POST-FILING 2021 RAMP WORKSHOP

June 17, 2021

AGENDA

• Opening Remarks	9:30 – 9:45
• Intro / Overview / Lessons Learned	9:45 – 10:30
• Risk Quantification Framework and RSE Methodology	10:30 – 11:15
• Cross Functional Factor Overview	11:15 – 11:45
• Lunch	11:45 – 12:45
• Incident Involving an Employee Overview	12:45 – 1:15
• Incident Related to the Medium Pressure System Overview	1:15 – 2:00
• Wildfire Involving SDG&E Equipment Overview: Part 1	2:00 – 2:45
• Break	2:45 – 3:00
• Wildfire Involving SDG&E Equipment Overview: Part 2	3:00 – 4:00
• Closing Remarks and Next Steps	4:00 – 4:30

INTRODUCTION

Overview – Application

The Company's respective Applications include, in part:

- A request that the Commission consolidate the Company's Application Proceedings
  - Joint ALJ Ruling was issued last week consolidating
- A proposed schedule
- An Overview and Roadmap of the Company's RAMP Reports

Overview – Application: Proposed Schedule

Proposed Schedule	
Application filed	**5/17/2021**
Workshop	6/17/2021
Protest	**~6/16/2021**
Replies	**~6/28/2021**
PHC + Scoping Memo	July
SPD Staff Report	**9/1/2021**
Workshop on SPD Staff Report	9/15/2021
Comments on SPD Staff Report and RAMP Report	**11/15/2021**
Reply Comments	**12/1/2021**

Overview – Application: SoCalGas RAMP Risk Chapters

SoCalGas RAMP Risk Chapters	
Chapter	**Subject**
SCG-Risk-1	Incident Related to the High Pressure System (Excluding Dig-in)
SCG-Risk-2	Excavation Damage (Dig-in) on the Gas System
SCG-Risk-3	Incident Related to the Medium Pressure System (Excluding Dig-in)
SCG-Risk-4	Incident Related to the Storage System (Excluding Dig-in)
SCG-Risk-5	Incident Involving an Employee
SCG-Risk-6 / SDG&E-Risk-6	Cybersecurity
SCG-Risk-7	Incident Involving a Contractor

Overview – Application: SDG&E RAMP Risk Chapters

SoCalGas RAMP Risk Chapters	
Chapter	**Subject**
SDG&E-Risk-1	Wildfire Involving SDG&E Equipment
SDG&E-Risk-2	Electric Infrastructure Integrity
SDG&E-Risk-3	Incident Related to the High Pressure System (Excluding Dig-in)
SDG&E-Risk-4	Incident Involving a Contractor
SDG&E-Risk-5	Customer and Public Safety – Contact with Electric Equipment
SDG&E-Risk-6 / SCG-Risk-6	Cybersecurity
SDG&E-Risk-7	Excavation Damage (Dig-in) on the Gas System
SDG&E-Risk-8	Incident Involving an Employee
SDG&E-Risk-9	Incident Related to the Medium Pressure System (Excluding Dig-in)

Overview – Application: Overview and Roadmap of Company's RAMP Reports

SoCalGas / SDG&E Introductory Chapters	
Chapter	**Subject**
RAMP-A	Overview and Approach (Joint)
RAMP-B	Enterprise Risk Management Framework (Company Specific)
RAMP-C	Risk Quantification Framework and Risk Spend Efficiency (Joint)
RAMP-D	Safety Culture, Organizational Structure, Executive and Utility Board Engagement, and Compensation Policies Related to Safety (Company Specific)
RAMP-E	Lessons Learned (Joint)

RAMP A – Overview and Approach

I. RAMP Overview
II. Summary of Approach to Meet RAMP Requirements
    A: Approach to Comply with the Adopted 10 Major Components of RAMP Filings
    B: RAMP Workshop Requirements
    C: Seven Changes from the 2019 RAMP
    D: Three Changes and Responses Subsequent to the Pre-filing workshops
III. Guiding Principles
IV. Risk Chapter Organization and Overview

RAMP A – Overview and Approach: Approach to Complying with Adopted Ten Major Components

1. Identify top risks
2. Describe the controls or mitigations currently in place
3. Present plan for improving the mitigation of each risk
4. Present two alternative mitigation plans that were considered
5. Present an early stage “risk mitigated to cost ratio” or related optimization
6. Identify lessons learned in the current round to apply to future rounds
7. Move towards probabilistic calculations, to the maximum extent possible
8. Improve the collection of data for those business areas with less data and provide a timeframe for improvement
9. Describe the company’s safety culture, executive engagement, and compensation policies.
10. Respond to immediate or short-term crises outside of the RAMP and GRC process.

RAMP A – Overview and Approach: Changes From 2019 RAMP

1. Changes to Risk Spend Efficiency Approach
2. Incorporate Additional Attributes
3. Modeling Public Safety Shut-Off De-Energizations
4. Additional Number of Tranches
5. Consolidation of Dig-In Into One Risk Chapter
6. Inclusion of Internal Labor
7. Creation of Cross-Functional Factors

RAMP A – Overview and Approach: Changes and Responses Subsequent to the Pre-RAMP Filing Workshops

1. Fourth Attribute
2. MAVF Weights
3. Granularity of Tranching

RAMP A – Overview and Approach: Risk Chapter Organization

I. Introduction
   - A. Risk Overview
   - B. Risk Definition
   - C. Scope

II. Risk Assessment
   - A. Risk Bow Tie and Risk Event Associated with the Risk
   - B. Cross-Functional Factors
   - C. Potential Drivers / Triggers
   - D. Potential Consequences
   - E. Risk Score

III. 2020 Controls

IV. 2022-2024 Control & Mitigation Plan
   - A. Changes to 2020 Controls
   - B. New Mitigations

V. Costs, Units, and Quantitative Summary Tables

VI. Alternatives

Appendix A: Summary of Elements of the Risk Bow Tie

Appendix B: Quantitative Analysis Source Data References

Overview: 2022-2024 Controls and Mitigation Plan

ID	SoCalGas High Pressure Control/Mitigation Description	2020 Control	2022-2024 Plan
C1	Cathodic Protection – Capital	X	X
C22-T1.1 C22-T1.2	Pipeline Safety Enhancement Plan (PSEP): Phase 1A – Refundable	X	No
C23-T1	Blythe Compressor Station Modernization	X	No
C23-T2	Ventura Compressor Station Modernization	X	X
C23-T3	Honor Rancho Storage Field Compressor Station Modernization	No	No
M2	Gas Transmission Safety Rule – Material Verification	No	X

2022-2024 Plan: Mitigations for which we anticipate requesting cost recovery in the Test Year 2024 GRC

Overview: Quantitative Analysis Source Data References – Wildfire Example

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 list below provides the inputs used as part of this assessment.

San Diego Gas & Electric, CPUC Reportable Fire Database

- 2014 –2020 ignition reporting (pursuant to D14-02-015, Ordering Paragraph 9 and Appendix C)

San Diego Gas & Electric, Electric Reliability Database

- 2010 –2020 internal reliability data

San Diego Gas & Electric, Asset Management data

- Various asset information, such as the count and type of assets, by HFTD tier

CALFIRE, Wildfire Activity Statistics (also known as Redbooks)
https://www.fire.ca.gov/stats-events

- Annual record of wildfire statistics such as location, size, and damage

Technosylva (internal consultant who performs wildfire modeling)

- WRRM consequence data

RAMP D – Safety Culture, Organizational Structure, Executive and Utility Board Engagement, and Compensation Policies Related to Safety

I. Introduction Background
II. Safety Organizational Structure and Culture
    A. Organizational Structure
    B. Safety Management System Implementation
III. Compensation Policies Related to Safety
IV. Executive and Senior Management Engagement in the Risks Assessment, Prioritization, Mitigation, and Budgeting Process
V. Board Engagement and Oversight Over Safety
VI. Conclusion

RAMP D – Safety Organizational Structure and Culture: SoCalGas Example

A. Organizational Structure
   1. Safety Management System Organization
   2. Enterprise Risk Management Organization
   3. Integrity Management Organization

B. Safety Management System Implementation
   1. Leadership Commitment
   2. Risk Management
   3. Employee and Stakeholder Engagement
   4. Competence, Awareness and Training
   5. Emergency Preparedness and Response
   6. Safety Compliance
   7. Continuous Improvement

LESSONS LEARNED

RAMP E – Lessons Learned: Considering 3rd Party Input

Topic	Party Comment	SoCalGas and SDG&E Response
Number of Attributes	Included only three attributes in the 2019 RAMP Report (Safety, Reliability, and Financial) even though when making investment decisions for risk mitigations, the Companies acknowledge a variety of other factors are considered.	The Companies and have revised the MAVF in this RAMP report. As described in Chapters SCG/SDG&E RAMP-A and C, SoCalGas's and SDG&E's 2021 RAMP Reports include additional attributes (a top and sub-attribute).
Adequate Staffing and Human Performance	Understaffing is not included as a driver/trigger in the risk bow-tie for any of the RAMP risks in the 2019 RAMP Report. Human error and a discussion about personnel competency are missing from the 2019 RAMP Report.	The Companies have improved their presentation for the 2021 RAMP Reports by addressing Workforce Planning / Qualified Workforce issues as a CFF in these RAMP Reports (see SCG- CFF-7; SDG&E-CFF-8). Training to minimize human error is discussed in the Incident Involving an Employee risk chapters (see SCG-Risk-5, SDG&E-Risk-8).
Climate Change	Climate change posed by SDG&E's and SoCalGas's operations was not addressed as an individual risk chapter in the 2019 RAMP Report.	The Companies have improved their presentation for the 2021 RAMP Reports. SoCalGas and SDG&E have incorporated additional information regarding climate change-related issues as a cross-functional factor (CFF) in these RAMP Reports (see SCG-CFF-2; SDG&E-CFF-2).

Lessons Learned – RAMP Maturity and Enhanced RAMP to GRC Integration Considerations

Use of frequency: The Companies suggest the parties further explore the use of frequency and likelihood in the S-MAP OIR.

Baseline for Risk Reduction Activities: The Companies understand that the topic of baseline and whether it should be a defined term in the lexicon is currently in scope for the open S-MAP OIR. Any adjustments to the Companies' approach, if necessary, should be made in future filings.

Validation of Data and Assumptions: The Companies expect that with the implementation of the Risk Mitigation Accountability Report, which is a topic in scope of the S-MAP OIR, additional data and validation will be required.

Equivalences Between Attributes in Risk quantification Framework: The Commission is considering whether to adopt a risk tolerance standard as a statewide issue in the ongoing S-MAP OIR.

Discounting of Costs: Additional discussion of discounting costs could be further discussed with interested stakeholders in the S-MAP OIR.

