# Risk Assessment and Mitigation Phase

# (Chapter SCG-Risk-4)

# Incident Related to the Storage System (Excluding Dig-In)

## May 17, 2021

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## RISK: INCIDENT RELATED TO THE STORAGE SYSTEM (EXCLUDING DIG-IN)

## I. INTRODUCTION

The purpose of this chapter is to present Southern California Gas Company's (SoCalGas or Company) risk control and mitigation plan for the Incident Related to the Storage System (Excluding Dig-In) (Storage risk). Each chapter in this Risk Assessment Mitigation Phase (RAMP) Report contains the information and analysis that meets the requirements adopted in Decision (D.) 16-08-018 and D.18-12-014 and the Settlement Agreement included therein (the Settlement Agreement Decision).[1]

SoCalGas has identified and defined RAMP risks in accordance with the process described in further detail in Chapter RAMP-B of this RAMP Report. On an annual basis, SoCalGas's Enterprise Risk Management (ERM) organization facilitates the Enterprise Risk Registry (ERR) process. The ERR process influenced how risks were selected for inclusion in this 2021 RAMP Report, consistent with the Settlement Decision's directives, as discussed in Chapter RAMP-C.

The RAMP Report's purpose is to "identify key safety risks and propose[d] programs to mitigate those risks," and is based on past incidents for the Company and industry.[2] The RAMP Report does not request funding. Any funding requests will be made in SoCalGas's General Rate Case (GRC) application. The costs presented in this 2021 RAMP Report are those costs for which SoCalGas anticipates requesting recovery in its Test Year (TY) 2024 GRC. SoCalGas's TY 2024 GRC presentation will integrate developed and updated funding requests from the 2021 RAMP Report, supported by witness testimony.[3] This 2021 RAMP Report is presented consistent with SoCalGas's GRC presentation, in that the last year of recorded data (2020) provides baseline costs and cost estimates are provided for years 2022-2024, as further discussed in Chapter RAMP-A. This 2021 RAMP Report presents capital costs as a sum of the years 2022,

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[1] D.16-08-018 also adopted the requirements previously set forth in D.14-12-025. D.18-12-014 adopted the Safety Model Assessment Proceeding (S-MAP) Settlement Agreement with modifications and contains the minimum required elements to be used by the utilities for risk and mitigation analysis in the RAMP and GRC.

[2] D.19-09-051 at 4.

[3] *See* D.18-12-014 at Attachment A, A-14 ("Mitigation Strategy Presentation in the RAMP and GRC").

2023, and 2024 as a three-year total; operations and maintenance (O&M) costs are only presented for TY 2024 (consistent with the GRC). Costs for each activity that directly address each risk are provided where those costs are available and within the scope of the analysis required in this RAMP Report.

Throughout this 2021 RAMP Report activities are delineated between controls and mitigations, consistent with the definitions adopted in the Settlement Decision's Revised Lexicon. A "control" is defined as a "[c]urrently established measure that is modifying risk."[4] A "mitigation" is defined as a "[m]easure or activity proposed or in process designed to reduce the impact/consequences and/or likelihood/probability of an event."[5] Activities presented in this chapter are representative of those that are primarily scoped to address SoCalGas's Storage risk; however, many of the activities presented herein also help mitigate other areas.

As discussed in Chapters RAMP-A and RAMP-C, SoCalGas has endeavored to calculate a Risk Spend Efficiency (RSE) for all controls and mitigations presented in this risk chapter. However, for controls and mitigations where no meaningful data or Subject Matter Expert (SME) opinion exists to calculate the RSE, SoCalGas has explained why no RSE can be provided, in accordance with California Public Utilities Commission (CPUC or Commission) Safety Policy Division (SPD) staff guidance.[6] Activities with no RSE value presented in this 2021 RAMP Report are identified in Section V below.

### A. Risk Overview

Gas storage assets, including underground and above ground facilities, are a necessary and critical component of California's reliable gas delivery infrastructure because gas storage supplies over 22 million customers and approximately half of the electric generation in SoCalGas's territory. SoCalGas operates four underground gas storage facilities: Aliso Canyon,

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4 *Id*. at 16.

5 *Id.* at 17.

6 See Safety Policy Division Staff Evaluation Report on PG&E's 2020 Risk Assessment and Mitigation Phase (RAMP) Application (A.) 20-06-012 at 5 ("SPD recommends PG&E and all IOUs provide RSE calculations for controls and mitigations or provide an explanation for why it is not able to provide such calculations.") (November 25, 2020).

La Goleta, Honor Rancho, and Playa del Rey with a current combined working capacity of approximately 84.4 Bcf.[7]

- Aliso Canyon is in Northern Los Angeles County and is the largest of the gas storage fields that deliver gas to the Los Angeles pipeline loop. Aliso Canyon has a design capacity of approximately 86 Bcf.[8] The current interim range of Aliso Canyon storage capacity is zero to 34 Bcf.[9] Aliso Canyon has 78 injection/withdrawal/ observation wells.[10]
- Honor Rancho is also located in Northern Los Angeles County, approximately ten miles north of Aliso Canyon, with a working capacity of approximately 27 Bcf and delivers to the Los Angeles pipeline loop. Honor Rancho has 35 gas injection/withdrawal wells and is designed for a maximum withdrawal capability of 1.0 Bcf per day.[11]
- La Goleta is in Santa Barbara County and provides service to the northern coastal area of the SoCalGas territory. La Goleta has a working capacity of approximately 21 Bcf. La Goleta has 12 gas injection/withdrawal/observation wells and is designed for a maximum withdrawal capability of 0.4 Bcf per day.[12]
- Playa del Rey, located in central Los Angeles County, has a working capacity of approximately 2.4 Bcf. Playa del Rey has 34 gas injection/withdrawal /observation wells.[13] Playa del Rey is designed for a maximum withdrawal rate of 0.4 Bcf per day to meet residential, commercial and industrial loads throughout the western part of Los Angeles, including electric generators and oil refineries.

