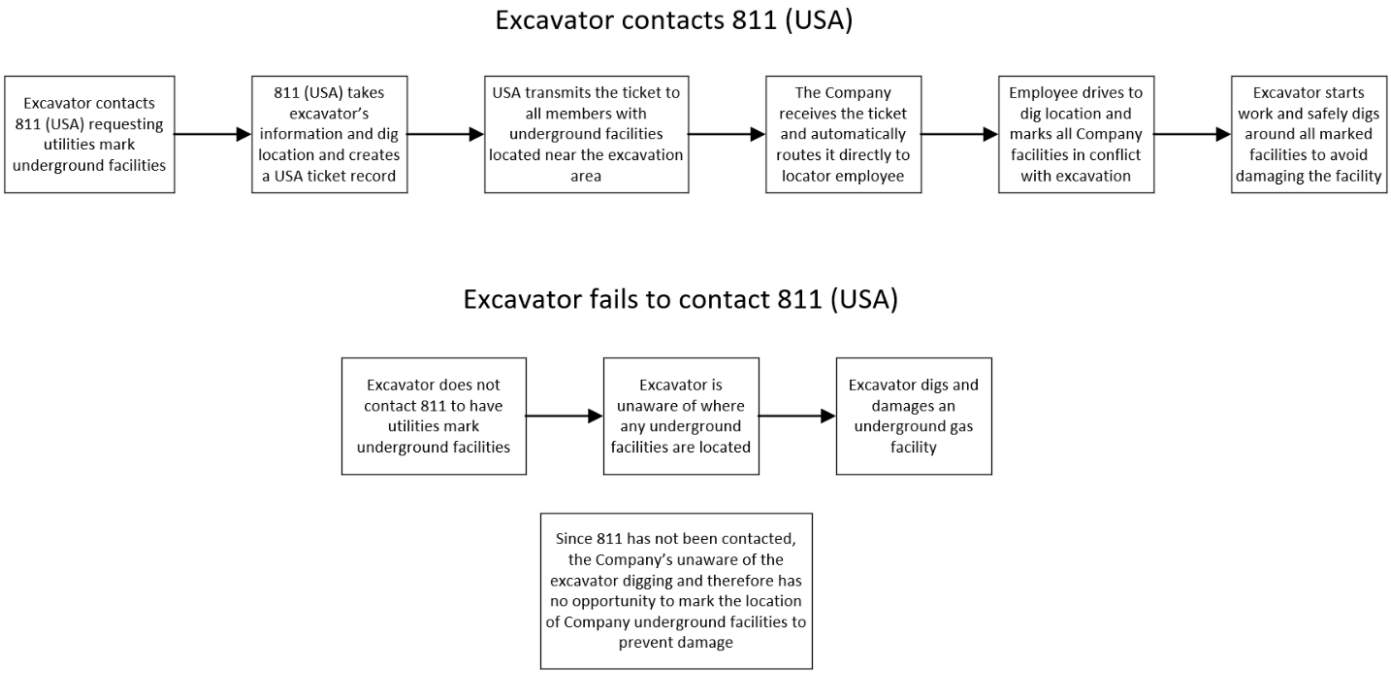
Figure 2 below illustrates the sequence of events that may occur when an excavator contacts 811 USA prior to conducting excavation work and, in contrast, the sequence that may occur when they do not.

[4] Cal. Gov. Code § 4216.2(b).

[5] Cal. Gov. Code § 4216.4(a)(1).

**Figure 2**

**Excavation Damage: Excavation Contact Process Flow**




While there may be more steps when an excavator calls 811 USA prior to commencing excavation work, it can protect from a negative outcome that might result were a call not made. When excavators call 811 USA before excavating, the risk of a dig-in is reduced. SDG&E managed over 210,000 natural gas 811 USA tickets and reported over 250 natural gas dig-in excavation damage incidents in 2024. Analysis of the data collected during routine damage investigations indicate that further analysis of the reported damage incidents shows that the majority of damages were caused by a lack of notification to 811 USA for a locate and mark ticket and the next greatest cause was inadequate excavation practices even after the excavator called 811 USA and underground facilities were marked.

In addition to direct involvement with excavators and 811 USA, SDG&E engages in promoting safe digging practices through its Public Awareness Program and corporate safety messaging through stakeholder outreach. This educational messaging comes in multiple formats, including mail, email, social media, television, radio, events, and association sponsorships.

### B. Risk Scope

SDG&E analysis considers the risk of a dig-in on the natural gas system that is either classified as high or medium pressure, including appurtenance piping, caused by excavation activities, which results in serious injuries, fatalities and/or damage to the infrastructure.

### C. Data Sources Used in Quantifying Risk Estimates[6]

SDG&E utilized internal data sources to determine Excavation Damage Pre-Mitigation Risk Value and calculate risk reduction estimates for migration activities (which enables estimation of Post Mitigation Monetized Risk Values and Cost Benefit Ratios). Where internal data is deemed insufficient, supplemental industry or national data is used as appropriate and adjusted to account for the risk characteristics associated with the Company's specific operating locations and service territory. For example, certain types of incident events have not occurred within the SoCalGas and SDG&E service territories. Expanding the quantitative data sources to include to encompass industry data where such incidents have been recorded is appropriate to establish a baseline of risk and risk addressed by mitigative activities. Attachment B provides additional information regarding these data resources.

## II. RISK ASSESSMENT

In accordance with Commission guidance, this section provides a qualitative description of Excavation Damage, including a risk Bow Tie which delineates potential Drivers/Triggers and Potential Consequences, followed by a description of the Tranches determined for this risk and the risk's Pre-Mitigated Risk Value.

### A. Risk Selection

Excavation Damage was included as a risk in SDG&E's 2021 RAMP and was included in the 2022, 2023 and 2024 Enterprise Risk Registries (ERR).[7] SDG&E's ERR evaluation and selection process is summarized in Chapter RAMP-2: Enterprise Risk Management Framework.

---

[6] Copies and/or links to these data resources are provided in the workpapers served with this Report on May 15, 2025.

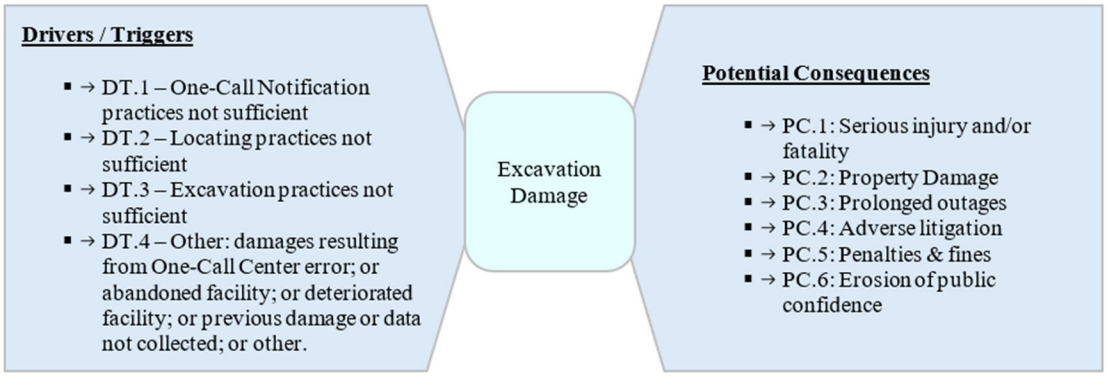
[7] In the 2021 RAMP Report this risk was called Excavation Damage (Dig-In) on the Gas System. The risk definition is unchanged.