RISK QUANTIFICATION FRAMEWORK AND RSE METHODOLOGY

Quantitative Section Overview

- ❑ Risk Quantification Framework
- ❑ Risk Spend Efficiency methodology
- ❑ Progress on Quantitative work

Question Period after each section

Risk Quantification Framework

RISK QUANTIFICATION FRAMEWORK

Attribute	Unit	Range	Weight
Health & Safety	Index	0 - 20	60%
Reliability	Index	0 - 1	23%
Financial	$M	$0 - 500M	15%
Stakeholder Satisfaction*	Index	0 - 100	2%

*Stakeholders: customers, employees, public, government, and regulators

Health & Safety Index

Sub Attribute	Value
Fatality	1
Serious Injury	0.25
Acres Burned*	0.00005

*Applies to Wildfire risk only

Reliability Index (SDG&E / SoCalGas)

Sub Attribute	Unit	Range	Weight
Gas Curtailment (80 / 250)	# MMcf	0 – 333 / 666	25% / 50%
Meters Loss of Service	# of meters	0 - 50,000 / 100,000	25% / 50%
Electric Outage Count	SAIFI Outages	0 – 1	25% / 0%
Electric Outage Duration	SAIDI Minutes	0 – 100	25% / 0%

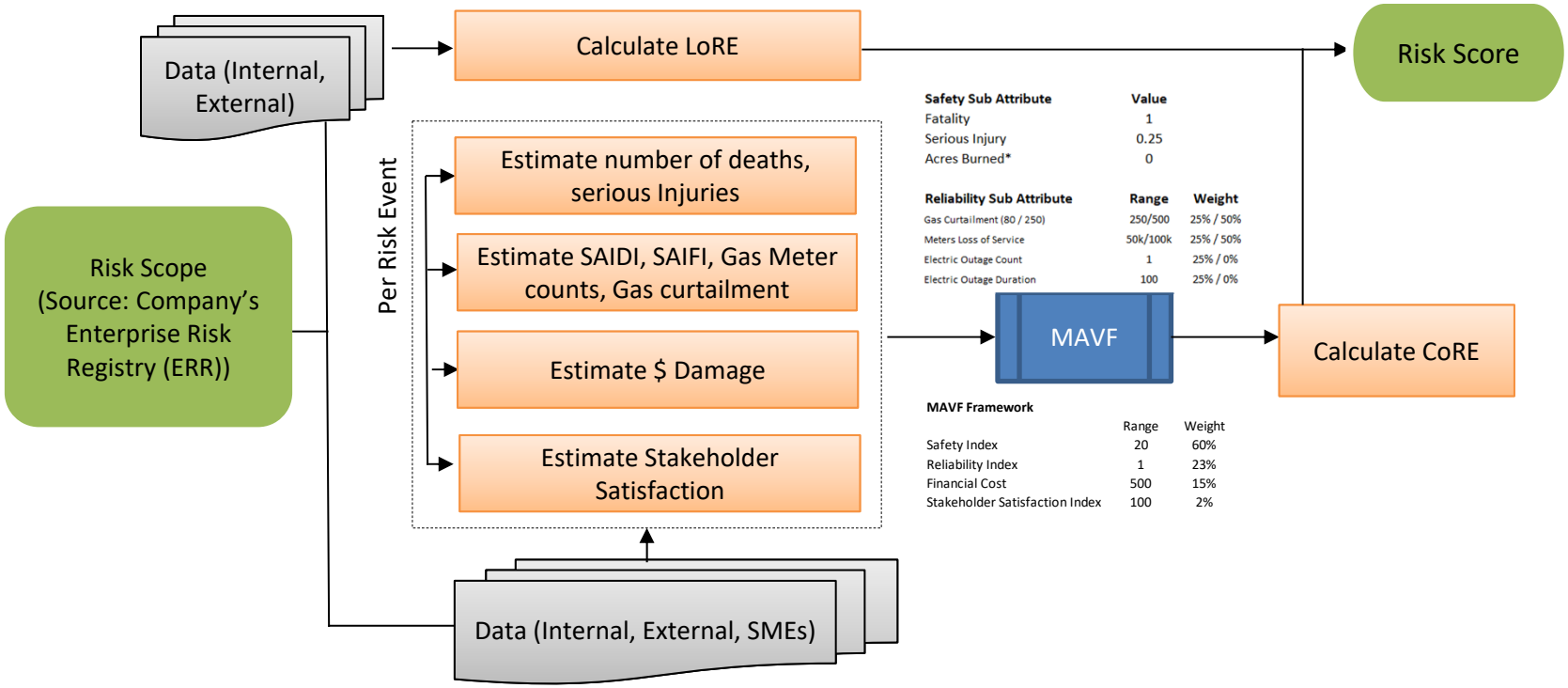
STAKEHOLDER SATISFACTION INDEX

Customer	
Definition	Impact on total customer satisfaction from a risk event
Measurement / Proxy	Customer Satisfaction Surveys
Score	**Equivalent**
1	Mild and temporary dissatisfaction to some customers
2	Mild and temporary dissatisfaction across many customers
5	Moderate and temporary dissatisfaction across many customers
10	Moderate and sustained dissatisfaction across many customers
20	Extreme and sustained dissatisfaction across entire customer base

RISK QUANTIFICATION FRAMEWORK

$$\text{Risk Score} = \text{Likelihood of Risk Event (LoRE)} \times \text{Consequence of Risk Event (CoRE)}$$

***Where**: CoRE is the sum of the four attributes of the MAVF (safety, financial, reliability, and stakeholder satisfaction)*



SoCalGas RAMP Risks & Quantification

Line No.	2021 RAMP Risk	LoRE	CoRE	Risk Score
1	Incident Related to the High Pressure System	8.64	538	4,644
2	Incident Related to the Medium Pressure System (Excluding Dig-in)	544.99	5.63	3,071
3	Incident Related to the Storage System (Excluding Dig-in)	0.29	9,306	2,721
4	Incident Involving an Employee	553.09	5	2,667
5	Excavation Damage (Dig-In) on the Gas System * (High Pressure)	0.70	3,114	2,180
6	Excavation Damage (Dig-In) on the Gas System * (Medium Pressure)	2,914.10	0.5	1,523
7	Cybersecurity	0.09	10,829	975
8	Incident Involving a Contractor	144.77	3	469

*Dig-In risks will be combined into one RAMP Chapter

SDG&E RAMP Risks & Quantification

Line No.	2021 RAMP Risk	LoRE	CoRE	Risk Score
1	Wildfires Involving SDG&E Equipment (WF/PSPS)	21.2/4	556/1,173	16,459 *(11,768/4,691)*
2	Electric Infrastructure Integrity	1,632	6	9,177
3	Incident Related to High Pressure Gas System (Excluding Dig-in)	0.88	2,301	2,029
4	Incident Involving a Contractor	1.83	1,033	1,894
5	Customer & Public Safety - Contact with Electric Equipment	1.17	1,197	1,396
6	Cybersecurity	0.08	16,446	1,316
7	Incident Involving an Employee	0.83	1,275	1,062
8	Excavation Damage (Dig-In) on the Gas System *(High Pressure)	0.19	4,235	815
9	Incident Related to Medium Pressure Gas System (Excluding Dig-in)	300.20	1	316
10	Excavation Damage (Dig-In) on the Gas System *(Medium Pressure)	101.42	5.97	606

*Dig-In risks will be combined into one RAMP Chapter

RAMP Walkthrough

Each RAMP risk chapter demonstrates in a table, the LoRE, CoRE, and Risk Score.

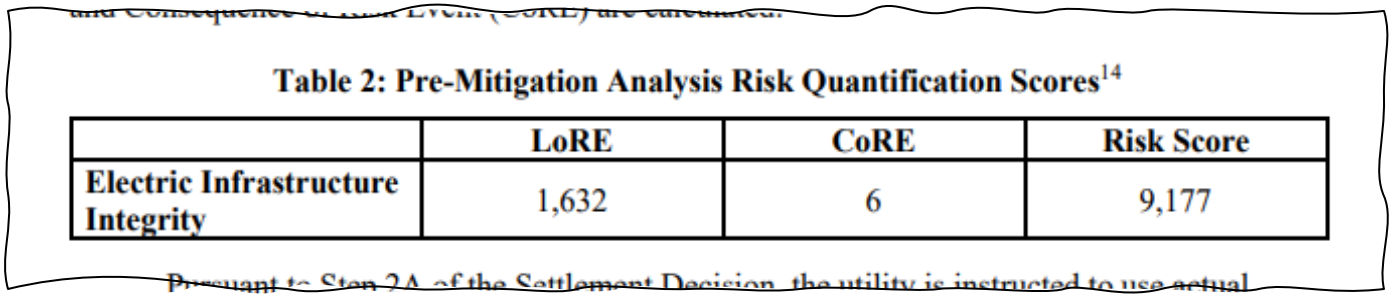


Table 2: Pre-Mitigation Analysis Risk Quantification Scores[14]

	LoRE	CoRE	Risk Score
Electric Infrastructure Integrity	1,632	6	9,177

From SDGE-RAMP-2 Electric Infrastructure Integrity

Risk Spend Efficiency Methodology

RSE METHODOLOGY

$$RSE\ per\ \$M = \frac{Risk\ Reduction \times Discounted\ Time}{Total\ Cost\ (\$M)}$$

Where:

Risk Reduction $= (Pre - Mitigated\ LoRE * Pre - Mitigated\ CoRE)$ -
$(Post - Mitigated\ LoRE * Post - Mitigated\ CoRE)$

$$Discounted\ Time = \frac{1 - \frac{1}{(1 + Benefit\ Discount\ Rate)^{Benefits\ Lifetime}}}{Benefit\ Discount\ Rate}$$

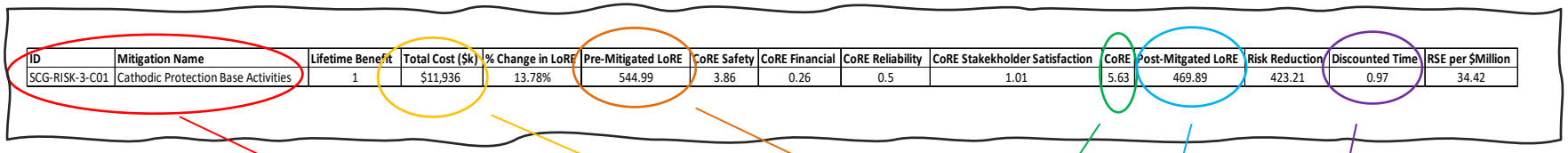
Discounted Time Example:

Benefit Life 30 years, 3% Benefit Discount Rate

Discounted Time = 19.6

RAMP Walkthrough

From Work Papers:



ID	Mitigation Name	Lifetime Benefit	Total Cost ($k)	% Change in LoRE	Pre-Mitigated LoRE	CoRE Safety	CoRE Financial	CoRE Reliability	CoRE Stakekholder Satisfaction	CoRE	Post-Mitgated LoRE	Risk Reduction	Discounted Time	RSE per $Million
SCG-RISK-3-C01	Cathodic Protection Base Activities	1	$11,936	13.78%	544.99	3.86	0.26	0.5	1.01	5.63	469.89	423.21	0.97	34.42

ID	Mitigation Name	Total Cost ($k)	Pre-Mitigated LoRE	CoRE	Post-Mitgated LoRE	Discounted Time
SCG-RISK-3-C01	Cathodic Protection Base Activities	$11,936	544.99	5.63	469.89	0.97

Risk Reduction $= (Pre - Mitigated\ LoRE * Pre - Mitigated\ CoRE)$ -
$(Post - Mitigated\ LoRE * Post - Mitigated\ CoRE)$

Risk Reduction $= (544.99 * 5.63)$ - $(469.89 * 5.63) = 423.21$

$$RSE\ per\ \$M = \frac{Risk\ Reduction \times Discounted\ Time}{Total\ Cost\ (\$M)}$$

RSE = (423.31 * 0.97) / $11,936 = 34.42

RAMP Walkthrough

Table 6: Risk Control & Mitigation Plan - Quantitative Analysis Summary

ID	Control/Mitigation Name	Forecast			
		LoRE	CoRE	Post Mitigation Risk Score	RSE
C1	Cathodic Protection Base Activities	470	5.63	2,648	34.4
C2	Cathodic Protection-CP10 Activities	537	5.63	3,028	115.2
C3	Cathodic Protection-100mV Requalification	541	5.63	3,050	50.8
C4	Meter & Regulator (M&R) Station and Electronic Pressure Monitors (EPM) Inspection and Maintenance	485	5.63	2,731	92.5
C5	Regulator Station Replacements/Installs	545	5.63	3,069	4.7
C6	Meter Set Assembly (MSA) Inspection and Maintenance	518	5.63	2,918	80.7
C7	Electronic Pressure Monitor (EPM) Replacement & Installs	542	5.63	3,052	106.6

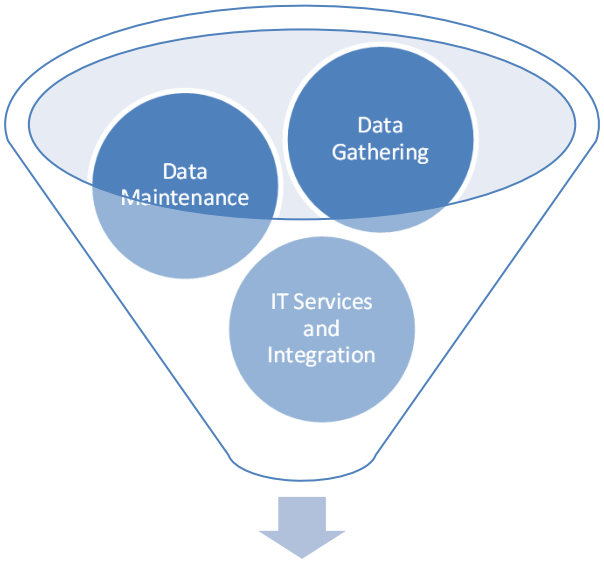
*Example from SoCalGas *Incident Related to the Medium Pressure System (Excluding Dig-in)*

Progress on Quantitative Work

Progress on Quantitative Work

- ❑ Continued progress with company-wide messaging and culture
- ❑ Extensive efforts in pursuit of data-driven & risk-informed decision making
  - Asset Management
  - Enterprise Risk Management
  - Data Science
- ❑ Cooperation with other IOUs and various regulatory stakeholder groups

Progress on Quantitative Work



	Examples
Data Gathering	Asset, Inspection (e.g. CMP, Leak Survey, Drone), SCADA, Meter, Vegetation, Risk Event (e.g. outage, ignition, etc.)
Data Maintenance	Creating single set of data, Validating records, linking data sources
IT Platform	Storing and giving access to data, non-local storage and computational abilities, resilience, dashboards

Quantitative Risk Analysis: *A systematic numerical methodology to evaluate current and potential risks, which includes the acknowledgement of: 1) drivers or stressors, and 2) consequences from detrimental outcomes.*

Progress on Quantitative Work

RAMP is a "snapshot in time". The utilities continually evolve their thinking and abilities.