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[7] The volumetric capacity of a natural gas storage field reservoir is measured in units of billion cubic feet (Bcf).

[8] Pipeline and Hazardous Materials Safety Administration (PHMSA), Underground Natural Gas Storage Facility Annual report for Calendar Year 2018 – Supplemental Report (May 20, 2019).

[9] *See* D.20-11-044 ("Decision Setting The Interim Range Of Aliso Canyon Storage Capacity At Zero To 34 Billion Cubic Feet").

[10] Withdrawal capacity is dependent on well availability and inventory.

[11] PHMSA Annual Report, *supra*.

[12] *Id.*

[13] *Id.*

This chapter considers risks associated with the following storage facility components: storage wells and reservoir, including casing, tubing, and tree/wellhead, compressor stations, dehydration and purification equipment, and other above ground piping and facilities. These risks are evaluated in the context of recent federal and state regulations of natural gas storage facilities, including:

- U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration's (PHMSA) Underground Storage regulations, 49 Code of Federal Regulations (CFR) § 192.12 Final Rule, effective March 13, 2020, which, among other things, adopts certain provisions of American Petroleum Industry (API) Recommended Practice 1171, Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs.
- The California Geologic Energy Management Division (CalGEM, formerly Division of Oil, Gas, and Geothermal Resources or DOGGR) Underground Gas Storage Regulations, 14 California Code of Regulations (CCR) §1726, effective October 1, 2018, which includes, among other things, requirements for operators to submit project-specific Risk Management Plans, Emergency Response Plans, project data requirements, a Records Management Program, well construction requirements, mechanical integrity testing requirements, and monitoring and reporting requirements.
- California Air Resources Board (CARB), Oil & Gas Rule. effective October 1, 2017, which describes monitoring requirements for natural gas underground storage facilities. SoCalGas has developed and received approval from CARB and the local air quality management districts for four individual storage monitoring plans. These include installation of continuous air monitoring to measure upwind and downwind ambient concentrations of methane and continuous leak screening at each injection/withdrawal wellhead assembly and attached pipelines.

SoCalGas has implemented activities and measures to comply with new federal and state regulations at an accelerated pace and has incorporated additional industry leading safety enhancements and improvements. These activities and measures are part of the implementation of SoCalGas's Storage Integrity Management Program (SIMP). SoCalGas's SIMP was initially modeled after the federally mandated distribution and transmission integrity management programs, and was designed to provide a forward looking, methodical, and structured approach, using state-of-the-art inspection technologies and risk management disciplines to address storage reservoir and well integrity issues.

SoCalGas has also introduced a suite of advanced leak-detection technologies and practices that allow for the early detection of leaks and to help quickly identify anomalies, such as changes in well pressure. These enhancements include:

- Around-the-clock monitoring of the pressure in all wells from each storage facility's 24-hour operations center;
- Continuous upwind/downwind ambient air monitoring and meteorological stations at each storage facility;
- Daily well inspections and/or continuous/real-time wellhead monitoring; and
- Enhanced training for employees and contractors.

SoCalGas also continues to support industry experts in their research efforts to advance storage safety.

### B. Risk Definition

For purposes of this RAMP Report, SoCalGas's Incident Related to the Storage System (excluding dig-in) risk (Storage risk) is defined as the risk of damage to the storage system, including wells, reservoirs, and surface equipment, which results in serious injuries, fatalities and/or damages to the infrastructure.

### C. Scope

Table 1 below provides what is considered in and out of scope for the Incident Related to the Storage System (excluding dig in) risk in this RAMP Application.

**Table 1: Risk Scope**

| | |
|---|---|
| **In-Scope:** | The risk of damage to the storage system including, wells, reservoirs and surface assets (compressors, laterals, oil/brine systems, etc.) which results in consequences such as injuries, fatalities or outages. |
| **Data Quantification Sources:** | SoCalGas used internal data sources for the calculation surrounding risk reduction; however, if internal data was not available or was insufficient, Industry or National data was utilized and was adjusted appropriately to fit the risk profile associated with the operating locations and parameters of the utilities. For example, certain types of incident events have not |

| | |
|---|---|
| | occurred within the SoCalGas service territory; therefore, SoCalGas examined industry data where those incident(s) have occurred to establish a baseline of risk.<br><br>See Appendix B for additional information. |

## II. RISK ASSESSMENT

In accordance with the Settlement Decision,[14] this section describes the risk bow tie, possible drivers, potential consequences, and the risk score for the Storage risk.

### A. Risk Bow Tie and Risk Event Associated with the Risk

The risk bow tie is a commonly used tool for risk analysis, and the Settlement Decision[15] instructs the utility to include a risk bow tie illustration for each risk included in RAMP. As illustrated in the risk bow tie shown below in Figure 1, the risk event (center of the bow tie) is the storage system incident (excluding dig-in) that leads to asset failure, the left side of the bow tie illustrates drivers/triggers that lead to the storage system incident that leads to asset failure, and the right side shows the potential consequences of the storage system incident that leads to asset failure. SoCalGas applied this framework to identify and summarize the information provided in Figure 1. A mapping of each mitigation to the element(s) of the risk bow tie addressed is provided in Appendix A.