SDG&E selected this risk in accordance with RDF Row 9.[8] Specifically, SDG&E assessed top risks from the Company's 2024 ERR based on the Consequence of a Risk Event (CoRE) Safety attribute. The Excavation Damage Risk was among the risks presented in SDG&E's list of Preliminary 2025 RAMP Risks on December 17, 2024 at a Pre-Filing Workshop. Excavation Damage was selected electively, as it did not qualify based on the Safety attribute alone. At the pre-filing workshop, no party expressed opposition to inclusion of this risk in SDG&E's 2025 RAMP Report.

### B. Risk Bow Tie

In accordance with Commission requirements, this section describes the risk Bow Tie, possible Drivers, potential Consequences, and a mapping of the elements in the Bow Tie to the mitigation(s) that addresses it.[9] As illustrated in the risk Bow Tie shown below in Figure 3, the Risk Event (center of the Bow Tie) is Excavation Damage that leads to asset failure, serious injury or death, the left side of the Bow Tie illustrates Drivers/Triggers that could lead to the Excavation Damage that could cause asset failure, serious injury or death, and the right side shows the Potential Consequences of the Excavation Damage. SDG&E applies this framework to identify and summarize the information provided in Figure 3. A mapping of each mitigation to the elements of the risk Bow Tie is provided in Attachment C.

**Figure 3**
**Excavation Damage: Risk Bow Tie**




[8] RDF Row 9 states that risks to be included in the RAMP Report, at minimum, are those identified in the Company's ERR comprising "the top 40% of ERR risks with a Safety Risk Value greater than zero dollars."

[9] D.24-05-064, RDF Row 15.

### C. Potential Risk Event Drivers/Triggers[10]

When performing a risk assessment for the Excavation Damage Risk, SDG&E identifies potential leading indicators, referred to as Drivers or Triggers, that reflect current and/or forecasted conditions and may include both external actions as well as characteristics inherent to the asset.[11] These Bow Tie Drivers/Triggers inform the Likelihood of a Risk Event (LoRE) component of the risk value. These include:

- **DT.1 –** One-Call Notification practices not sufficient: damages resulting from no notification made to the One-Call Center; or notification made to One-Call Center, but not sufficient; or wrong information provided to One-Call Center, which could lead to one or many of the potential consequences listed below occurring.
- **DT.2** – Locating practices not sufficient: damages resulting from facility could not be found or located; or the facility marking or location is not sufficient pursuant to requirements; or the facility was not located or marked; or incorrect facility records/maps, which may lead to one of the potential consequences listed below occurring if not mitigated through other practices.
- **DT.3** – Excavation practices not sufficient by excavator: damages resulting from failure to maintain marks; or failure to support exposed facilities; or failure to use hand tools where required; or failure to test-hole (pothole); or improper backfilling practices; or failure to maintain clearance; or other insufficient excavation practice, which could lead to one or many of the potential consequences listed below occurring.
- **DT.4** – Other: damages resulting from One-Call Center error; or abandoned facility; or deteriorated facility; or previous damage or data not collected; or other, which could lead to one or many of the potential consequences listed below occurring.

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

[11] D.24-05-064, RDF Row 10-11.

### D. Potential Consequences of Risk Event (CoRE)

Potential Consequences are listed to the right side of the risk Bow Tie. SDG&E identifies the Potential Consequences of this Risk by analyzing internal data sources where available, industry data, and subject matter expertise (SME).[12] These Bow Tie Consequences inform the CoRE component of the risk value. If one or more of the Drivers listed above were to result in an incident, the Potential Consequences, in a plausible worst-case scenario, could include:

- **PC.1:** Serious injury and/or fatality
- **PC.2:** Property Damage
- **PC.3:** Prolonged outages
- **PC.4:** litigation
- **PC.5:** Penalties & fines
- **PC.6:** Erosion of public confidence

These Potential Consequences were used by SDG&E in the scoring of Excavation Damage during the development of its SDG&E's 2024 ERR.

### E. Evolution of Its Drivers and Consequences

As specified in the Phase 3 Decision,[13] the following changes to the previous ERR and/or the 2021 RAMP include the following.

#### 1. Changes to Drivers/Triggers of the Risk Bow Tie

While evaluating this risk to consolidate HP and MP into one risk, it was also recognized that many of the 2021 drivers had the same root driver and as such were consolidated into four (4) drivers seen in the 2025 RAMP bowtie. To clarify, the following drivers were present in 2021 RAMP but removed in 2025 RAMP:

- DT.1 – Excavators such as contractors or property homeowners/tenants do not follow 811 One-Call Dig-Safe law requirements (USA) for locate and mark prior to excavation
- DT.2 – Excavator fails to contact company "standby" personnel

[12] D.24-05-064, RDF Row 10.

[13] *Id.*, RDF Row 8.

- DT.3 – Hand excavation and other required excavation practices are not performed in the vicinity of located underground facilities
- DT. 4 – Company does not respond to 811 requests in required timeframe
- DT.5 – Company does not "standby" when requested near required facilities
- DT.6 – Locator error contributing to the incorrect marking of underground facilities
- DT. 7 – Delayed updates to asset records of underground facilities leading to incorrect locate and mark
- DT. 8 – Incorrect/inadequate information in existing asset records leading to incorrect locate and mark
- DT.9 – Execution Constraints

As discussed above, the following drivers were established for the 2025 RAMP:

- DT.1 – One-Call Notification practices not sufficient
- DT.2 – Locating practices not sufficient
- DT.3 – Excavation practices not sufficient
- DT.4 – Other: damages resulting from One-Call Center error; or abandoned facility; or deteriorated facility; or previous damage or data not collected; or other.

**2. Changes to Potential Consequences of the Risk Bow Tie**

- No changes to potential consequences

**F. Summary of Tranches**

To determine groups of assets or systems with similar risk profiles, or Tranches, and in accordance with Row 14 of the RDF, SDG&E applied the Homogeneous Tranching Methodology (HTM) as outlined in Chapter RAMP - 3: Risk Quantification Framework. As a result, the following classes, LoRE-CoRE pairs, and resulting number of Tranches were determined:

**Table 1: Excavation Damage Risk**
**Tranche Identification**

| Class | Number of LoRE-CoRE Pairs | Number of Resulting Tranches |
|---|---|---|
| HP | 48 | 12 |
| MP | 91 | 20 |
| **TOTAL** | **139** | **32** |

Attachment D illustrates the derivation of the Tranches, as shown in Table 1 above, in accordance with the HTM. The classes were identified by SDG&E subject matter experts as logical groups of assets and systems based on the Company's operations. These classes also align risk treatments with asset risk profiles reflective of SDG&E's operations. More detailed Tranche information, including risk quantification by LoRE-CoRE pair, Tranche names, and mitigation associations (*i.e.*, cost mapping and risk reduction) to Tranches, is provided in workpapers.