Continuously Changing Environment

Topic	Potential Change	Potential Reason For Change
Risk and Risk Scope	• Enterprise Risk Registry has annual reviews • Risks may be added or removed or re-scoped	• Recent Events • Lessons learned • Priorities become more refined
Mitigations	• New mitigations are developed • Existing ones are completed or revised.	• New technologies • Become aware of new methods • Lessons learned
Analytical Approaches	• Change in data sets • Change in logic or analytical approach • LoRE and CoRE change • Risk Models get updated	• More data becomes available • Different techniques are learned • Technology improves • Recent event or lack thereof • Costs change

CROSS-FUNCTIONAL FACTOR OVERVIEW

What are Cross-Functional Factors (CFFs)?

Additional information regarding safety-related initiatives associated with several of SoCalGas's or SDG&E's RAMP risks

Why are CFFs being presented?

Created in response to feedback received to address some of the various topics raised by parties that would not be standalone risk chapters

Established as a CFF volume for ease of presentation rather than dispersing information throughout the RAMP Report

CFFs *are*:

- ❑ Safety-related challenges that impact multiple RAMP risks (as a driver/trigger, activity, program)
- ❑ Generally foundational in nature
- ❑ Presented differently from the RAMP risk chapters (e.g., no risk spend efficiency calculations, units, or alternatives are provided)

SoCalGas Cross-Functional Factor Chapters

SoCalGas Cross-Functional Factor Volume	
Chapter	**Subject**
SCG-CFF-1	Asset and Records Management
SCG-CFF-2	Energy Resilience
SCG-CFF-3	Emergency Preparedness and Response and Pandemic
SCG-CFF-4	Foundational Technology Systems
SCG-CFF-5	Physical Security
SCG-CFF-6	Safety Management System
SCG-CFF-7	Workforce Planning / Qualified Workforce

SDG&E Cross-Functional Factor Chapters

SDG&E Cross-Functional Factor Volume	
Chapter	**Subject**
SDG&E-CFF-1	Asset Management
SDG&E-CFF-2	Climate Change Adaptation, Energy System Resilience, and GHG Emission Reductions
SDG&E-CFF-3	Emergency Preparedness and Response and Pandemic
SDG&E-CFF-4	Foundational Technology Systems
SDG&E-CFF-5	Physical Security
SDG&E-CFF-6	Records Management
SDG&E-CFF-7	Safety Management System
SDG&E-CFF-8	Workforce Planning / Qualified Workforce

Cross-Functional Factor Chapter Outline

I. Introduction

II. Overview

III. Associated Risk Events

IV. 2020 Projects and Programs

V. 2022-2024 Projects and Programs

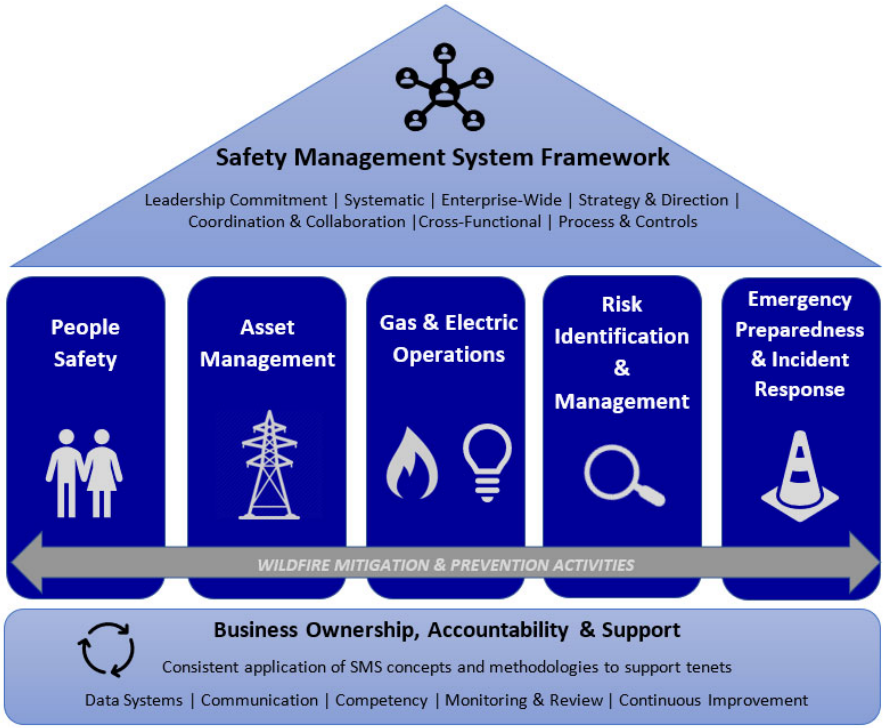
VI. Costs

SDG&E-CFF-7 – Safety Management System: Overview

SDG&E's SMS is a company-wide program that provides the umbrella framework to align our business units and the structure to strengthen our safety programs

A SMS adds value by:

- ❑ Implementing standardized processes that build safety into everything we do
- ❑ Eliminating silos and more closely integrating asset and risk management with operations
- ❑ Soliciting increased employee and contractor feedback and building trust with open two-way communication and consistent follow-up; elevating concerns
- ❑ Using increased data and analytics to proactively identify and manage safety risk
- ❑ Following the Plan-Do-Check-Act cycle and measuring effectiveness to identify opportunities for **continuous safety improvement**



SDGE A Sempra Energy utility

SMS Process-Based Approach

As part of our SMS, we developed processes based on industry safety standards and best practices. These SMS processes:

- ❑ Provide greater integration of safety, risk, asset management, and investment prioritization with operational needs;
- ❑ Include step-by-step repeatable activities with identified roles and responsibilities;
- ❑ Increase the use of leading and lagging indicators to measure and assess effectiveness to identify opportunities for continuous improvement.

Consistent application of safety-focused processes with repeatable and measurable activities enhances the effectiveness of SDG&E's risk and safety programs.

SMS Continuous Improvement Framework

Follows the Plan – Do – Check – Act cycle for continuous improvement

PLAN

Consider the risks of the job and establish a plan (process, procedures, training, etc.) to support safe and successful completion.

DO

Perform the job based on the plan.

CHECK

Assess the work to see that it was completed according to the plan.

ACT

Make any necessary adjustments (process, procedures, training, etc.) and communicate lessons learned. Ask the question…**How can we do better?**

Effectiveness is measured by increased data, analytics and employee feedback

SDG&E SMS CFF Chapter Overview

- Because it is a systematic, enterprise-wide framework to manage risk and to promote continuous improvements in safety, SDG&E's SMS spans all lines of business.
- SMS activities impact the risks described in SDG&E's RAMP risk chapters and several CFF chapters.
- Projects and programs are put forth for 2020 and through the 2022-24 time frame.

Line No.	Project/Program Description
1	Development and Implementation of an Enterprise-Wide SMS
2	Enhanced Employee and Stakeholder Engagement, including SMS Competence, Awareness, Survey and Training
3	Integration of New Technology and Enhanced Data and Analytics Capabilities for Continuous Safety Improvement
4	Enhanced Documentation and Recordkeeping Practices
5	Expanded Quality Management Program Focused on Asset Safety
6	Enhanced Stakeholder Feedback and Key Performance Indicator Monitoring, Tracking, and Reporting
7	Development and Implementation of a Strong Management of Change Platform
8	SMS Program Benchmarking, Measurement, and Maturity Assessment for Continuous Improvement

SDGE A Sempra Energy utility

LUNCH

INCIDENT INVOLVING AN EMPLOYEE OVERVIEW

(SDG&E)

Outline

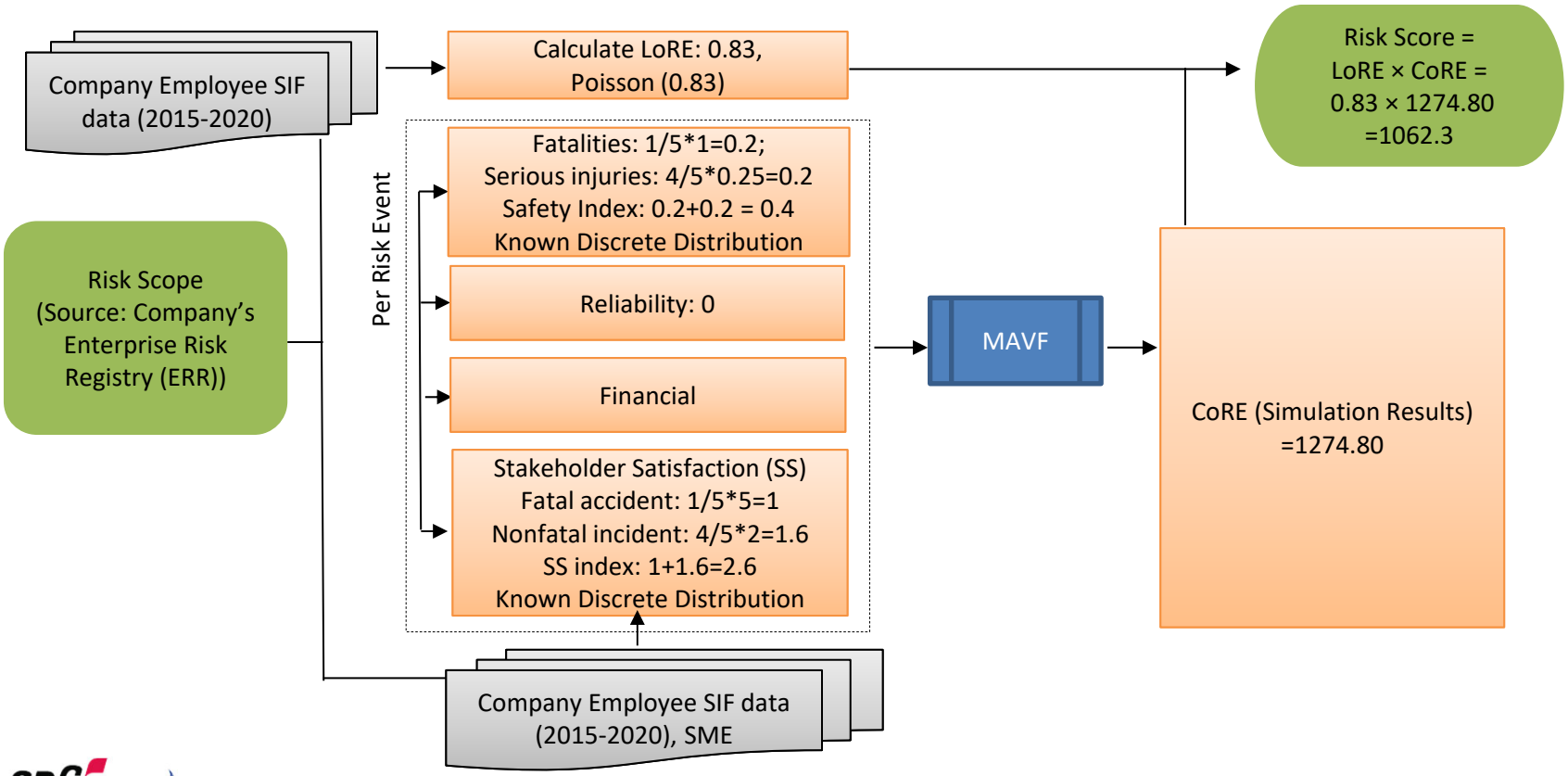
- Risk Score Walkthrough
- Mitigation Activity Overview
- RSE Walkthrough

SDGE A Sempra Energy utility

Risk Score Walkthrough

Risk Scope : The risk of an incident, involving one or more on-duty employees, that causes a fatality or serious injury (as defined by OSHA) to a company employee.

$$\text{Risk Score} = \text{Likelihood of Risk Event (LoRE)} \times \text{Consequence of Risk Event (CoRE)}$$



SDGE A Sempra Energy utility

Mitigation Activity Overview

SDG&E-Risk-8-C14: Enhanced Safety in Action Program

Designed for executives and field operations directors, the enhanced Safety in Action (SIA) initiative provides SDG&E with the necessary tools to measure Serious Injury and Fatality (SIF) exposure, understand the Company's specific SIF precursors, and design effective steps to mitigate SIF exposure. The SIF assessment was completed in 2020 and we received executive approval to move forward with implementing the SIF program. The 2020 SIF assessment project consisted of defining a SIF definition for SDG&E, developed a SIF decision tree, determined SIF metrics (leading and lagging), and incorporated a precursor analysis tool to reduce SIF exposure. A SIF Governance has been developed with clear objectives for the SIF program that demonstrates a forward-moving effort to improve safety.