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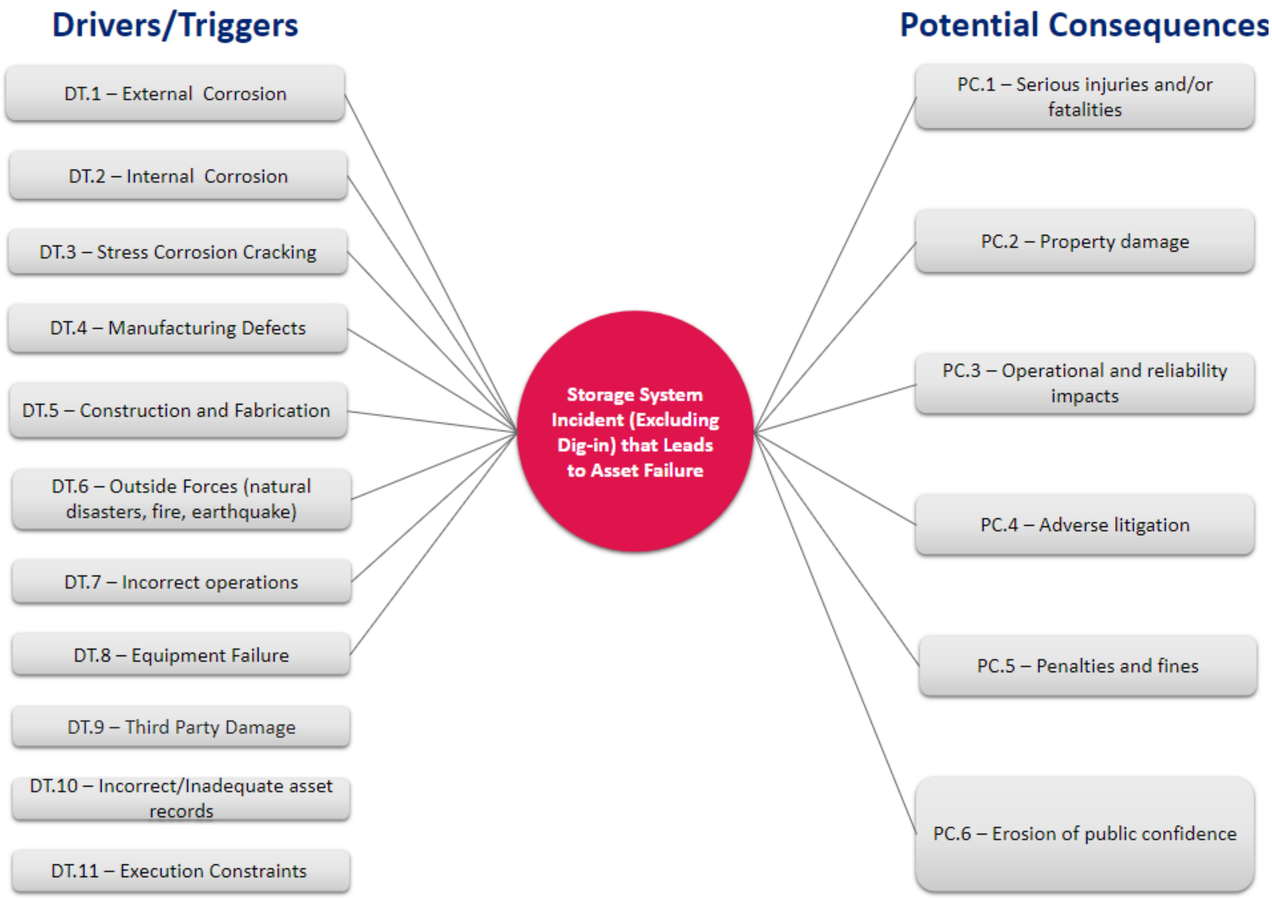
14 D.18-12-014 at 33 and Attachment A, A-11 ("Bow Tie").

15 *Id.* at Attachment A, A-11 ("Bow Tie").

**Figure 1: Risk Bow Tie**




### B. Cross-Functional Factors

The following CFFs have programs and/or projects that affect this risk chapter: Asset and Records Management, Energy Resilience, Emergency Preparedness and Response and Pandemic, Foundational Technology Systems, Physical Security, Safety Management System (SMS), and Workforce Planning / Quality Workforce. As an example, efforts discussed in the Energy Resilience Cross-Functional Factor chapter address specific drivers to the asset-based risks. Additional information is provided in the narratives for the referenced CFFs.

### C. Potential Drivers/Triggers[16]

The Settlement Decision[17] instructs the utility to identify which element(s) of the associated risk Bow Tie are addressed by each mitigation. When performing the risk assessment for Storage, SoCalGas identified potential leading indicators, referred to as Drivers or Triggers. These include, but are not limited to:

- **DT.1 –External corrosion**: A naturally occurring phenomenon commonly defined as the deterioration of a material (usually a metal) that results from a chemical or electrochemical reaction with its environment.[18] This risk driver is based on the potential for corrosion on the external surface of such assets as steel tubing, casing, and pipelines that are exposed to corrosive environments.
- **DT.2 – Internal corrosion:** Deterioration of the interior of an asset as a result of the environmental conditions on the inside of the pipeline.[19] This risk driver is based on the potential for corrosion on the internal surface of such assets as steel tubing, casing, and pipelines. Internal corrosion may be caused by the corrosive effect of fluid, sand, and/or reactive constituents such as carbon dioxide in the gas withdrawn from the storage formations.
- **DT.3 – Stress Corrosion Cracking**: A type of environmentally assisted cracking usually resulting from the formation of cracks due to various factors in combination with the environment surrounding the pipe that together reduce the pressure-carrying capability of the pipe.[20]
- **DT.4 – Manufacturing Defects**: This risk driver is based on the potential for failure of storage assets due to defects introduced during the manufacturing process. It is attributable to material defect within the pipe, component or joint due to faulty manufacturing procedures, design defects, or in-service stresses such as vibration, fatigue and environmental cracking.