## III. PRE MITIGATION RISK VALUE

In accordance with the RDF Row 19, the table below provides the pre-mitigation risk values for the Excavation Damage Risk. Further details, including pre-mitigation risk values by tranche, are provided in workpapers. Explanations of risk quantification methodology and other higher-level assumptions are provided in Chapter RAMP-3: Risk Quantification Framework.

**Table 2: Excavation Damage Risk**
**Monetized Risk Values**
**(Direct, in 2024 $ millions)**

| LoRE | CoRE [Risk-Adjusted Attribute Values] | | | Total CoRE | Total Risk [LoRE x Total CoRE] |
|---|---|---|---|---|---|
| | Safety | Reliability | Financial | | |
| 323.18 | $0.005 | $0.013 | $0.002 | $0.021 | $6.83 |

### A. Risk Value Methodology

SDG&E's risk modeling for the Excavation Damage risk follows RDF guidance[14] for implementing a Cost Benefit Approach, as described below:

**1. Cost Benefit Approach Principle 1 – Attribute Hierarchy (RDF Row 2):** Excavation Damage risk is quantified in a combined attribute hierarchy as

[14] D.24-05-064, RDF Rows 2-7.

shown in the table above, such that Safety, Reliability, and Financial are presented based on available, observable and measurable data.

2. **Cost Benefit Approach Principle 2 – Measured Observations (RDF Row 3):** Excavation Damage risk features observable and measurable CoRE values. SDG&E utilized its database of reportable excavation damage incidents data (mentioned in the introduction of this Chapter) to represent natural units for excavation damage events.

3. **Cost Benefit Approach Principle 3-Comparison (RDF Row 4):** Excavation Damage quantification did not include any attributes that are not directly measurable, so proxy data, as described in the RDF, was not necessary.

4. **Cost Benefit Approach Principle 4-Risk Assessment (RDF Row 5):** The data sources used for Excavation Damage – as described in the preceding paragraphs – were sufficient to model probability distributions for use in estimating risk values.

5. **Cost Benefit Approach Principle 5-Monetized Levels of Attributes (RDF Row 6):** As described more fully in Volume 1, Chapter RAMP-3, the Safety CoRE attribute is valued at a monetized equivalent of $16.2 million per fatality, $49 thousand for minor injuries, and $4.1 million per serious injury; the Gas Reliability CoRE attribute is valued at a monetized equivalent of $3,868 per gas meter outage; and the Financial CoRE attribute is valued at $1 per dollar.[15] The Electric Reliability CoRE attribute is not considered for SDG&E's Excavation Damage Risk.

Further information regarding SDG&E's quantitative risk analyses, including raw data, calculations, and technical references, are provided in workpapers.

[15] *See* Chapter RAMP-3: Risk Quantification Framework, Section II.

### 6. Cost Benefit Approach Principle 6-Adjusted Attribute Level (RDF Row 7):

**Table 3: Excavation Damage Risk**
**Risk Scaled vs Unscaled Value by CoRE Attribute**
**(Direct, in 2024 $ millions)**

| | Safety | Reliability | Financial | Total |
|---|---|---|---|---|
| Unscaled Risk Value | $0.50 | $2.60 | $0.75 | $3.85 |
| Scaled Risk Value | $1.75 | $4.30 | $0.78 | $6.83 |

The values in the table above are the result of SDG&E applying the risk scaling methodology described in Chapter RAMP-3 to the CoRE attributes for the Excavation Damage Risk. Excavation Damage Risk features significant risk aversion scaling due to the potential for high impact consequence outcomes resulting from excavation damage leading to an asset failure/uncontrolled release of gas.

For further information regarding the risk scaling function, including the risk scaling factor and the loss threshold at which the risk scaling factor begins to apply, is provided in Chapter-RAMP-3.

## IV. 2024-2031 CONTROL & MITIGATION PLAN

This section identifies and describes the controls and mitigations comprising the portfolio of mitigations for Excavation Damage and reflects any changes to the portfolio expected to occur from the last year of recorded costs at the time of filing this RAMP Report (2024) through the 2028 GRC cycle (2031). For clarity, a current activity that is included in the plan may be referred to as either a control and/or a mitigation. Table 4 below shows which control activities are in place in 2024 and which are expected to be on-going, completed, or new during the 2025-2031 time periods. Because the TY 2024 GRC proceeding established rates through 2027,[16] information through 2027 is calculated as part of the baseline risk, in accordance with D.21-11-009.[17] For the TY 2028 GRC, SDG&E calculated CBRs beginning with TY 2028 and for each Post-Test Year 2029, 2030, and 2031.[18]

---

[16] *See* D.24-12-074.

[17] D.21-11-009 at 136 (Conclusion of Law (COL) 7) (providing a definition for "baselines" and "baseline risk").

[18] In the TY 2028 GRC, the last year of recorded costs, or base year, will be 2025. SoCalGas and SDG&E will forecast information for 2026 through 2031, in accordance with the Rate Case Plan.

**Table 4: Excavation Damage Risk**
**2024-2031 Control and Mitigation Plan Summary**

| ID | Control/Mitigation Description | 2024 Control | 2025-2031 Plan |
|---|---|---|---|
| C001 | Damage Prevention Strategies | X | Ongoing |
| C002 | Damage Prevention Activities – Gas | X | Ongoing |
| C003 | Damage Prevention – Public Awareness | X | Ongoing |
| C004 | Damage Prevention Mapping | X | Ongoing |

### A. Control Programs

In accordance with Commission guidance, this section "[d]escribe[s] the controls or mitigations currently in place"[19] (*i.e.*, activities in this section were in place as of December 31, 2024). Controls that will continue as part of the risk mitigation plan are identified in Table 4 above.

- **C001: Damage Prevention Strategies:**

  The Damage Prevention Strategies control is spearheaded on two fronts, the Damage Prevention Analyst Program and Ticket Risk Analysis (TRA).

  The Damage Prevention Analyst (DPA) Program aims to mitigate third-party damages to gas facilities by identifying high-risk excavating contractors through data analysis and informing them that their practices may be in violation of digging laws and standards such as, but not limited to, proper one-call procedures and safe digging techniques. The benefits of the DPA are numerous. First, it enables SDG&E to check if underground markings are present where they happen to notice construction occurring. Second, it provides an opportunity to educate contractors on the requirements before digging or when digging around gas facilities before damage is done. This education has far-reaching benefits as the contractor will perform future projects in other districts not currently part of the program, and the education can be applied to those future projects. Third, it creates a list of contractors who might be repeat offenders and/or prevalent site characteristics to improve prioritization of future construction site inspections.

[19] D.18-12-014 at 33.