RSE Walkthrough

SDG&E-Risk-8-C14: Enhanced Safety in Action Program

$$RSE\ per\ \$M = \frac{Risk\ Reduction \times Discounted\ Time}{Total\ Cost\ (\$M)}$$

Risk Reduction $= \text{Mitigation Effectiveness} \times (\text{Pre} - \text{Mitigated LoRE} \times \text{Pre} - \text{Mitigated CoRE})$
$= 4.5\% \times 0.83 \times 1274.80 = 47.81$
Where :
Mitigation Effectiveness =4.5% , from Subject Matter Expertise (SME)

$$\textbf{Discounted Time} = \frac{1 - \frac{1}{(1 + Benefit\ Discount\ Rate)^{Benefits\ Lifetime}}}{Benefit\ Discount\ Rate} = \frac{1 - \frac{1}{(1+0.03)^1}}{0.03} = 0.97$$

Total Cost: Total ($) cost of the mitigation = $0.155M

$$\textbf{RSE per \$M} = \frac{Risk\ Reduction * Discounted\ Time}{Total\ Cost\ (\$M)} = \frac{47.81 * 0.97}{0.155} = 299.4$$

SDGE A Sempra Energy utility

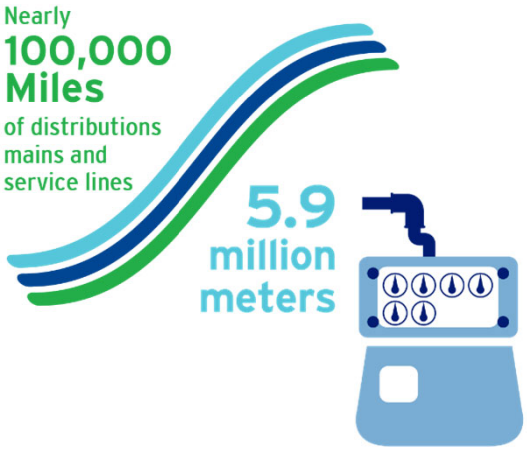
INCIDENT RELATED TO THE MEDIUM PRESSURE SYSTEM OVERVIEW

(SoCalGas)

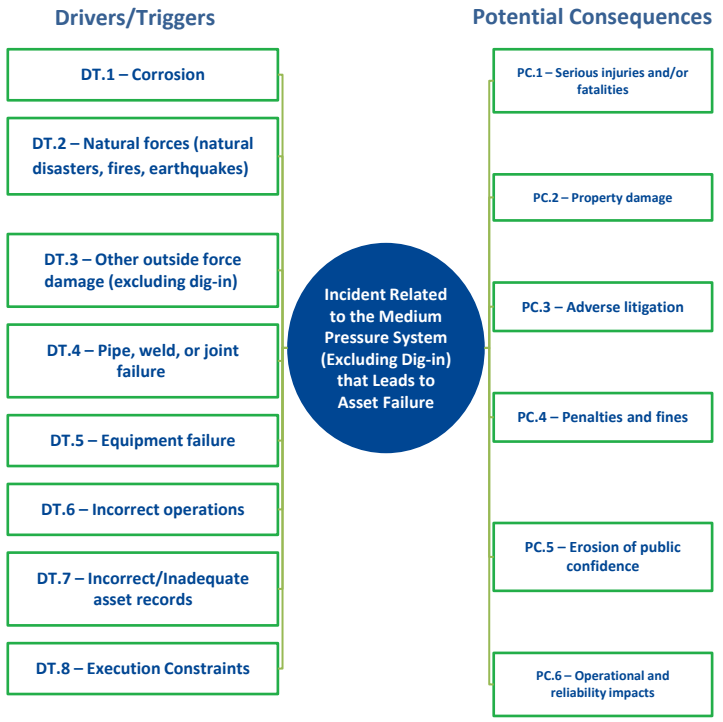
Outline

- Risk Background & Scope
- Risk Score Walkthrough
  - Sub-events
  - Attributes
  - Example CoRE Calculation
- Mitigation Activity Overview & Background
- RSE Walkthrough
  - %%%
  - Justifications

Incident Related to the Medium Pressure System (Excluding Dig-In)



The risk of damage, caused by a medium pressure system (maximum allowable operating pressure (MAOP) at or lower than 60 psig) failure event, which results in serious consequences such as injuries, fatalities, or outages and includes consequences beyond the customer meter.



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Risk Score Walkthrough – MP Incident

Risk Score = Likelihood of Risk Event (LoRE) x Consequence of Risk Event (CoRE)

Risk Score

$$\frac{\sum_{i=1}^{n} LoRE_i}{\frac{1}{\sum_{i=1}^{n} LoRE_i} \sum_{j=1}^{4} \sum_{i=1}^{n} LoRE_i CoRE_{ij}}$$

Where $i = 1, \ldots, n$ sub-events and j ranges through the four attributes of the MAVF (safety, financial, reliability, and stakeholder satisfaction) and

$CoRE_{ij}$ is the CoRE for the j[th] attribute of the i[th] sub-event

For example, $CoRE_{11}$ would correspond to the safety core of the first sub-event.

Risk Score Walkthrough – MP Incident

Risk Score = Likelihood of Risk Event (LoRE) x Consequence of Risk Event (CoRE)

Risk Score

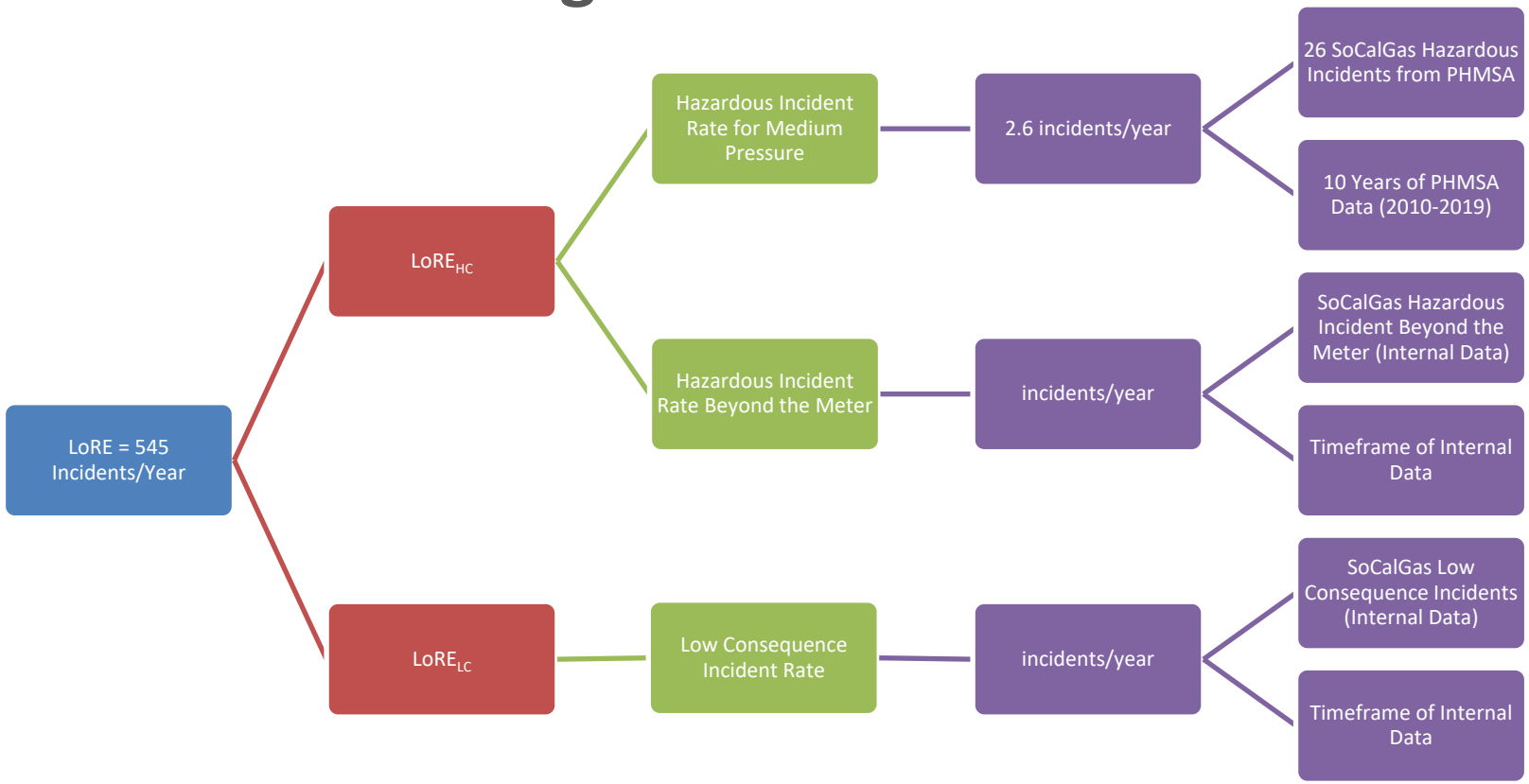
$$LoRE_{High\ Consequence\ Event} + LoRE_{Low\ Consequence\ Event}$$

$$\frac{1}{(LoRE_{HC} + LoRE_{LC})}[(LoRE_{HC} * CoRE_{Safety_{HC}} + LoRE_{LC} * CoRE_{Safety_{LC}}) + (LoRE_{HC} * CoRE_{Financial_{HC}} + LoRE_{LC} * CoRE_{Financial_{LC}}) + (LoRE_{HC} * CoRE_{Reliability_{HC}} + LoRE_{LC} * CoRE_{Reliability_{LC}}) + (LoRE_{HC} * CoRE_{Stakeholder\ Satisfaction_{HC}} + LoRE_{LC} * CoRE_{FStakeholder\ Satisfaction_{LC}})]$$

$\because$ *High Consequence Event* $\equiv$ *a PHMSA Reportable Incident resulting in an explosion or rupture and/or safety impacts aka Hazardous Incident*

& *Low Consequence Event* $\equiv$ *a non − safety − related event*

Risk Score Walkthrough – MP Incident LoRE



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Risk Score Walkthrough – MP Incident $CoRE_{safety}$

Consequence of Risk Event (CoRE)