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

17 D.18-12-014 at Attachment A, A-11 (“Bow Tie”).

18 See American Society of Mechanical Engineers (ASME) B31.8S.

19 *Id.*

20 *Id.*

- **DT.5 – Construction and Fabrication**: This risk driver is based on the potential for failure of storage assets due to defects introduced during the construction and fabrication process. It is attributable to the construction methodology applied during the installation of pipeline components specifically based on the vintage of the construction standards, fabrication techniques (welding, bending, etc.) and overall guiding regulations.
- **DT.6 – Outside forces (natural disasters, fire, earthquake):** This risk driver includes both natural forces and those from external sources that can affect the integrity of the storage facilities. Examples of natural forces include ground movement, landslides, and subsidence from earthquakes.
- **DT.7 – Incorrect Operations:** This risk driver is based on the potential for maintenance or inspection functions to be performed incorrectly by employees or contractors.
- **DT.8 – Equipment Failure**: This risk driver is based on the potential for failure of storage equipment not due to either manufacturing or construction related defects. It is attributable to malfunction of components, including but not limited to, regulators, valves, meters, flanges, gaskets, collars, couples, etc.
- **DT.9 – Third Party Damage (except underground damages)**: This risk driver is based on the potential for damage to a storage asset by an outside party other than those performing work for SoCalGas.
- **DT.10 – Incorrect/Inadequate Asset Records:** This risk driver is based on the potential for inaccurate or incomplete information that could result in the failure to construct, operate, and maintain SoCalGas's storage assets safely.
- **DT.11 – Execution Constraints:** This risk driver refers to constraints (excluding damages caused by outside forces) that may result in disruptions to the business or impede the completion of projects or initiatives. These may include, for example, operational compliance, quality assurance and control, delayed timeliness in response and awareness of operational issues, resource constraints, inefficiencies and re-allocation (human and material), unexpected maintenance or unanticipated regulatory requirement.

### D. Potential Consequences of Risk Event

Potential consequences[21] are listed to the right side of the risk bow tie illustration provided above. If one or more of the drivers/triggers listed above were to result in an incident, the potential consequences, in a reasonable worst-case scenario, could include:

- Serious injuries[22] and/or fatalities;
- Property damage;
- Operational and reliability impacts;
- Adverse litigation;
- Penalties and fines; or
- Erosion of public confidence.

These Potential Consequences were used in the scoring of Storage Risks that occurred during the development of SoCalGas's 2020 Enterprise Risk Registry.

### E. Risk Score

The Settlement Decision requires a pre- and post-mitigation risk calculation.[23] Chapter RAMP-B of this RAMP Application explains the Risk Quantification Framework which underlies this Chapter, including how the Pre-Mitigation Risk Score, Likelihood of Risk Event (LoRE), and Consequence of Risk Event (CoRE) are calculated.

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[21] D.18-12-014 at 16 and Attachment A, A-8 ("Identification of Potential Consequences of Risk Event").

[22] As defined by Cal/OSHA as "any injury or illness occurring in a place of employment or in connection with any employment which requires inpatient hospitalization for a period in excess of 24 hours for other than medical observation or in which an employee suffers a loss of any member of the body or suffers any serious degree of permanent disfigurement, but does not include any injury or illness or death caused by the commission of a Penal Code violation, except the violation of Section 385 of the Penal Code, or an accident on a public street or highway." (Available at: *http://services.claremont.edu/ehs/wp-content/uploads/sites/16/2017/03/calosha-serious-injury-definition.pdf*).

[23] D.18-12-014 at Attachment A, A-11 ("Calculation of Risk").

**Table 1: Pre-Mitigation Analysis Risk Quantification Scores**[24]

| | LoRE | CoRE | Risk Score |
|---|---|---|---|
| **Incident Related to the Storage System** | 0.29 | 9,306 | 2,721 |

Pursuant to Step 2A of the Settlement Decision, the utility is instructed to use actual results, available and appropriate data (*e.g.,* Pipeline and Hazardous Materials Safety Administration data).[25]

The safety risk assessment primarily considered historical occurrences of unintended releases from underground gas storage facilities of varying severity as described in the "Analysis of Occurrences at Underground Fuel Storage Facilities and Assessment of the Main Mechanisms Leading to Loss of Storage Integrity" paper referenced in Appendix B below. The incident rates with safety consequences were calculated as the product of the national average (the frequency of an incident per field) and the number of fields SoCalGas operates currently. The safety risk was evaluated using a Monte Carlo simulation.

The reliability assessment considered internal and national data. Internal and PHMSA data over the past five years indicates no storage risk incidents which led to loss of service to customers; therefore, SME input was utilized to determine the reliability impacts due to a storage incident.

The financial assessment was estimated based on historical data from the U.S. Natural Gas Storage Risk-Based Ranking Methodology and Results[28] and further supported by input from Company subject matter experts (SMEs). The data includes storage field incidents dating back approximately 70 years and their respective estimated financial impacts.

## III. 2020 CONTROLS

This section "[d]escribe[s] the controls or mitigations currently in place" as required by the Settlement Decision.[26] The activities in this section were in place as of December 31, 2020.

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24 The term "pre-mitigation analysis," in the language of the S-MAP Settlement Agreement Decision (Attachment A, A-12 ("Determination of Pre-Mitigation LoRE by Tranche," "Determination of Pre-Mitigation CoRE," "Measurement of Pre-Mitigation Risk Score")), refers to required pre-activity analysis conducted prior to implementing control or mitigation activity.

25 *Id.* at Attachment A, A-8 ("Identification of Potential Consequences of Risk Event").

26 S-MAP Settlement Agreement Decision at 33.

Controls that will continue as part of the risk controls and mitigation plan are addressed in Section IV.

### A. C1: Integrity Demonstration, Verification, and Monitoring Practices

SoCalGas performs integrity inspections on gas storage wells to verify the pressure containing capability of the well, detect possible leaks, and identify metal loss anomalies in the tubing and casing. Types of inspections include pressure testing, noise and temperature surveys, magnetic flux leakage (MFL) inspection, and ultrasonic (UT) inspection. Pressure testing and wall thickness inspections (MFL or UT) are currently required for each gas storage well at a two-year recurring frequency.[27] Temperature and noise surveys are required at least annually at Aliso Canyon and Honor Rancho. Temperature surveys are required semiannually, and noise surveys are required annually, at La Goleta and Playa del Rey.

Remediation activities performed during, or as a result of integrity demonstration, verification, and monitoring practices can reduce the risk of failure during operations. These activities may include replacement of the wellhead, replacement of valves, replacement of the tubing and packer, installation of an inner casing string or liner, and installation of shallow-set subsurface safety valves.