The DPAs focus on districts with the greatest number of reported incidents by driving to and physically inspecting excavation projects with 811 USA ticket requests. The analysts stop at some other construction projects to investigate if the excavator notified USA 811 and if safe excavating techniques are followed. SDG&E expects to expand this program with additional analysts and broader system-wide coverage. SDG&E's DPAs have stopped many jobs since the program's inception in 2024 and have conducted over 2,500 contractor outreach and educational opportunities. The final activity of the DPAs is to validate that locators are following processes and procedures when performing locating tasks on all SDG&E substructures to include natural gas, electric, and fiber optic substructures. This Quality Assurance by DPA evaluators document each ticket assessment and identify opportunities for improvement. SDG&E's Gas Quality Assurance department administers the DPA program and visits every operating district at least once per year. During these visits, they select a prescribed number of 811 USA tickets for each Locator, check the employee's Operator Qualification status, and evaluate the documentation on the ticket. Additionally, they will perform field visits, when possible, to evaluate in-field activities such as equipment setup and use, Company Gas Standard compliance, accuracy of locate and mark placement (on natural gas, electric, and fiber optic substructures), proper documentation, and proper use of the Korterra ticket management system, among other activities. Feedback on a quality assurance audit is provided to each local supervisor who is responsible for following up with employees and providing coaching or refresher training.

The TRA portal is a proprietary in-house software tool designed to assist DPA and field supervisors by providing a GIS map interface that highlights high-risk tickets. Key features include color-coded ticket locations, advanced filtering capabilities, and the ability to display pipeline locations. The portal also offers automated email notifications to ticket requesters based on custom criteria, such as boring, and categorizes tickets using a model that considers work type. A typical use case involves a DPA using the TRA portal to identify clusters of high-

risk tickets, enabling them to prioritize their efforts on areas with the highest potential for damage.

- **C002: Damage Prevention Activities-Gas:**

  The purpose of the Damage Prevention Activities – Gas is to prevent damage to gas infrastructure caused by third-party excavators. Three primary locate and mark activities are listed below:
  (1) locating and marking underground gas facilities before excavation occurs;
  (2) observing (stand-by) pipeline excavation activities; and
  (3) providing staff support for compliance and improvement.

  The first of these activities refers to the physical act of locating and marking underground facilities. SDG&E has been moving towards in-sourcing work related to locate and mark activities. In 2024, SDG&E responded to over 210,000 natural gas locate-and-mark ticket requests. By providing a visual indication of the location of underground facilities, the excavator has the necessary information to excavate safely.
  The second activity is pipeline observation, or "stand-by," which is a critical activity that requires a qualified Company representative to be present anytime excavation activities take place near high-priority pipelines. The purpose of this activity is to decrease the likelihood of damage occurring by having a dedicated employee present to maintain the integrity of the pipeline.
  The third activity is providing daily damage prevention staff support to operations by interpreting policies, tracking compliance, evaluating tools, equipment, and new technologies, providing refresher training, and tracking and trending locate-and-mark data to proactively identify areas for improvement. This is a critical risk reduction activity that directly supports the field locator personnel in their daily activities and leads to more accurate and timely responses to locate-and-mark tickets and reductions in damages. This collection of Damage Prevention Activities – Gas ultimately provides the excavator with additional information to avoid hitting or damaging gas facilities.

- **C003: Damage Prevention - Public Awareness:**[20]
  SDG&E is dedicated to raising public awareness about damage prevention through a series of strategic controls and enhancements. These efforts are designed to educate the public, promote safe practices, and reduce the risk of damage to subsurface facilities. Key components include:
- **Compliance Monitoring**: The Company endeavors to comply with public awareness regulations and standards. This includes adhering legal requirements for public education and outreach. Regular audits and reviews are conducted to monitor compliance and identify areas for improvement.
- **Public Education Campaigns**: The Company conducts ongoing public education campaigns to inform the community about the importance of safe excavation practices. These campaigns utilize various media channels, including social media, print, and broadcast, to reach a wide audience.
- **Educational Materials**: The Company develops and distributes educational materials, such as brochures, flyers, and instructional videos, to provide clear and accessible information on safe excavation practices. These materials are made available at public events, community centers, and online.
- **Collaborative Partnerships**: The Company collaborates with local governments, industry associations, and other stakeholders to enhance public awareness efforts. These partnerships help amplify the message and promote a coordinated approach to damage prevention.
- **Community Outreach Programs**: Through community outreach programs, the Company engages directly with local communities. These programs include workshops, seminars, and informational sessions that provide valuable insights into damage prevention and the proper use of 811 services.
- **Feedback and Improvement**: The Company actively seeks feedback from the public and stakeholders to continuously improve its public awareness initiatives.

[20] In 2028 SB1371 costs associated with Public Awareness media and marketing campaigns (which began in 2020) will transfer to the TY2028 GRC Base O&M request.

This feedback is used to refine messaging, identify new outreach opportunities, and enhance the overall effectiveness of the program.

By implementing these controls and enhancements, the Company aims to promote safety and awareness among the public, ultimately reducing the risk of damage to subsurface facilities and promoting safer excavation practices.

- **C004: Damage Prevention Mapping:**

  The entirety of the accurate and complete GIS mapping records of the Gas Distribution and Transmission system is a critical risk mitigation measure in identifying hazards to public and employee safety, infrastructure sustainability, and also supports the reliable delivery of natural gas to SDG&E's customers. As gas system construction, maintenance, and repair projects are completed throughout SDG&E's service territory, accurate pipeline data is captured and records kept for the life of the pipeline, consistent with GO 112-F and 58-A. Projects requiring mapping and database records work include all new business activity, pipeline relocations, main extensions, pressure betterment projects, pipeline replacements, and various other operational activities that change the gas system configuration. The GIS-based mapping system includes the capability to capture pipeline attribute data, and this data is added to the facilities when mapped in GIS. GIS mapping personnel are responsible for updating all distribution infrastructure maps whenever facilities in the field are constructed, modified, or replaced. The timely maintenance of these Gas Distribution system records is a critical risk mitigation measure in preventing hazards to public and employee safety, infrastructure integrity, and to the reliable delivery of natural gas to SDG&E's customers.

**B. Changes from 2024 Controls**

SDG&E plans to continue each of the existing controls discussed above, and reflected in Table 1, through the 2025-2031 period without any significant changes.

**C. Mitigation Programs**

SDG&E does not currently foresee implementing new mitigations not described above during the 2025-2031 period.

### D. Climate Change Adaptation

In assessing Excavation Damage, controls and/or mitigations that address climate adaptation planning were determined to be inapplicable (from the perspective of climate exposure, asset sensitivity, and asset adaptive capacity). A list of climate-relevant controls and mitigations is provided in Volume 1, Chapter RAMP-5: Climate Change Adaptation.

### E. Foundational Programs

Foundational Programs are "[i]nitiatives that support or enable two or more Mitigation programs or two or more Risks but do not directly reduce the Consequences or reduce the Likelihood of safety Risk Events."[21] There are no activities that meet this definition of a foundational activity.

### F. Estimates of Costs, Units, and Cost-Benefit Ratios (CBRs)

The tables in this section provide a quantitative summary of the risk control and mitigation plan for Excavation Damage, including the associated costs, units, and CBRs. Additional information by Tranche is provided in workpapers. The costs shown are estimated using assumptions provided by SMEs and available data. In compliance with the Phase 3 Decision,[22] for each enterprise risk, SDG&E uses actual results and industry data and when that is not available, supplements the data with SME input. Additional details regarding the data and expertise relied upon in developing these estimates are provided in Attachment B.