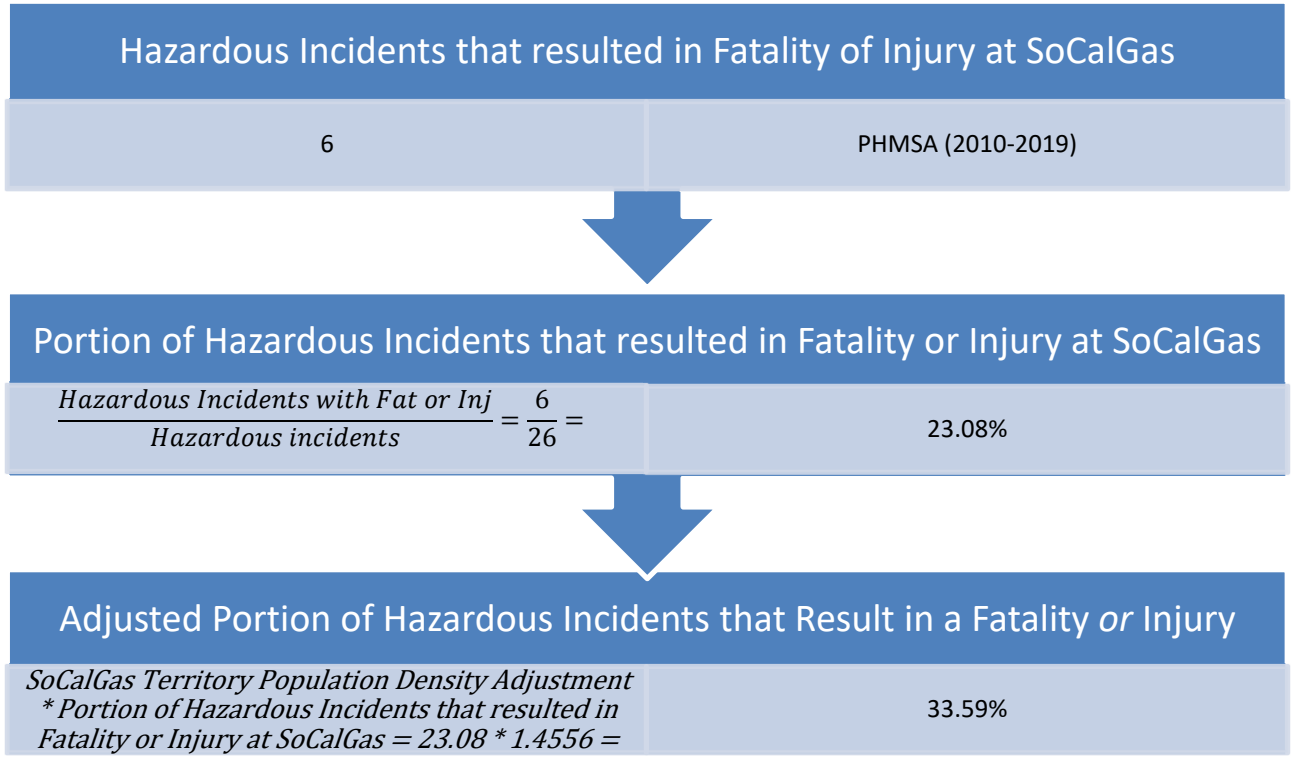
$$CoRE_{safety} = \frac{1}{\sum_{i=1}^{n} LoRE_i} \sum_{i=1}^{n} LoRE_i * CoRE_{Safety_i}$$

$$CoRE_{Safety_i} = \frac{Fatalities_{expected_i} * Fatalities_{index} + Injuries_{expected_i} * Injuries_{index}}{Safety_{range}} * Safety_{weight} * Readability\ Factor$$

Total $CoRE$ is the sum of the $CoRE$'s for the 4 attributes of MAVF

Risk Score = $\sum_{j=1}^{4} \sum_{i=1}^{2} LoRE_i CoRE_{ij}$

Risk Score Walkthrough – MP Incident $CoRE_{SafetyHC}$



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Risk Score Walkthrough – MP Incident $CoRE_{SafetyHC}$

Average Fatalities & Injuries per Incident [PHMSA (2010-2019)]	
$Average\ Fatalities\ =\ 0.3393$	$Average\ Injuries\ =\ 1.6905$

Expected Fatalities per Incident	
$Fatalities_{avg}$ **Adjusted Portion of Hazardous Incidents that Result in a Fatality or Injury =*	$33.59 * 0.3393\ = 0.1140$

Expected Injuries per Incident	
$Injuries_{avg}$ **Adjusted Portion of Hazardous Incidents that Result in a Fatality or Injury =*	$33.59 * 1.6905\ = 0.5678$

Risk Score Walkthrough – MP Incident $CoRE_{SafetyHC}$

Consequence of Risk Event
(CoRE)

$$CoRE_{Safety_n} = \frac{Fatalities_{expected_n} * Fatalities_{index} + Injuries_{expected_n} * Injuries_{index}}{Safety_{range}} * Safety_{weight} * Readability\ Factor$$

$$CoRE_{Safety_{HC}} = \frac{Fatalities_{expected_{HC}} * Fatalities_{index} + Injuries_{expected_{HC}} * Injuries_{index}}{Safety_{range}} * Safety_{weight} * Readability\ Factor$$

$$CoRE_{Safety_{HC}} = \frac{0.1140 * 1 + 0.5678 * 0.25}{20} * 60\% * 100{,}000$$

$$CoRE_{Safety_{HC}} = 767.78$$

Risk Score Walkthrough – MP Incident $CoRE_{Safety}$

$$CoRE_{Safety_{HC}} = 767.78$$

$$CoRE_{Safety_{LC}} = \frac{Fatalities_{expected_{LC}} * Fatalities_{index} + Injuries_{expected_{LC}} * Injuries_{index}}{Safety_{range}} * Safety_{weight} * Readability\ Factor$$

$$CoRE_{Safety_{HC}} = \frac{0 * 1 + 0 * 0.25}{20} * 60\% * 100{,}000$$

Subject Matter Expertise was utilized to establish a zero safety impact for Low Consequence Events in the MP Incident Risk

$$CoRE_{Safety} = \frac{1}{(LoRE)}[(LoRE_{HC} * CoRE_{Safety_{HC}} + LoRE_{LC} * CoRE_{Safety_{LC}})]$$

$$CoRE_{Safety} = \frac{1}{545}[(2{,}103.7)] = 3.86$$

Risk Score Walkthrough – MP Incident

$$\textbf{Risk Score} = LoRE_{High\ Consequence\ Event} + LoRE_{Low\ Consequence\ Event} \ x \ \frac{1}{(LoRE_{HC} + LoRE_{LC})}[(LoRE_{HC} * CoRE_{Safety_{HC}} + LoRE_{LC} * CoRE_{Safety_{LC}}) + (LoRE_{HC} * CoRE_{Finacial_{HC}} + LoRE_{LC} * CoRE_{Finacial_{LC}}) + (LoRE_{HC} * CoRE_{Reliability_{HC}} + LoRE_{LC} * CoRE_{Reliability_{LC}}) + (LoRE_{HC} * CoRE_{Stakeholder\ Satisfaction_{HC}} + LoRE_{LC} * CoRE_{FStakeholder\ Satisfaction_{LC}})]$$

$$Risk\ Score = (LoRE_{HC} + LoRE_{LC}) * \left\{\frac{1}{(LoRE_{HC} + LoRE_{LC})}[(LoRE_{HC} * CoRE_{Safety_{HC}} + LoRE_{LC} * CoRE_{Safety_{LC}}) + (LoRE_{HC} * CoRE_{Finacial_{HC}} + LoRE_{LC} * CoRE_{Finacial_{LC}}) + (LoRE_{HC} * CoRE_{Reliability_{HC}} + LoRE_{LC} * CoRE_{Reliability_{LC}}) + (LoRE_{HC} * CoRE_{Stakeholder\ Satisfaction_{HC}} + LoRE_{LC} * CoRE_{FStakeholder\ Satisfaction_{LC}})]\right\}$$

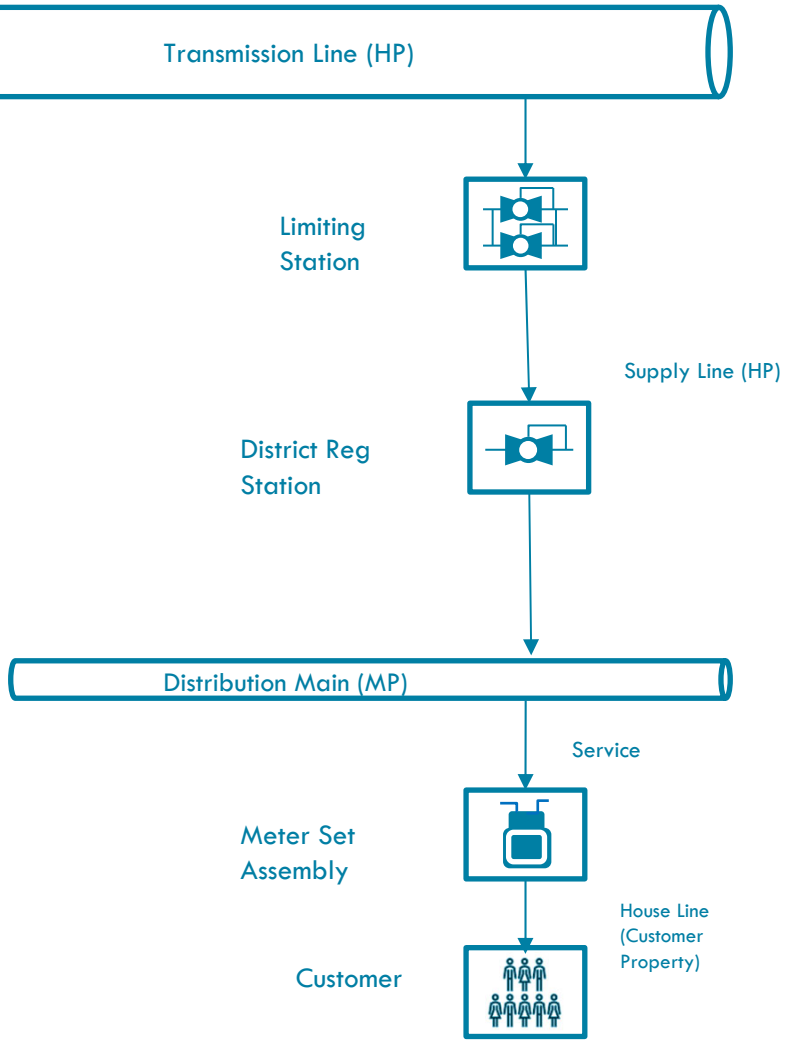
$$Risk\ Score = 545 * \left\{\frac{1}{545}[(2{,}103.71) + (143.93) + (275.15) + (548)]\right\}$$

$$Risk\ Score = 3{,}070.95$$

RSE Walkthrough

SCG-RISK-3-C05: Regulator Station Replacements/Installs

- Regulator Stations are a critical component to the Gas System
- Some stations cut from high-pressure to high pressure, while others cut from high-pressure to medium pressure.
- Failure of a Regulator Station could result in an over pressure or under pressure event
- Replacements/Installations could be as a result of aging infrastructure, load growth, new developments, risk-based prioritization, smart technology enhancements, etc.
- They are control points in the system.



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RSE Walkthrough

SCG-RISK-3-C05: Regulator Station Replacements/Installs

» District Reg Station

» Above Ground Reg Station

» Below Ground Reg Station

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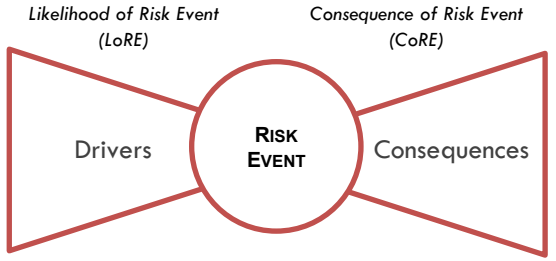
RSE Walkthrough

SCG-RISK-3-C05: Regulator Station Replacements/Installs

- The Risk Spend Efficiency is the overall change in the risk score – your reduction in risk score for the activity you're doing – over the amount of money spent to complete said activity
- The risk score can change by identifying activities that decrease the likelihood and/or consequence of a risk event. For this activity, a reduction in LoRE was determined.

$$RSE = \frac{Risk\ Reduction}{Cost}$$

% Risk Addressed
•
% Mitigation Scope
•
% Effectiveness



O&M and Capital costs throughout the life of the mitigation

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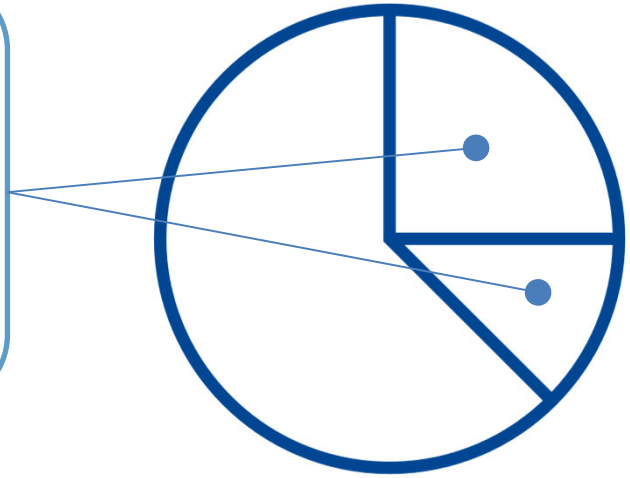
RSE Walkthrough - %%% Method