In addition, SoCalGas has integrated its Risk Management for Gas Storage Operations into SoCalGas's Integrity Management organization, aligning the underground gas storage integrity management practices with its transmission and distribution integrity management practices. The Integrity Management organization is tasked with such responsibilities as developing and implementing processes and procedures to manage storage well integrity and compliance with new underground storage regulations; advancing the approach to data management, data governance and risk assessment; developing and tracking training of Company employees on procedures pertinent to storage integrity management; and supporting execution of drills and exercises to evaluate emergency response plans. Since the Integrity Management organization supports numerous efforts aimed at reducing the risk of an incident related to the storage system, the costs for this control are allocated across the other underground storage controls.

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[27] 14 CCR § 1726.6(a)(3).

As discussed in the SMS CFF chapter, SoCalGas has been implementing the Company's SMS, which includes the principles set forth in the American Petroleum Institute (API) Recommended Practice 1173 Pipeline Safety Management System. API 1173 is a systematic way to identify hazards and control risks while validating that these risk controls are effective, and places strong emphasis on process safety and safety culture. SoCalGas also highlights several new regulations that support this implementation and which share elements of API 1173:

- PHMSA Underground Storage regulations, 49 CFR § 192.12, adopts API 1171, Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs into regulation, and is an integral component of creating an SMS for Underground Storage. Specifically, "[s]torage design, construction, operation, and maintenance include activities in risk management, site security, safety, emergency preparedness, and procedural documentation and training to embed human and organizational competence in the management of storage facilities."[28]
- CalGEM Requirements for California Underground Gas Storage Projects, 14 CCR § 1726.3, which includes, among other things, incorporation of human factors into risk management plans.[29]

## B. C2: Well Abandonment and Replacement

Under certain circumstances, SoCalGas may abandon a well rather than continue to utilize it for gas storage operations. The decision to plug and abandon a well is driven by various factors including, but not limited to, well-specific information; location-specific information; deliverability; operation and maintenance history; and operational needs. To abandon a well, SoCalGas isolates the well from injection and withdrawal operations, removes the wellhead and casing to a certain depth, and fills the wellbore with cement. Depending on the impact of abandonments to gas storage operations, new wells may need to be drilled to replace the injection and withdrawal capabilities of the abandoned wells.

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28 American Petroleum Institute, Recommended Practice 1171 at "Preamble" (September 2015), available at *http://www.api.org/~/media/files/publications/whats%20new/1171_e1%20pa.pdf*.

29 14 CCR § 1726.3.

### C. C3: Pressure Monitoring and Alarming

SoCalGas has implemented continuous, real-time pressure monitoring at gas storage wells in each storage facility. Monitoring devices are installed at each tubing and casing annulus, with certain setpoints established to reflect normal operating conditions. Through automated alerts, exceedance of a setpoint will notify local operations, enabling SoCalGas to investigate a potential abnormal condition. The equipment functions continuously unless it needs to be deactivated on a temporary basis for maintenance purposes. In those instances, pressure reads are conducted manually.

### D. C4: Wellhead Leak Detection and Repair

Wellhead leak detection and repair entails performing a daily audio-visual inspection, as well as a quarterly leak survey with the use of optical gas imaging. Inspections are performed on each active and idle injection/withdrawal wellhead assembly owned and operated by SoCalGas.

SoCalGas also has implemented and follows a CARB-approved monitoring plan for its underground storage facilities in compliance with the CARB Oil & Gas Rule, 17 CCR § 95668(h) as of August 6, 2019. This monitoring plan addresses three CARB Oil & Gas Rule regulatory requirements: (1) continuous ambient air monitoring, (2) wellhead daily or continuous leak screening, and (3) well blowout procedures. The CARB Oil & Gas Rule requires daily or continuous leak screening at each injection/withdrawal wellhead assembly and attached pipelines according to one or both of the following methods: (1) daily leak screening with the use of an U.S. Environmental Protection Agency Reference Method 21 instrument, or the use of Optical Gas Imaging, or (2) continuous leak screening with the use of automated instruments and a monitoring system with an alarm system.[30]

Additionally, pursuant to the CARB Oil & Gas Rule regulations, on or after January 1, 2020, any component with a leak measuring total hydrocarbon concentrations greater than or equal to 1,000 parts per million volume (ppmv), but not greater than 9,999 ppmv, will be successfully repaired or removed from service within 14 calendar days of initial leak detection. Component leaks with measured total hydrocarbon concentrations greater than or equal to 10,000 ppmv, but not greater than 49,999 ppmv, will be successfully repaired or removed from service within five (5) calendar days of initial leak detection. Component leaks with measured

[30] 17 CCR § 95668(h).

total hydrocarbon concentrations greater than or equal to 50,000 ppmv will be successfully repaired or removed from service within two (2) calendar days of initial leak detection. Critical components or critical process units will be successfully repaired by the end of the next process shutdown or within 12 months from the date of initial leak detection, whichever is sooner.

### E. C5: Storage Field Maintenance

SoCalGas uses its storage assets to efficiently meet gas balancing requirements on its transmission pipeline and distribution system. To satisfy these needs, the individual storage facilities act as "gas suppliers" or "consumers," depending upon the withdrawal or injection requirements, as managed by SoCalGas's Gas Control department. Fluctuating demands may require storage operations to perform gas injection or withdrawal functions at any hour of the day, 365 days per year. Storage fields are continually staffed with operating crews and on-call personnel to support these critical 24/7 operations.

Storage is critical to maintain a reliable supply of natural gas in Southern California, particularly during periods of extreme weather conditions occurring locally or out of state, unforeseen pipeline maintenance, or the temporary reduction of interstate supplies for other reasons. Continuous maintenance activities and ongoing investments are necessary to make certain that the storage system remains capable of providing supply during such periods.

Aboveground operation and maintenance activities include pipeline patrols, inspections, and corrosion control and other maintenance on a regular basis throughout the year.