**Table 5: Excavation Damage Risk**
**Risk Control and Mitigation Plan – Recorded and Forecast Costs Summary**
**(Direct, in 2024 $thousands)**

| ID | Control/Mitigation Name | Recorded Costs | | Forecast Costs | | | |
|---|---|---|---|---|---|---|---|
| | | 2024 Capital | 2024 O&M | 2028 O&M | 2025-2028 Capital | PTY Capital | PTY O&M |
| C001 | Damage Prevention Strategies | 0 | 598 | 800 | 0 | 0 | 2,400 |
| C002 | Damage Prevention Activities – Gas | 0 | 6,547 | 7,811 | 0 | 0 | 25,615 |
| C003 | Damage Prevention – Public Awareness | 0 | 1,142 | 1,029 | 0 | 0 | 3,087 |
| C004 | Damage Prevention Mapping | 0 | 686 | 686 | 0 | 0 | 2,058 |

[21] D.24-05-064, Appendix A at A-4.

[22] D.24-05-064, RDF Row 10.

**Table 6: Excavation Damage Risk**
**Risk Control & Mitigation Plan – Units Summary**

| Control/Mitigation Name | | Recorded Units | | | Forecast Units | | | |
|---|---|---|---|---|---|---|---|---|
| **ID** | **Name** | **Unit of Measure** | **2024 Capital** | **2024 O&M** | **2028 O&M** | **2025-2028 Capital** | **PTY Capital** | **PTY O&M** |
| C001 | Damage Prevention Strategies | Employees | 0 | 6 | 8 | 0 | 0 | 24 |
| C002 | Damage Prevention Activities – Gas | Tickets | 0 | 212,553 | 253,614 | 0 | 0 | 831,629 |
| C003 | Damage Prevention – Public Awareness | Customers reached | 0 | 56,078 | 56,539 | 0 | 0 | 169,617 |
| C004 | Damage Prevention Mapping | Reconciled work orders | 0 | 3,366 | 3,366 | 0 | 0 | 10,098 |

In the table below, CBRs are presented in summary at the mitigation or control level for the aggregate 2028-2031 period, reflective of the Test Year 2028 GRC cycle. CBRs are calculated based on scaled, expected values, unless otherwise noted and are calculated for each of the three required discount rates[23] in each year of the GRC cycle and for the Post-Test Years in aggregate (2029-2031). Costs and CBRs for each year of the GRC cycle and the aggregated years are provided in workpapers.

**Table 7: Excavation Damage Risk**
**Cost Benefit Ratio Results Summary (2028-2031)**
**(Direct, in 2024 $ millions)**

| ID | Control/Mitigation Name | Capital (2028-2031) | O&M (2028-2031) | CBR (Societal) | CBR (Hybrid) | CBR (WACC) |
|---|---|---|---|---|---|---|
| **C001** | **Damage Prevention Strategies** | 0 | 3.2 | 0.68 | 0.72 | 0.68 |
| **C002** | **Damage Prevention Activities – Gas** | 0 | 33.426 | 6.17 | 6.60 | 6.21 |
| **C003** | **Damage Prevention – Public Awareness** | 0 | 4.116 | 0.28 | 0.30 | 0.28 |
| **C004** | **Damage Prevention Mapping** | 0 | 2.744 | 4.31 | 1.47 | 1.14 |

***Bold*** *indicates a mandated program.*

[23] *See* Chapter RAMP-3: for definitions of discount rates, as ordered in the Phase 3 Decision.

## V. ALTERNATIVE MITIGATIONS

Pursuant to D.14-12-025 and D.16-08-018,[24] SDG&E considered two alternatives to the risk mitigation plan for the Excavation Damage risk. Typically, analysis of alternatives occurs when implementing activities to obtain the best result or product for the cost. The alternatives analysis for this plan considers changes in risk reduction, cost, reasonableness, current conditions, modifications to plan and constraints, such as budget and resources.

**Table 8: Excavation Damage Risk**
**Alternative Mitigation Plan Forecasted Costs Summary (2028-2031)**
**(Direct, in 2024 $millions)**

| ID | Alternative Mitigation Name | Forecast Costs | | | |
|---|---|---|---|---|---|
| | | 2025-2028 Capital | PTY Capital | 2025-2028 O&M | PTY O&M |
| A001 | MP Standby for Repeat Offenders | 0 | 0 | 24 | 18 |
| A002 | Installation of non-required EFV's | 0 | 0 | 3.2 | 2.4 |

**Table 9: Excavation Damage Risk**
**Cost Benefit Ratio Results Summary**
**(Direct, in 2024 $millions)**

| ID | Alternative Mitigation Name | Capital TY 2028 | O&M TY 2028 | CBR (Societal) | CBR (Hybrid) | CBR (WACC) |
|---|---|---|---|---|---|---|
| A001 | MP Standby for Repeat Offenders | 0 | 6 | 0.03 | 0.03 | 0.03 |
| A002 | Installation of non-required EFVs | 0 | 0.8 | ~0.00 | ~0.00 | ~0.00 |

### A. Alternative 1: MP Standby for Repeat Offenders

1. This alternative mitigation will require additional oversight on excavation damage repeat offenders (RO)[25] when excavating within 10 feet of Company medium pressure substructures. This assumes that the excavator has complied with the applicable law related to notifications. This would require Company personnel to meet onsite with an RO to agree upon excavation activities prior to legal excavation start date and verify the RO

[24] *See, e.g.,* D.18-12-014 at 33-35.

[25] Repeat Offender is defined as an excavator who has more than two damages on company substructures in a running 12-month period.

is using appropriate excavation activities to reduce the risk of Company substructure being damaged by the RO. This mitigation would mirror current California code 4216.2c requirements for high priority subsurface installations.

By implementing this mitigation plan, the Company would aim to encourage responsible behavior among contractors, enhance safety standards, and reduce the need for stand-by activities. This approach not only promotes compliance but also fosters a collaborative relationship between the Company and excavators within the company's service territory. The company has not included this mitigation as part of the control plan because it would not mitigate risks beyond a narrow group of excavators and yet the costs would be significant.