SCG-RISK-3-C05: Regulator Station Replacements/Installs

Risk Addressed: Percent of overall risk that mitigation addresses
Mitigation Scope: Percent of assets mitigation will affect over its lifetime.
Mitigation Effectiveness: Percent effectiveness of the mitigation
Benefits Lifetime: Length of time the mitigation is expected to provide benefits.
Total Cost: Total ($) cost of the mitigation

Representation of Risk to the Enterprise from MP Incidents



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RSE Walkthrough - %%% Method

SCG-RISK-3-C05: Regulator Station Replacements/Installs

$$RSE = \frac{Risk\ Reduction}{Total\ Cost} * Benefit\ lifetime\ * Readability\ Factor$$

$$RSE = \frac{\frac{Risk\ Score_{Pre-Mitigated} - Risk\ Score_{Post-Mitigated}}{Risk\ Score_{Pre-Mitigated}}}{Total\ Cost} * Benefit\ lifetime\ * Readability\ Factor$$

$$RSE = \frac{\frac{LoRE_{Pre-Mitigated} - LoRE_{Post-Mitigated}}{LoRE_{Pre-Mitigated}} * LoRE_{Pre-Mitigated} * CoRE}{Total\ Cost} * Benefit\ lifetime\ * Readability\ Factor$$

$$RSE = \frac{\%_{risk\ addressed} * \%_{mitigation\ Scope} * \%_{mitigation\ effectiveness} * Risk\ Score_{Pre-mitigated}}{Total\ Cost} * Benefit\ lifetime\ * Readability\ Factor$$

RSE Walkthrough - %%% Method

SCG-RISK-3-C05: Regulator Station Replacements/Installs

Name	Value	Reasoning
% Risk Addressed	4.19%	4.2%. 23 incidents where System Part Involved was district regulator/meter set with causes corrosion, natural force, outside force, equipment failure, incorrect operation. Incidents are tracked by PHMSA serve as the basis for risk addressed. The value provided represents the percentage of incidents described as a fraction of all incidents (549 total). This is based on ten years of national data.
% Mitigation Scope	1.38%	1.4%. 27 reg station installs/replacements over the next 3 years. This is proportional to the 1,963 total reg stations across the system.
% Mitigation Effectiveness	100%	New installation/replacement effectiveness 100% based on SME input
Benefit Lifetime (years)	47/25.02	47 years based on accounting average service life. 25.02 based on 3% discounted risk reduction benefits
Total Cost ($M)	$9,450	Forecasted from 2022 through 2024

RSE Walkthrough - %%% Method

SCG-RISK-3-C05: Regulator Station Replacements/Installs

$$RSE = \frac{\%_{risk\ addressed} * \%_{mitigation\ Scope} * \%_{mitigation\ effectiveness} * Risk\ Score_{Pre-mitigated}}{Total\ Cost} * Benefit\ lifetime_{Discounted}$$

$$RSE = \frac{4.19 * 1.38 * 100 * 3{,}071}{9{,}450{,}000} * 25.02$$

$$RSE = 4.7$$

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Wildfire Involving SDG&E Equipment
OVERVIEW: PART 1

Risk Score Walkthrough – Wildfire

$$\text{Risk Score} = \text{Likelihood of Risk Event (LoRE)} \times \text{Consequence of Risk Event (CoRE)}$$

Risk Score

$$\sum_{i=1}^{n} LoRE_i$$

$$\frac{1}{\sum_{i=1}^{n} LoRE_i} \sum_{j=1}^{4} \sum_{i=1}^{n} LoRE_i CoRE_{ij}$$

Where $i = 1, \ldots, n$ sub-events and j ranges through the four attributes of the MAVF (safety, financial, reliability, and stakeholder satisfaction) and

$CoRE_{ij}$ is the CoRE for the jth attribute of the ith sub-event

For example, $CoRE_{11}$ would correspond to the safety core of the first sub-event.

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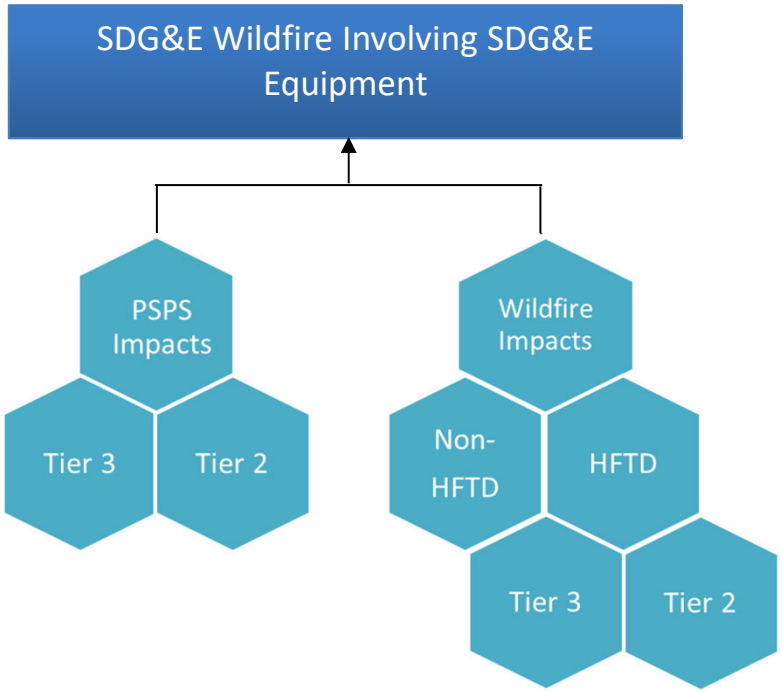
Risk Score Walkthrough – Wildfire



LoRE - Wildfire Impacts

Incident Type	Expected Value	Source
Tier 3	5.13	2015 –2019 ignition data, SME inputs
Tier 2	6.84	2015 –2019 ignition data, SME inputs
Non-HFTD	9.20	2015 –2019 ignition data, SME inputs

LoRE - PSPS Impacts

Incident Type	Expected Value	Source
Tier 3	4.00	Internal reliability data
Tier 2	4.00	Internal reliability data

$$\sum_{i=1}^{n} LoRE_i$$

LoRE - Wildfire Impacts = 5.13+6.84+9.20= 21.17

LoRE - PSPS Impacts = 4

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Risk Score Walkthrough – Wildfire Cont

Example: Wildfire Impacts

$$\frac{1}{\sum_{i=1}^{n} LoRE_i} \sum_{j=1}^{4} \sum_{i=1}^{n} LoRE_i CoRE_{ij}$$

$$= \frac{1}{(LoRE_{T3} + LoRE_{T2} + LoRE_{nonHFTD})} \left[\left(CoRE_{Safety_{T3}} * LoRE_{T3} + CoRE_{Safety_{T2}} * LoRE_{T2} + CoRE_{Safety_{nonHFTD}} * LoRE_{nonHFTD} \right) + \left(CoRE_{Reliability_{T3}} * LoRE_{T3} + CoRE_{Reliability_{T2}} * LoRE_{T2} + CoRE_{Reliability_{nonHFTD}} * LoRE_{nonHFTD} \right) + \left(CoRE_{Financial_{T3}} * LoRE_{T3} + CoRE_{Financial_{T2}} * LoRE_{T2} + CoRE_{Financial_{nonHFTD}} * LoRE_{nonHFTD} \right) + \left(CoRE_{Stakeholder\ Satisfaction_{T3}} * LoRE_{T3} + CoRE_{FStakeholder\ Satisfaction_{T2}} * LoRE_{T2} + CoRE_{FStakeholder\ Satisfaction_{nonHFTD}} * LoRE_{nonHFTD} \right) \right]$$

$$= 10000 * * \frac{1}{(5.13 + 6.84 + 9.20)} \left[\frac{(0.167 * 5.13 + 0.073 * 6.84 + 0.003 * 9.2)}{20} * 0.6 + \frac{(0.0047 * 5.13 + 0.0021 * 6.84 + 0.000 * 9.20)}{1} * 0.23 + \frac{(26.35 * 5.13 + 11.52 * 6.84 + 0.53 * 9.20)}{500} * 0.15 + \frac{(0.564 * 5.13 + 0.564 * 6.84 + 0.113 * 9.20)}{100} * 0.2 \right]$$

$$= 555.89$$

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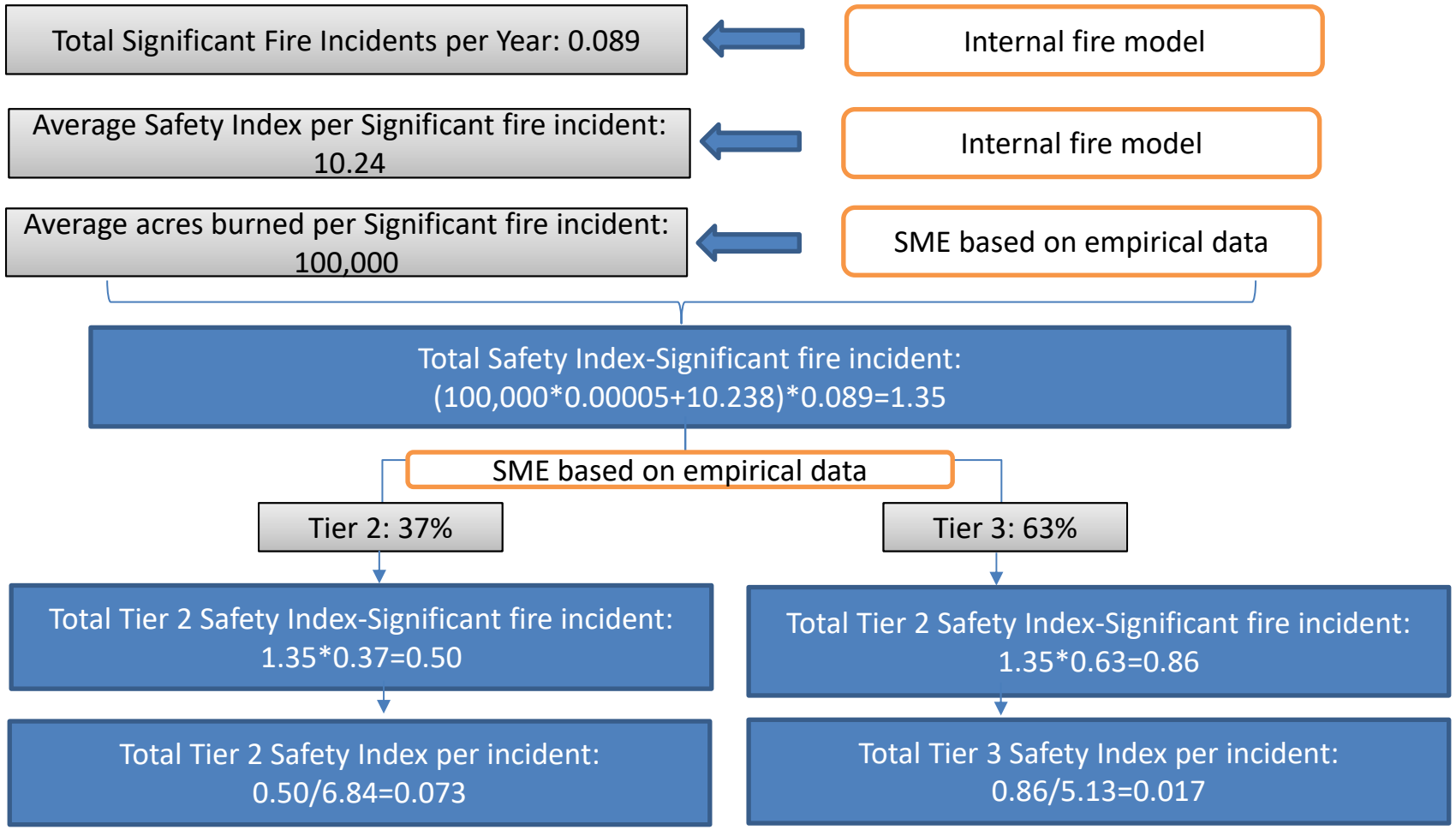
Risk Score Walkthrough – Wildfire Cont'd