### F. C6: Compressor Overhauls

Storage compressor units increase the pressure of natural gas so it can be injected into the underground reservoirs. Examples of equipment within this area include engines and high pressure gas compressors. Periodic overhauls of this equipment are necessary to uphold safety, maintain or improve system reliability, extend equipment life, achieve environmental compliance, and meet required injection capacities.

This mitigation will inspect, repair or replace, as needed, engine and compressor parts, such as, cranks, bearings, seals, cylinder heads, pistons, and connecting rods. These inspections and repair activities on the storage compressor units help to keep them in good working order and help to reduce the likelihood of failures of components, such as camshafts, heads, pistons, valves, bearings, and gaskets, that could result in the release of natural gas inside the compressor building or catastrophic failure of a compressor or engine that could result in fire, injury to personnel, extensive property damage, or environmental damage.

### G. C7: Upgrade to Purification Equipment

Purification equipment is used primarily for the removal of impurities from, or the conditioning of, natural gas withdrawn from storage. Examples of equipment included in this area are dehydrators, coolers, scrubbers, boilers and tanks. Upgrades to this equipment will allow SoCalGas to address potential safety issues related to uncontrolled releases due to equipment failures, maintain or improve reliability, meet regulatory and environmental requirements, and meet the required capacities and specifications of various purification systems.

Upgrades to purification equipment help to mitigate the risk of the failure of pressure vessels, heat exchangers, or piping components that could result in the release of natural gas or liquids. Dehydration equipment that does not function properly could result in gas that does not meet the pipeline gas quality specifications (Rule 30), potentially resulting in safety issues or impacts to customer service due to the possible formation of liquids in downstream piping.

## IV. 2022-2024 CONTROL & MITIGATION PLAN

This section contains a table identifying the controls and mitigations comprising the portfolio of mitigations for this risk.[31]

As reflected in the Table below, all of the activities discussed in Section III above are expected to continue during the TY 2024 GRC. For clarity, a current activity that is included in the Plan may be referred to as either a Control and/or a Mitigation. For purposes of this RAMP Report, a control that will continue as a mitigation will retain its control ID unless the size and/or scope of that activity will be modified, in which case that activity's control ID will be replaced with a mitigation ID. The table below shows which activities are expected to continue.

[31] *See* D.18-12-014, Attachment A at A-14 ("Mitigation Strategy Presentation in the RAMP and GRC").

**Table 2: Control and Mitigation Plan Summary**

| Line No. | Control/ Mitigation ID | Control/Mitigation Description | 2020 Controls | 2022-2024 Plan |
|---|---|---|---|---|
| 1 | C1 | Integrity Demonstration, Verification, and Monitoring Practices | X | X |
| 2 | C2 | Well Abandonment and Replacement | X | X |
| 3 | C3 | Pressure Monitoring and Alarming | X | X |
| 4 | C4 | Wellhead Leak Detection and Repair | X | X |
| 6 | C5 | Storage Field Maintenance | X | X |
| 7 | C6 | Compressor Overhauls | X | X |
| 8 | C7 | Upgrade to Purification Equipment | X | X |
| 9 | M1 | Facilities Integrity Management Program (FIMP) | No | X |

For activities SoCalGas plans to perform that remain unchanged, please refer to the description in Section III. If changes to the various activities are anticipated, such modifications are further described in this section below.

SoCalGas plans to continue implementing each of the activities discussed above without any significant changes.

### A. 2022 – 2024 Mitigations

#### 1. M1: Facilities Integrity Management Program (FIMP)

SoCalGas is developing a Facilities Integrity Management Program (FIMP) based on principles developed by the Canadian Energy Pipeline Association and the Pipeline Research Council International. FIMP is not intended to duplicate any systems or processes that may already exist; rather, it is intended to supplement the already existing programs (*e.g.*, SIMP, Transmission Integrity Management Program, and Distribution Integrity Management Program) and current integrity processes to enhance the safety and integrity of SoCalGas's facility assets. FIMP will apply integrity management principles to particular above ground facility assets to reduce risks and promote operational excellence. Initial FIMP activities include program development and data collection and integration efforts on pressure vessels, tanks, and certain piping at storage facilities and compressor stations.

## V. COSTS, UNITS, AND QUANTITATIVE SUMMARY TABLES

The tables in this section provide a summary of the risk control and mitigation plan, including the associated costs, units, and the RSEs, by tranche. When an RSE could not be performed, an explanation is provided. SoCalGas does not account for and track costs by activity or tranche; rather, SoCalGas accounts for and tracks costs by cost center and capital budget code. The costs shown were estimated using assumptions provided by SMEs and available accounting data.

**Table 3: Risk Control and Mitigation Plan - Recorded and Forecast Dollars Summary[32]**
**(Direct After Allocations, In 2020 $000)**

| ID | Control/Mitigation Name | Recorded Dollars | | Forecast Dollars | | | |
|---|---|---|---|---|---|---|---|
| | | 2020 Capital[33] | 2020 O&M | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 O&M (Low) | TY 2024 O&M (High) |
| C1 | Integrity Demonstration, Verification, and Monitoring Practices | 66,676 | 13,413 | 263,720 | 319,240 | 14,834 | 17,957 |
| C2 | Well Abandonment and Replacement | 14,926 | - | 120,625 | 146,020 | - | - |
| C3 | Pressure Monitoring and Alarming | - | 284 | - | - | 387 | 468 |
| C4 | Wellhead Leak Detection and Repair | - | 7,913 | - | - | 7,490 | 9,066 |
| C5 | Storage Field Maintenance | - | 36,295 | - | - | 33,599 | 40,672 |

32 Recorded costs and forecast ranges are rounded. Additional cost-related information is provided in workpapers. Costs presented in the workpapers may differ from this table due to rounding. The figures provided are direct charges and do not include Company loaders, with the exception of vacation and sick. The costs are also in 2020 dollar and have not been escalated to 2021 amounts. The capital presented is the sum of the years 2022, 2023, and 2024, or a three-year total. Years 2022, 2023 and 2024 are the forecast years for SoCalGas's Test Year 2024 GRC Application.