**B. Alternative 2: Installation of non-required EFV's**

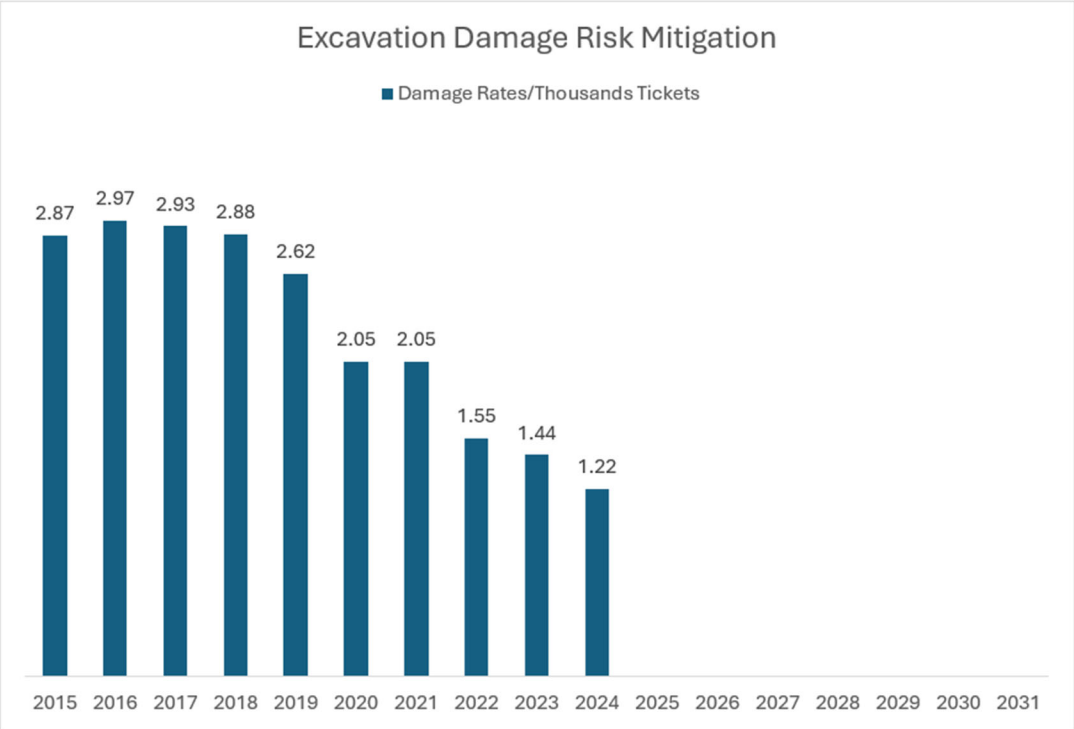
Per CFR 192.385 installation of manual service line shut-off valve (a "curb" valve or other manually operated valve) or an excess flow valve (EFV) are required on new or replaced service lines with meter capacity exceeding 1,000 Standard Cubic Foot Hours. This alternative mitigation would install EFV's on all existing services that fall under the capacity requirements of CFR 192.385. By implementing this alternative mitigation plan, the Company could enhance the safety of its gas distribution system. The installation of EFVs on all service lines would help prevent uncontrolled gas flow, reduce the risk of gas leaks, and protect customers and infrastructure. The Company has not included this mitigation as part of the control plan because the Company is currently compliant with CFR 192.385 and additional in-depth analysis would be required to determine feasibility dependent on service line customer consumption and industry EFV technology.

## VI. HISTORICAL GRAPHICS

As directed by the Commission in D.22-10-002, this section illustrates the accomplishments in safety work and the progress in mitigating safety risks over the two immediately preceding RAMP cycles. A bar chart graphic is employed to depict historical progress. This graphic uses a key metric that aligns with Company safety goals to illustrate trends in historical progress and identify the remaining tasks necessary to continue mitigating risks.

**Figure 4**

**Excavation Damage: Safety Progress 2016-2024**




The historical safety work activities completed using the above metric from 2016-2024 include:

- 2019: Damage Prevention Strategies Program created to reduce excavation damages, educate excavation community on 811 requirements, and improve safe excavation. Create and maintain relationships with municipalities and excavators.
- 2019/2020: Shared service with SoCalGas. Focus on Engagement, Education, Enforcement, and Enhancements. In-House Ticket Risk Assessment tool created to identify potential high risk excavation sites.
- 2019/2020: Ticket Risk Assessment (TRA) tool developed with continuance updates and retraining of model.
- 2020/2021: Collaborate with Public Awareness and Marketing/Communication teams to meet compliance requirements and enhance the communication and awareness to the local communities of 811 and the importance of calling before digging.

- 2020/2021: 100% Internal Locate & Mark Workforce: Address pride in addressing all tickets with internal resources.
- 2021: Repeat Offender Program initiated to identify and educate excavators who have more than 2 damages in a 12-month period.
- 2023: Partnership with PHMSA, CPUC and USB to develop a reporting platform for excavations caused by no notification made to 811.
- 2024: Launched 811 Dig Champions Ambassador Program to internal employees to report unsafe excavation activities.

The safety work that remains to be done is addressed the controls/mitigations detailed above in Section III. 2024-2031 Control & Mitigation Plan.

# ATTACHMENTS

**ATTACHMENT A**

**EXCAVATION DAMAGE - CONTROLS AND MITIGATIONS WITH REQUIRED COMPLIANCE DRIVERS**

The table below indicates the compliance drivers which underpin identified controls and mitigations.

| ID | Control/Mitigation Name | Compliance Driver |
|---|---|---|
| C001 | Damage Prevention Strategies | PHMSA, CPUC GO-112F, California Gov Code 4216 |
| C002 | Damage Prevention Activities – Gas | 49 CFR § 192, CPUC GO-112F, California Gov Code 4216 |
| C003 | Damage Prevention – Public Awareness | 49 CFR § 192, CPUC GO-112F |
| C004 | Damage Prevention Mapping | 49 CFR § 192, California Gov Code 4216 |

## ATTACHMENT B

## EXCAVATION DAMAGE - REFERENCE MATERIAL FOR QUANTITATIVE ANALYSES

The Phase 3 Decision at RDF Row 10 and Row 29 directs each utility to identify Potential Consequences of a Risk Event using available and appropriate data.[26] Appropriate data may include Company specific data or industry data supplemented by the judgment of subject matter experts. Provided below is a listing of the inputs utilized as part of this assessment and the description of the data.

Excavation damage was modelled as a driver in both the medium pressure and high pressure risk models. For data sources used to model risk see Attachment B in the High Pressure Gas System and Medium Pressure Gas System risk chapters. Risk data unique to quantification of excavation damage risk is provided below.

| **Risk Data** | **Source Type** | **Source Information** |
|---|---|---|
| Excavation damages by cause | Internal Data | Source: Internal data managed by the Gas System Integrity Department.<br><br>Description: Data was used to quantify benefits to controls and mitigation that address specific causes of excavation damage, such as locate and mark or mapping issues. |
| Excavation damages from repeat offenders | Internal Data | Source: Internal data managed by the Gas System Integrity Department.<br><br>Description: Data was used to quantify damages caused by repeat offenders for benefits calculation. |

[26] D.24-05-064, RDF Rows 9-11, Risk Assessment and Risk Ranking in Preparation for RAMP.