Example: Safety CoREs



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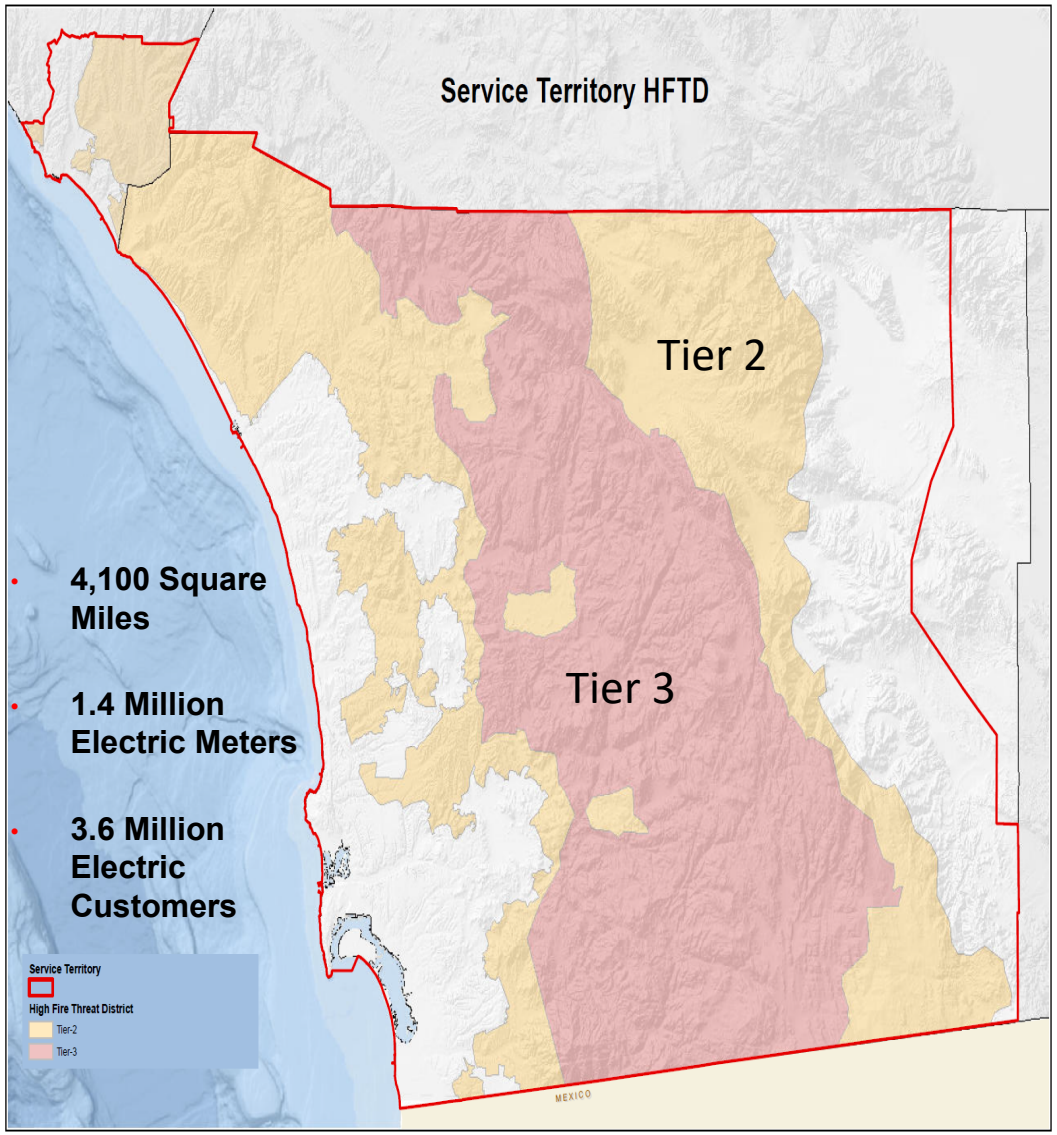
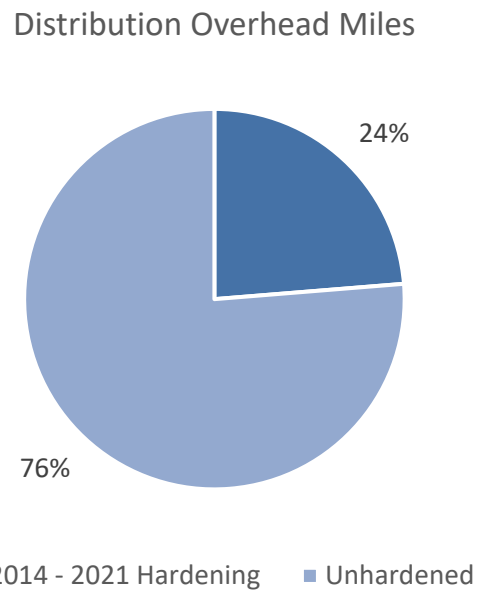
Sarah

Wildfire – Grid Hardening Background



64% Service territory area in HFTD*

3,500 Distribution Overhead miles in HFTD



** HFTD – High Fire Threat District*

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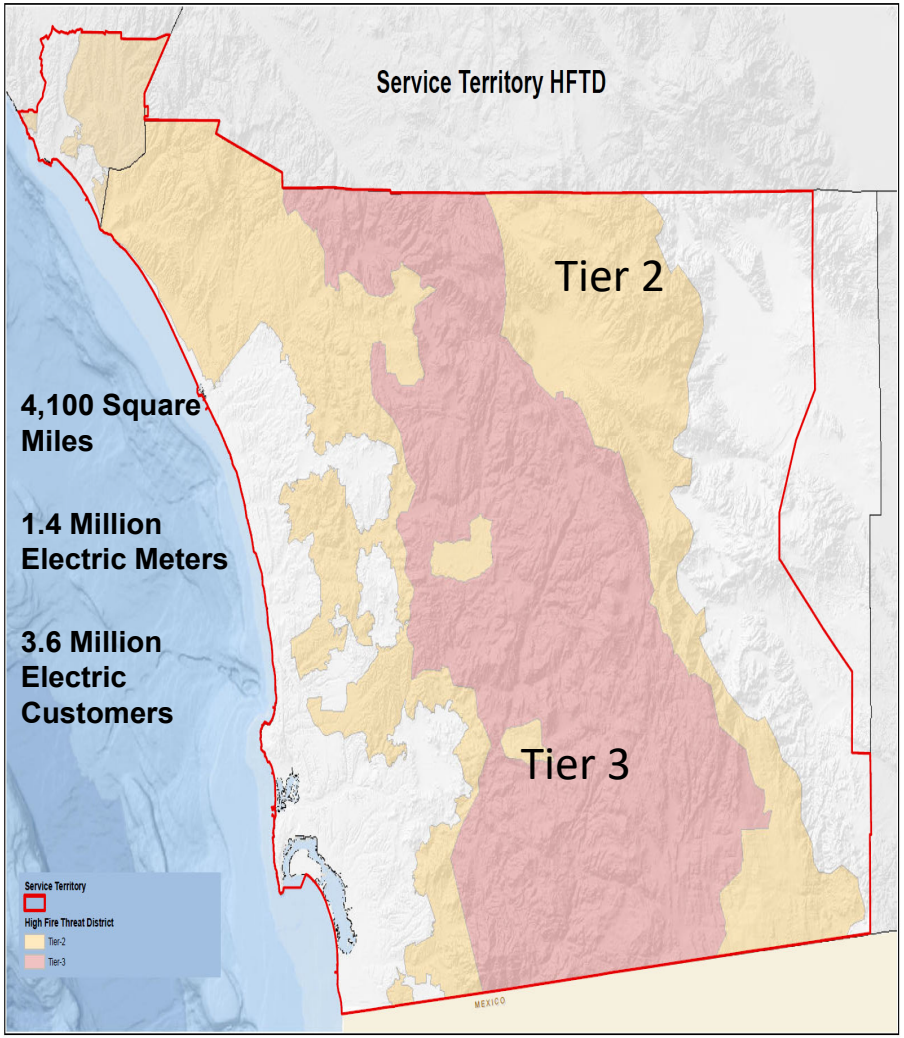
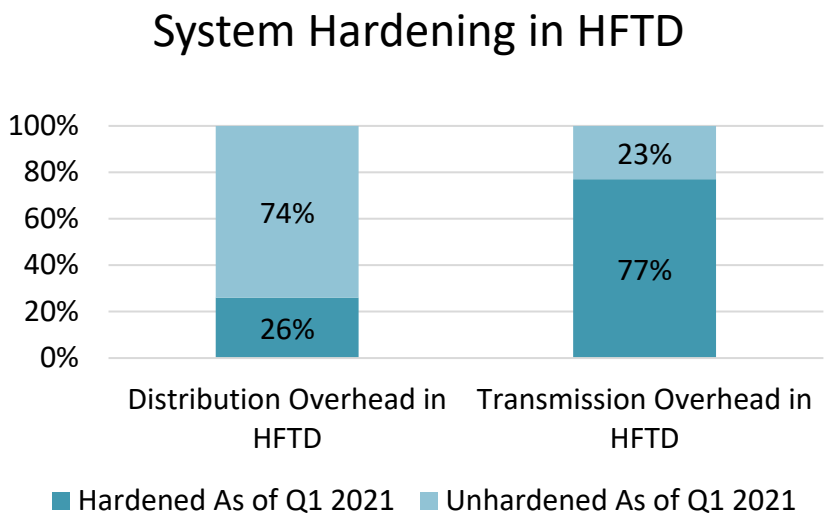
Wildfire – Grid Hardening Background



64% Service territory area in HFTD*

3,500 Distribution Overhead miles in HFTD

1,000 Transmission Overhead miles in HFTD



** HFTD – High Fire Threat District*

Wildfire – Grid Hardening Scope

Grid Hardening Scope Overview

Mitigation	Miles			
	2022	**2023**	**2024**	***Total***
Covered Conductor	60	100	100	**260**
Underground	80	125	150	**355**
Bare Conductor Hardening	5	0	0	**5**
Total	**145**	**225**	**250**	**620**

Analysis

- Prior risk models used for bare conductor hardening
- Targeted mitigation for PSPS reductions
- Updated WiNGS model analysis
- Majority of scope was informed by WiNGS analysis

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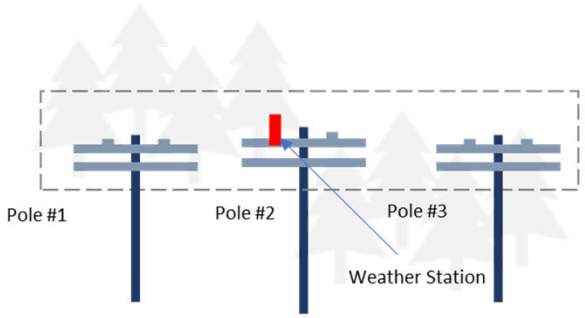
Wildfire – WiNGS Model Overview

Developed WiNGS to assess segment-level risk with the objective of reducing PSPS and wildfire risk

Asset-Level Strategies

- Targeted investments in replacing high risk equipment
- Use of PSPS to further reduce risk during fire season

Wildfire Risk Reduction Model (WRRM)



Segment-Level Strategies*

- Targeted investments based on segment-level risk
- Includes a look at both wildfire risk reduction as well as PSPS risk reduction

Wildfire Next Generation System (WiNGS)

System-Level Strategies

- Annual enterprise risk management process
- Risk Spend Efficiency assessments at the program level (RAMP)

Enterprise Risk Quantification Framework (RQF)

Spectrum of Granularity

*Segments are comprised of multiple spans and structures between two isolation points and are typically thought of in terms of how SDG&E operates PSPS