33 Pursuant to D.14-12-025 and D.16-08-018, the Company provides the 2020 "baseline" capital costs associated with Controls. The 2020 capital amounts are for illustrative purposes only. Because capital programs generally span several years, considering only one year of capital may not represent the entire activity.

| ID | Control/Mitigation Name | Recorded Dollars | | Forecast Dollars | | | |
|---|---|---|---|---|---|---|---|
| | | 2020 Capital[33] | 2020 O&M | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 O&M (Low) | TY 2024 O&M (High) |
| C6 | Compressor Overhauls | 1,959 | - | 13,232 | 17,902 | - | - |
| C7 | Upgrade to Purification Equipment | 1,136 | - | 17,070 | 23,095 | - | - |
| M1 | Facilities Integrity Management Program (FIMP) | - | 1,801 | - | - | 1,330 | 2,470 |

**Table 4: Risk Control & Mitigation Plan - Units Summary**

| ID | Control/Mitigation Name | Units Description | | Recorded Units | | Forecast Units | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Capital | O&M | 2020 Capital | 2020 O&M | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 (Low) O&M | TY 2024 (High) O&M |
| C1 | Integrity Demonstration, Verification, and Monitoring Practices | # wells having undergone integrity assessment | | 52 | 52 | 174 | 210 | 58 | 70 |
| C2 | Well Abandonment and Replacement | # wells abandoned | | 9 | - | 23 | 28 | - | - |
| C3 | Pressure Monitoring and Alarming | # storage wells with annulus monitoring | | - | 118 | - | - | 108 | 112 |
| C4 | Wellhead Leak Detection and Repair | # storage wells subject to wellhead leak detection and repair activities | | - | 118 | - | - | 108 | 112 |
| C5 | Storage Field Maintenance | The variety of work activities makes it infeasible to identify a single unit of measurement | | | | | | | |
| C6 | Compressor Overhauls | # compressor overhauls | | 4.5 | - | 12 | 18 | - | - |
| C7 | Upgrade to Purification Equipment | # storage fields | | 4 | - | 12 | 12 | - | - |

| ID | Control/Mitigation Name | Units Description | | Recorded Units | | Forecast Units | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Capital | O&M | 2020 Capital | 2020 O&M | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 (Low) O&M | TY 2024 (High) O&M |
| M1 | Facilities Integrity Management Program (FIMP) | # of Storage Fields | | - | 4 | - | - | 1 | 4 |

**Table 5: Risk Control & Mitigation Plan – Quantitative Analysis Summary (Direct After Allocations, In 2020 $000)**

| ID | Control/Mitigation Name | Forecast | | | |
|---|---|---|---|---|---|
| | | LoRE | CoRE | Post Mitigation Risk Score | RSE |
| C1 | Integrity Demonstration, Verification, and Monitoring Practices | 0.29 | 9,306 | 2,676 | 0.3 |
| C2 | Well Abandonment and Replacement | 0.27 | 9,306 | 2,534 | 2.8 |
| C3 | Pressure Monitoring and Alarming | See Table 6 | | | |
| C4 | Wellhead Leak Detection and Repair | See Table 6 | | | |
| C5 | Storage Field Maintenance | 0.16 | 9,306 | 1,479 | 35.1 |
| C6 | Compressor Overhauls | 0.26 | 9,306 | 2,440 | 82.7 |
| C7 | Upgrade to Purification Equipment | 0.28 | 9,306 | 2,603 | 5.7 |
| M1 | Facilities Integrity Management Program (FIMP) | See Table 6 | | | |

**Table 6: Risk Control & Mitigation Plan - Quantitative Analysis Summary for RSE Exclusions**

| ID | Control/Mitigation Name | RSE Exclusion Rationale |
|---|---|---|
| C3 | Pressure Monitoring and Alarming | While the Company possesses data, such as well pressures, well monitor repairs and replacements, etc., the data to link the decrease in likelihood or consequence of a storage incident does not exist. Although this activity is expected to reduce the likelihood of a storage-related incident, quantitative information linking monitors to risk reduction does not exist, either internally or externally. Additionally, SMEs are unable to reliably quantify a risk-reduction benefit of this activity. |
| C4 | Wellhead Leak Detection and Repair | Similar to Control 3, it is not possible to quantify the risk-reduction benefit of this activity due to an absence of relevant data, and SMEs are unable to reliably quantify a risk-reduction benefit. |
| M1 | Facilities Integrity Management Program | Due to the program still being in a development stage, the activities that will be included in the program are still being identified. When program scoping is completed, activities that have been included will be tracked and risk mitigations will be defined and subsequently quantified, if feasible. |

## VI. ALTERNATIVES

Pursuant to D.14-12-025 and D.16-08-018, SoCalGas considered alternatives to the risk control and mitigation plan for the Storage risk. SoCalGas typically analyzes alternatives when implementing activities to obtain the best result or product for the cost. The alternatives analysis for this risk control and mitigation plan also took into account modifications to the plan and constraints, such as budget and resources.

### A. A1: Risk-based well casing inspection frequency

Per existing regulation, SoCalGas is required to perform metal loss inspections on gas storage well casings on a 24-month recurring frequency. SoCalGas has evaluated an alternate approach that assigns a well-specific inspection interval, determined in accordance with prior inspection results and an engineering evaluation of the casing's ability to contain pressure. This alternative would likely result in less frequent inspections, which could mitigate risks associated with frequent well interventions stemming from the temporary reconfiguration of well barriers, the potential for incorrect operations during complex well entry activities, and the higher presence of personnel that is required on-site during these activities. While this represents SoCalGas's preferred approach, approval from CalGEM is required before this alternative can be implemented. SoCalGas continues to discuss this approach with CalGEM.