## ATTACHMENT C

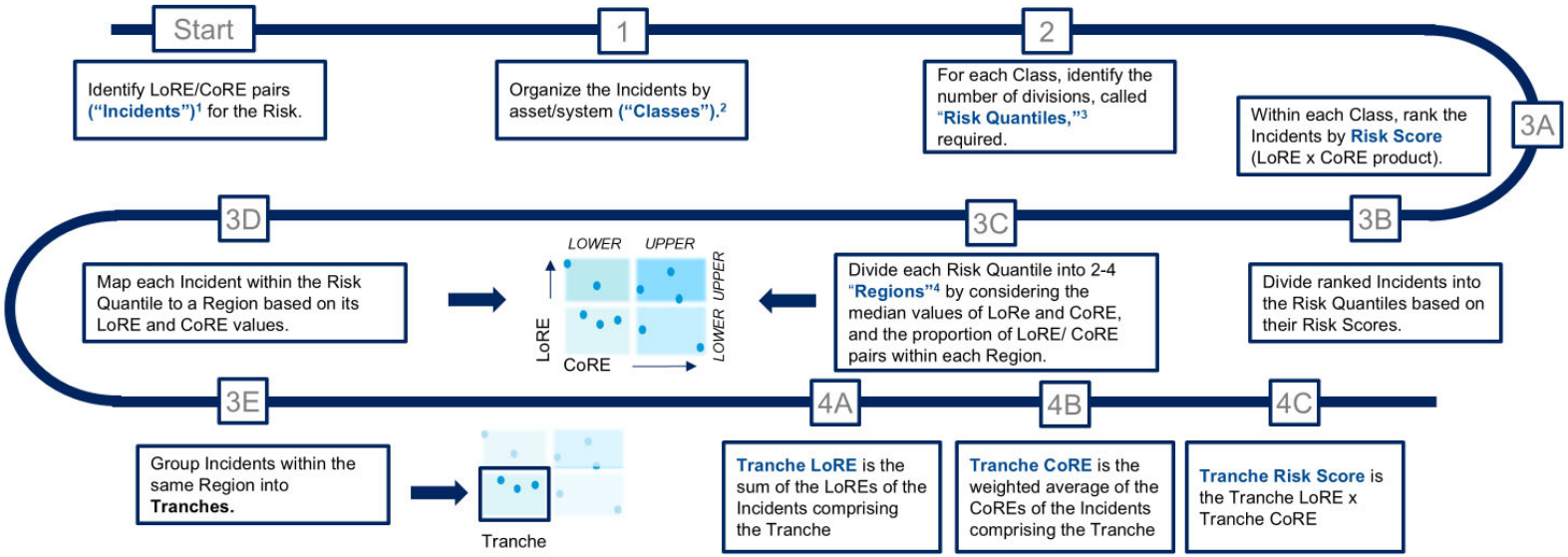
## EXCAVATION DAMAGE - SUMMARY OF ELEMENTS OF BOW TIE

| SUMMARY OF ELEMENTS OF BOW TIE | | | |
|---|---|---|---|
| **ID** | **Control/Mitigation Name** | **Drivers Addressed** | **Consequences Addressed** |
| C001 | Damage Prevention Strategies | 1, 3, 4 | 1,2,3,4,5,6 |
| C002 | Damage Prevention Activities – Gas | 2 | 1,2,3,4,5,6 |
| C003 | Damage Prevention – Public Awareness | 1, 3, 4 | 1,2,3,4,5,6 |
| C004 | Damage Prevention Mapping | 2 | 1,2,3,4,5,6 |

**ATTACHMENT D**

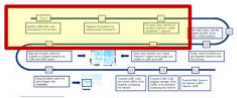
**EXCAVATION DAMAGE - APPLICATION OF TRANCHING METHODOLOGY**

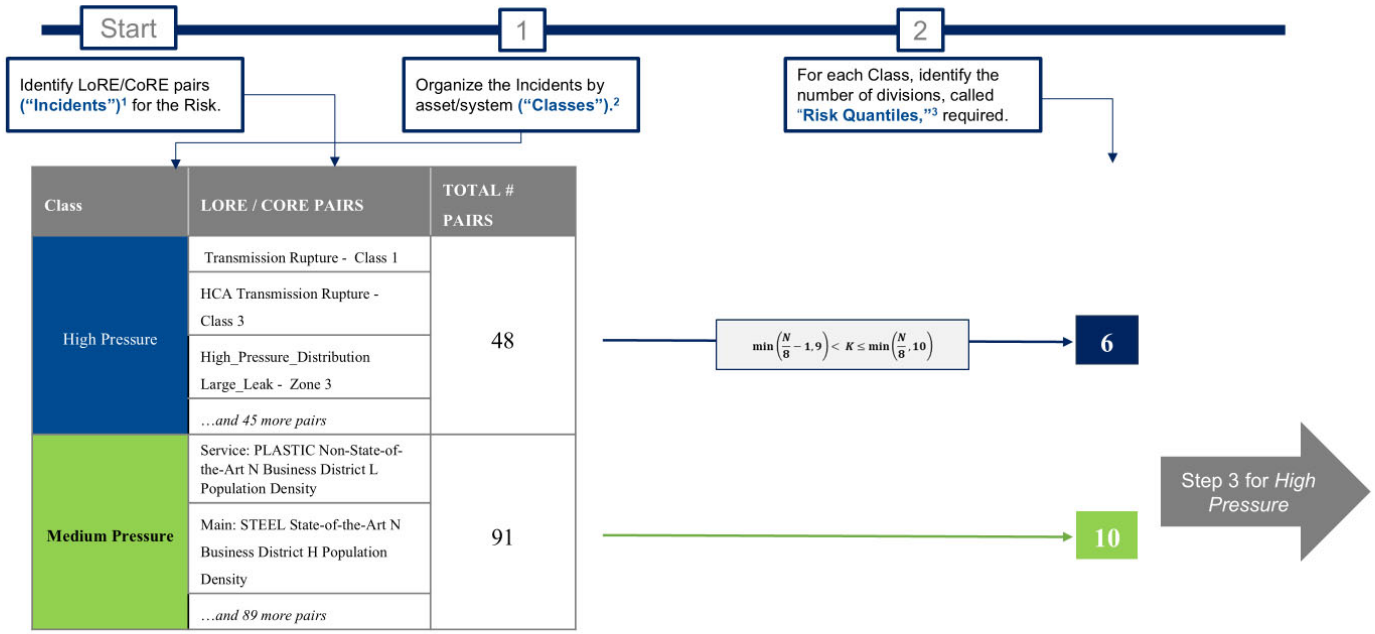
A sample walkthrough of the Homogeneous Tranching Methodology (HTM) as outlined in Volume 1, Chapter RAMP-3: Risk Quantification Framework is provided.

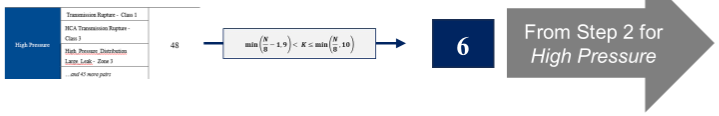



**NOTES**

[1]*For example, **Incidents (or "Risk Incidents")** for Excavation Damage these include leaks or damages cause by dig ins.*
[2]*For example, **Classes (or "Asset Classes")** for Excavation Damage these include High or Medium pressure pipe.*
[3]***Quantiles** are divisions of equal numbers of incidents (quartiles have 4 divisions, quintiles have 5, etc.) The number of incidents dictates the number of quantiles needed.*
[4]*The four **Regions** are: 1. Lower LoRE-Lower CoRE (LL-LC), 2. Lower LoRE-Upper CoRE (LL-UC), 3. Upper LoRE-Lower CoRE (UL-LC), and 4. Upper LoRE-Upper CoRE (UL-UC).*




Start
1
2
Identify LoRE/CoRE pairs ("Incidents")[1] for the Risk.
Organize the Incidents by asset/system ("Classes").[2]
For each Class, identify the number of divisions, called "Risk Quantiles,"[3] required.
Class
LORE / CORE PAIRS
TOTAL # PAIRS
High Pressure
Transmission Rupture - Class 1
HCA Transmission Rupture - Class 3
High_Pressure_Distribution Large_Leak - Zone 3
…and 45 more pairs
48
$\min\left(\frac{N}{8}-1,9\right) < K \leq \min\left(\frac{N}{8},10\right)$
6
Medium Pressure
Service: PLASTIC Non-State-of-the-Art N Business District L Population Density
Main: STEEL State-of-the-Art N Business District H Population Density
…and 89 more pairs
91
10
Step 3 for High Pressure



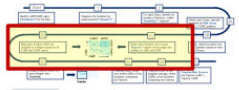

Within each Class, rank the Incidents by **Risk Score** (LoRE x CoRE product). 3A

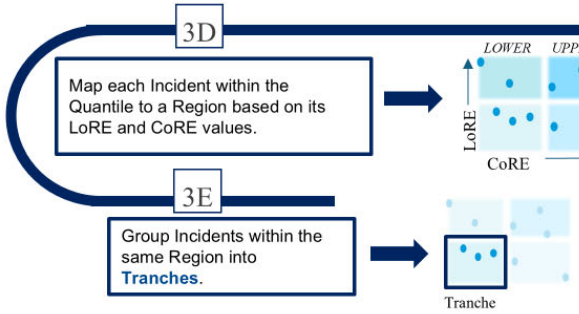
3B

Divide ranked Incidents into the Risk Quantiles based on their Risk Scores.

3A 3B

| Incident (LoRE/CoRE) Pair | Risk Score | Rank | Quantile |
|---|---|---|---|
| HCA Transmission Rupture - Class 3 | 1,439,367.14 | 1 | #1 |
| HCA Transmission Large_Leak - Class 3 | 383,149.72 | 2 | |
| HCA Transmission Rupture - Class 4 | 374,565.09 | 3 | |
| Transmission Rupture - Class 2 | 292,214.96 | 4 | |
| Transmission Large_Leak - Class 2 | 228,971.45 | 5 | |
| Transmission Rupture - Class 1 | 188,418.18 | 6 | |
| Transmission Large_Leak - Class 1 | 147,716.67 | 7 | |
| High_Pressure_Distribution Rupture - Zone 3 | 64,774.66 | 8 | |
| High_Pressure_Distribution Rupture - Zone 4 | 43,046.06 | 9 | |
| MCA Transmission Large_Leak - Class 1 | 27,422.18 | 10 | |
| MCA Transmission Rupture - Class 1 | 34,504.56 | 11 | #2 |
| MCA Transmission Large_Leak - Class 2 | 22,287.86 | 12 | |
| MCA Transmission Rupture - Class 2 | 28,540.07 | 13 | |
| HCA Transmission Large_Leak - Class 4 | 32,432.86 | 14 | |
| High_Pressure_Distribution Large_Leak - Zone 3 | 27,533.98 | 15 | |
| High_Pressure_Distribution Small_Leak - Zone 3 | 31,832.58 | 16 | |
| ... | ... | 17-48 | ... |






| | | 3A | 3B | 3C | 3D |
|---|---|---|---|---|---|
| Incident (LoRE/CoRE) Pair | Risk Score | Rank | Quantile | Region | Tranche |
| HCA Transmission Rupture - Class 3 | 1,439,367.14 | 1 | #1 | LL/UC | HP-1-1 |
| HCA Transmission Large_Leak - Class 3 | 383,149.72 | 2 | | UL/LC | HP-1-2 |
| HCA Transmission Rupture - Class 4 | 374,565.09 | 3 | | LL/UC | HP-1-1 |
| Transmission Rupture - Class 2 | 292,214.96 | 4 | | LL/UC | HP-1-1 |
| Transmission Large_Leak - Class 2 | 228,971.45 | 5 | | UL/LC | HP-1-2 |
| Transmission Rupture - Class 1 | 188,418.18 | 6 | | LL/UC | HP-1-1 |
| Transmission Large_Leak - Class 1 | 147,716.67 | 7 | | UL/LC | HP-1-2 |
| High_Pressure_Distribution Rupture - Zone 3 | 64,774.66 | 8 | | UL/LC | HP-1-2 |
| High_Pressure_Distribution Rupture - Zone 4 | 43,046.06 | 9 | | LL/UC | HP-2-3 |
| MCA Transmission Large_Leak - Class 1 | 27,422.18 | 10 | | LL/UC | HP-2-3 |
| MCA Transmission Rupture - Class 1 | 34,504.56 | 11 | #2 | LL/UC | HP-2-3 |
| MCA Transmission Large_Leak - Class 2 | 22,287.86 | 12 | | LL/UC | HP-2-3 |
| MCA Transmission Rupture - Class 2 | 28,540.07 | 13 | | LL/UC | HP-2-3 |
| HCA Transmission Large_Leak - Class 4 | 32,432.86 | 14 | | LL/UC | HP-2-3 |
| High_Pressure_Distribution Large_Leak - Zone 3 | 27,533.98 | 15 | | UL/LC | HP-2-4 |
| High_Pressure_Distribution Small_Leak - Zone 3 | 31,832.58 | 16 | | UL/LC | HP-2-4 |
| ... | ... | 17-48 | | ... | |

4A

**Tranche LoRE** is the sum of the LoREs of the Incidents comprising the Tranche

4B

**Tranche CoRE** is the weighted average of the CoREs of the Incidents comprising the Tranche

4C

**Tranche Risk Score** is the Tranche LoRE x Tranche CoRE

| Incident (LoRE/CoRE) Pair | Tranche | 4A Tranche LoRE | 4B Tranche CoRE | 4C Tranche Risk Score |
|---|---|---|---|---|
| HCA Transmission Rupture - Class 3 | HP-1-1 | 0.005 | 509,413,537 | $2,294,565 |
| HCA Transmission Rupture - Class 4 | HP-1-1 | | | |
| Transmission Rupture - Class 2 | HP-1-1 | | | |
| Transmission Rupture - Class 1 | HP-1-1 | | | |
| HCA Transmission Large_Leak - Class 3 | HP-1-2 | 0.007 | 126,185,292 | $824,612 |
| Transmission Large_Leak - Class 2 | HP-1-2 | | | |
| Transmission Large_Leak - Class 1 | HP-1-2 | | | |
| High_Pressure_Distribution Rupture - Zone 3 | HP-1-2 | | | |
| High_Pressure_Distribution Rupture - Zone 4 | HP-2-3 | 0.001 | 228,296,464 | 188,233 |
| MCA Transmission Large_Leak - Class 1 | HP-2-3 | | | |
| MCA Transmission Rupture - Class 1 | HP-2-3 | | | |
| MCA Transmission Large_Leak - Class 2 | HP-2-3 | | | |
| MCA Transmission Rupture - Class 2 | HP-2-3 | | | |
| HCA Transmission Large_Leak - Class 4 | HP-2-3 | | | |
| High_Pressure_Distribution Large_Leak - Zone 3 | HP-2-4 | 0.170 | 349,290 | $59,367 |
| High_Pressure_Distribution Small_Leak - Zone 3 | HP-2-4 | | | |