### B. A2: Alternate technology for methane monitoring

As described in Section III of this chapter, SoCalGas currently has a control in place for wellhead leak detection and repair. Each gas storage well is equipped with methane monitoring that is set to alert operations personnel if methane concentrations reach certain thresholds, which could indicate leaks from the well or connected piping. Leak indications are followed up on by operations personnel, with corrective action taken as necessary. As technologies develop and improve, there may be opportunities to supplement or upgrade the current monitoring devices to further improve measurement accuracy, reduce the required calibration frequency, and lessen sensitivity to non-methane environmental conditions.

**Table 7: Alternate Mitigation Plan - Forecast Dollars Summary[34]**
**(Direct After Allocations, In 2020 $000)**

| ID | Alternate Mitigation Name | Forecast Dollars | | | |
|---|---|---|---|---|---|
| | | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 O&M (Low) | TY 2024 O&M (High) |
| A1 | Risk-based well casing inspection frequency | 18,398 | 84,914 | - | - |
| A2 | Alternate technology for methane monitoring | 3,800 | 3,800 | - | - |

34 Recorded costs and forecast ranges are rounded. Additional cost-related information is provided in workpapers. Costs presented in the workpapers may differ from this table due to rounding. The figures provided are direct charges and do not include Company loaders, with the exception of vacation and sick. The costs are also in 2020 dollar and have not been escalated to 2021 amounts. The capital presented is the sum of the years 2022, 2023, and 2024, or a three-year total. Years 2022, 2023 and 2024 are the forecast years for SDG&E's Test Year 2024 GRC Application.

**Table 8: Alternate Mitigation Plan - Units Summary**

| ID | Control/Mitigation Name | Units Description | | Forecast Units | | | |
|---|---|---|---|---|---|---|---|
| | | Capital | O&M | 2022-2024 Capital (Low) | 2022-2024 Capital (High) | TY 2024 (Low) O&M | TY 2024 (High) O&M |
| A1 | Risk-based well casing inspection frequency | Wells | | 13 | 60 | - | - |
| A2 | Alternate technology for methane monitoring | Monitors | | 276 | 276 | - | - |

**Table 9: Alternate Mitigation Plan - Quantitative Analysis Summary**
**(Direct After Allocations, In 2020 $000)**

| ID | Control/Mitigation Name | Forecast | | | |
|---|---|---|---|---|---|
| | | LoRE | CoRE | Post Mitigation Risk Score | RSE |
| A1 | Risk-based well casing inspection frequency | 0.29 | 9,306 | 2,710 | 0.8 |
| A2 | Alternate technology for methane monitoring | 0.29 | 9,306 | 2,715 | 7.1 |

# APPENDIX A: SUMMARY OF ELEMENTS OF THE RISK BOW TIE

## APPENDIX A: SUMMARY OF ELEMENTS OF THE RISK BOW TIE

### Storage Risk: Summary of Elements of the Risk Bow Tie

| ID | Control/Mitigation Name | Elements of the Risk Bow Tie Addressed |
|---|---|---|
| C1 | Integrity Demonstration, Verification, and Monitoring Practices | DT.1, DT.2, DT.4, DT.6, DT.8, DT.9 |
| C2 | Well Abandonment and Replacement | DT.1, DT.2, DT.6, DT.8, DT.9 |
| C3 | Pressure Monitoring and Alarming | DT.4, DT.5, DT.8, DT.10 |
| C4 | Wellhead Leak Detection and Repair | DT.4, DT.5, DT.8, DT.10 |
| C5 | Storage Field Maintenance | DT.1, DT.2, DT.6, DT.7, DT.8, DT.10 |
| C6 | Compressor Overhauls | DT.4, DT.5, DT.6, DT.8 |
| C7 | Upgrade to Purification Equipment | DT.1, DT.2, DT.5, DT.6, DT.7, DT.8, DT.10 |
| M1 | Facilities Integrity Management Program (FIMP) | DT.1, DT.2, DT.3, DT.4, DT.5, DT. 6, DT.7, DT.8, DT.9, DT.10, DT.11, PC.1, PC.2, PC.3, PC.4, PC.5, PC.6 |

# APPENDIX B: QUANTITATIVE ANALYSIS SOURCE DATA REFERENCES

## APPENDIX B: QUANTITATIVE ANALYSIS SOURCE DATA REFERENCES

The Settlement Decision directs the utility to identify Potential Consequences of a Risk Event using available and appropriate data. The below provides a listing of the inputs utilized as part of this assessment.

Analysis of Occurrences at Underground Fuel Storage Facilities and Assessment of the Main Mechanisms Leading to Loss of Storage Integrity
Conference: 51st US Rock Mechanics/Geomechanics Symposium, at San Francisco, California
Authors: Evans, David J. British Geological Survey, UK; Schultz, Richard A. Petroleum and Geosystems Engineering, The University of Texas at Austin, USA
Link:
*https://www.researchgate.net/publication/317873326_Analysis_of_Occurrences_at_Underground_Fuel_Storage_Facilities_and_Assessment_of_the_Main_Mechanisms_Leading_to_Loss_of_Storage_IntegrityLink: Annual Report mileage for Gas Distribution Systems*

<u>Historical Failures</u> Chapter 4. Integral Engineering, 2020.

SoCalGas Well Summary Report which provides well count data according to well type across SoCalGas storage fields.

Number of Depleted Fields, Underground Natural Gas Storage Capacity
Agency: U.S. Energy Information Administration (EIA)
Link: *https://www.eia.gov/dnav/ng/ng_stor_cap_a_EPG0_SA2_Count_a.htm*

U.S. Natural Gas Storage Risk-Based Ranking Methodology and Results
Agency: Argonne National Laboratory (U.S. Department of Energy laboratory)
Link: *https://publications.anl.gov/anlpubs/2016/12/132436.pdf*

Annual Report Mileage for Natural Gas Transmission & Gathering Systems
Agency: Pipeline and Hazardous Materials Safety Administration
Link: *https://cms.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-natural-gas-transmission-gathering-systems*

Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data
Agency: Pipeline and Hazardous Materials Safety Administration
Link: *https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data*