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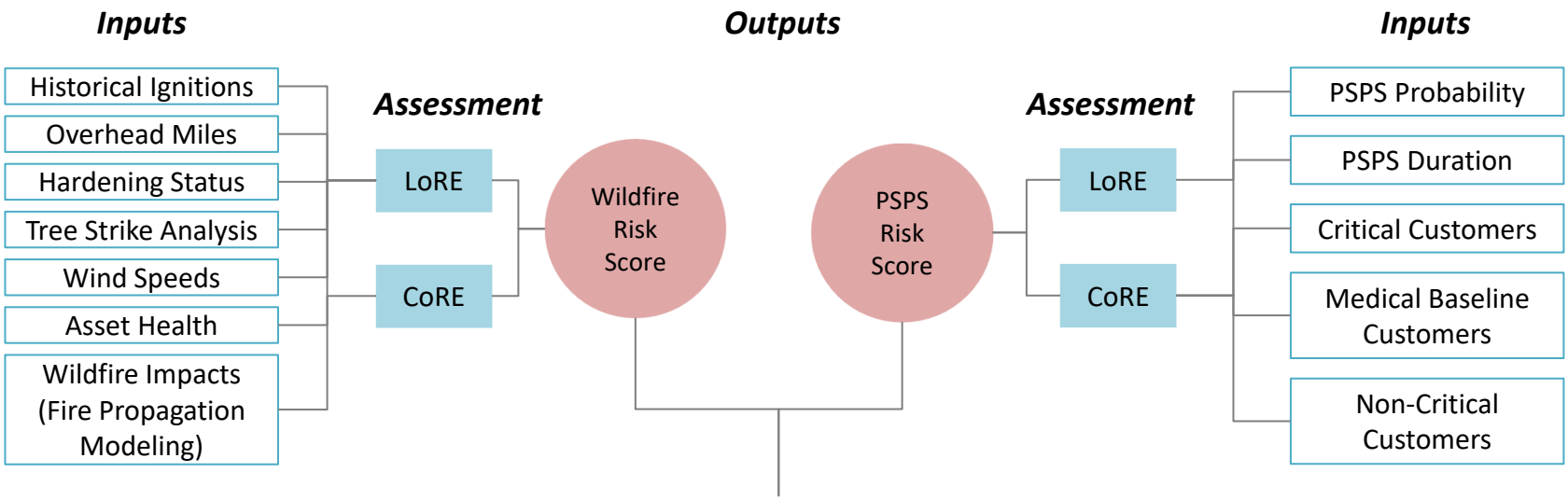
Wildfire – WiNGS Model Overview



Mitigation Alternatives Analysis on >600 Circuit Segments

Illustrative

				Underground			Covered Conductor		
Segment	**WF Risk**	**PSPS Risk**	**Total Risk**	**Risk Reduction**	**Cost**	**RSE**	**Risk Reduction**	**Cost**	**RSE**
Segment 1	15	5	20	18	$15M	55	10	$7M	85
Segment 2	23	15	38	30	$30M	45	15	$12M	60
……	…	…	…	…	…	…	…	…	…
Segment n	10	8	18	16	$10M	60	5	$5M	35

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Wildfire –WiNGS Grid Hardening Scope

Long-Term Objective

Maximize wildfire risk reduction while selecting cost-effective mitigations

Segments Selection and Prioritization

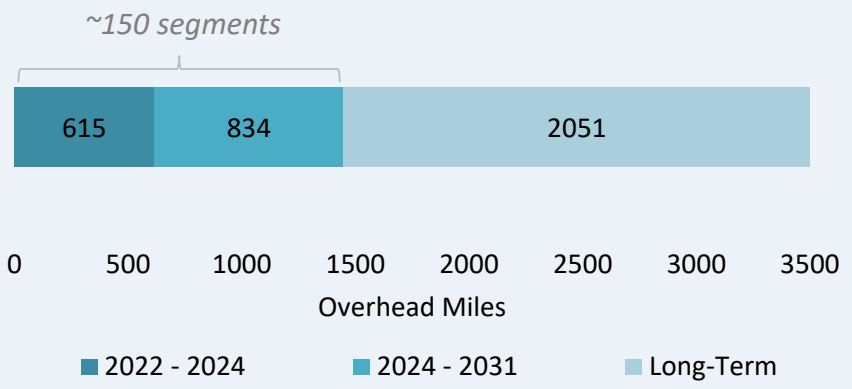
- Evaluate and compare baseline risk across >600 segments
- Evaluate and compare RSE alternatives
- Identify top segments to prioritize grid hardening solutions on

Outcome

- Identified ~150 segments to prioritize grid hardening mitigations on
- Remaining segments to be monitored and re-evaluated for other mitigation needs

Balancing Risk Reduction and Costs

Long Term Overhead Distribution Hardening
Underground and Covered Conductor



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RSE Walkthrough – Wildfire – Grid Hardening

Aggregation of Segment Analysis to Program Numbers for RSE Calculation

Segment	Mitigation
1	CC
2	UG
3	N/A
4	CC
5	N/A
……	…
n	UG

Covered Conductor Scope and Risk Reduction

Underground Scope and Risk Reduction

$$RSE\ per\ \$M = \frac{Risk\ Reduction \times Discounted\ Time}{Total\ Cost\ (\$M)}$$

Segment	Total Miles	Total Risk Reduction	Total Cost ($M)	Life of Project	Discounted Time	RSE
Underground	355	5124.64	1,007.49	40	$\frac{1-\frac{1}{(1+0.03)^{40}}}{0.03}$ = 23.11	=5124.64*23.11/1007.49= 117.57
Covered Conductor	260	522.50	415.26	40	$\frac{1-\frac{1}{(1+0.03)^{40}}}{0.03}$ = 23.11	=522.50*23.11/145.26 =29.08

Wildfire – Grid Hardening Conclusion

Key Takeaways

- The selection of hardening strategies for each segment in the near term affects the long-term potential for risk reduction
- Scoping can change mitigations as feasibility analysis and other field considerations are taken into account
- Achieving PSPS reductions can vary depending on future weather conditions

Opportunities for Improvement

- PSPS analysis is at the early stages and will continue to evolve to consider different types of customers and further tailor assumptions to each segment
- Cost of mitigations does not currently take into account life cycle costs and benefits of avoided costs as a result of grid hardening
- Costs of mitigating segments can be further tailored to each segment's characteristics
- Effectiveness assumptions for covered conductor can be refined as more data from field implementation is gathered
- Continuous improvement of data inputs and the implementation of machine learning models will further enhance WiNGS assessments

BREAK

WILDFIRE OVERVIEW: PART 2

Distribution Overhead Hardening Efficacy

Background Information

- SDG&E's FiRM (Fire Risk Mitigation) program was established in 2013 as an overhead distribution fire-hardening initiative
- Goal is to replace small conductor known to have higher failure rates with high-strength conductor, replace wood poles with steel poles, and design for known local weather conditions
- FiRM program has hardened over 400 miles of overhead distribution, and is now simply referred to as our Traditional or Bare Conductor Overhead Distribution Hardening.

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Distribution Overhead Hardening Efficacy

Scope

- Analyze the last 20 years of reliability data and hardening information across 214 overhead distribution hardening projects

Goal

- Quantify the effectiveness of overhead system hardening for both faults (risk events) and ignitions

Data Cleanup and Parameters

- Only include overhead distribution reliability data
- Filtered project information to only include when both reconductor and steel pole installation completed
- Compare unhardened and hardened data to fault history

Distribution Overhead Hardening Efficacy

Results – Reduction by Cause

Primary Cause	Unhardened	Hardened	Unhardened fault rate	Hardened fault rate	Rate Change
EQUIPMENT FAILURE	106	10	2.64	1.89	28.3%
FOREIGN OBJECT IN LINE	83	7	2.07	1.32	35.9%
SDG&E/CONTRACTOR CONTACT	12	1	0.30	0.19	36.7%
THIRD PARTY CONTACT (Non-SDG&E)	64	3	1.57	0.57	63.8%
UNKNOWN	5	1	0.12	0.19	-51.9%
WEATHER RELATED	102	4	2.54	0.76	70.2%
ALL TYPES	**372**	**26**	**9.24**	**4.92**	**46.8%**

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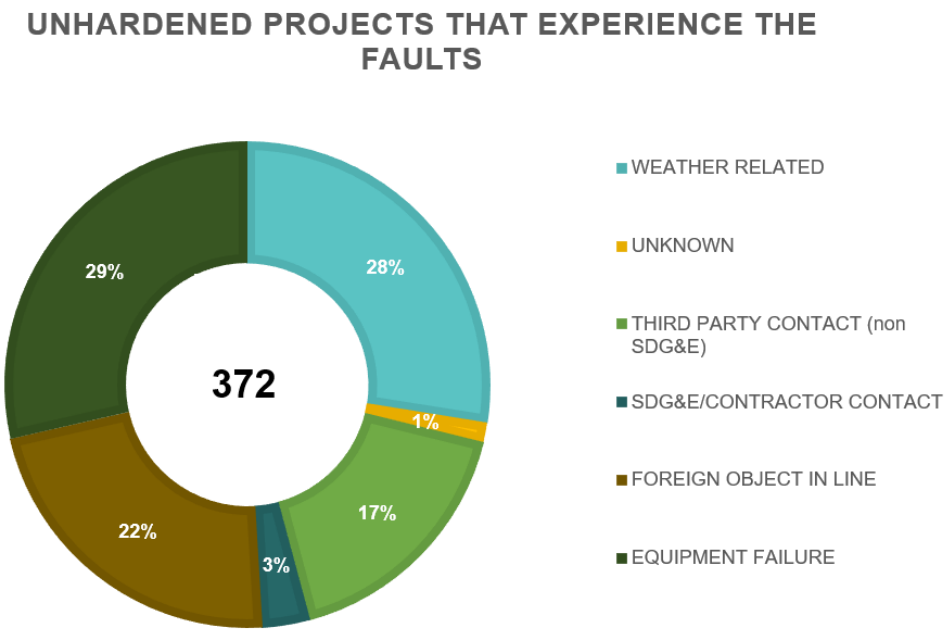
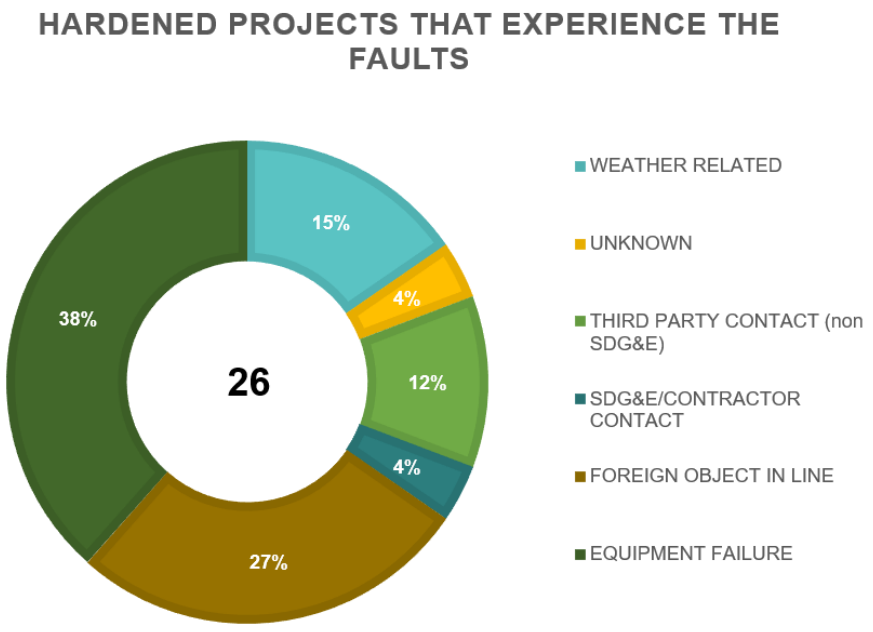
Distribution Overhead Hardening Efficacy

Results – Before and After Hardening





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Distribution Overhead Hardening Efficacy

Results

Before Hardening			After Hardening			
Avg Faults	Avg years	Fault Rate*	Avg Faults	Avg years	Fault Rate*	Reduction in Fault Rate
1.73	17.68	**9.24**	0.12	2.33	**4.92**	**46.8%**

Fault rate is normalized utilizing:

- Average span length of 228 ft. (SDG&E HFTD GIS Data)
- 2,316 poles per 100 circuit miles

Calculation:

- Avg. Faults / Avg. Years / Avg. # Poles * 2,316 poles per 100 miles)

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Jonathan/Shaun

Distribution Overhead Hardening Efficacy

Statistical Significance

Null Hypothesis: Reduction in fault rate after hardening is not statistically significant
Alternate Hypothesis: Reduction in fault rate after hardening is not statistically significant

Conclusion:

1. At 0.05 significance level, we reject the null hypothesis so the reduction in faults after hardening is statistically significant.
2. At 95% confidence interval , we see a reduction in the fault rate after hardening.

Results of Z-test: Using a table of standard normal values with a *z*-value of $z_0 = 2.53833$ we find that the probability value is 0.00557.

.

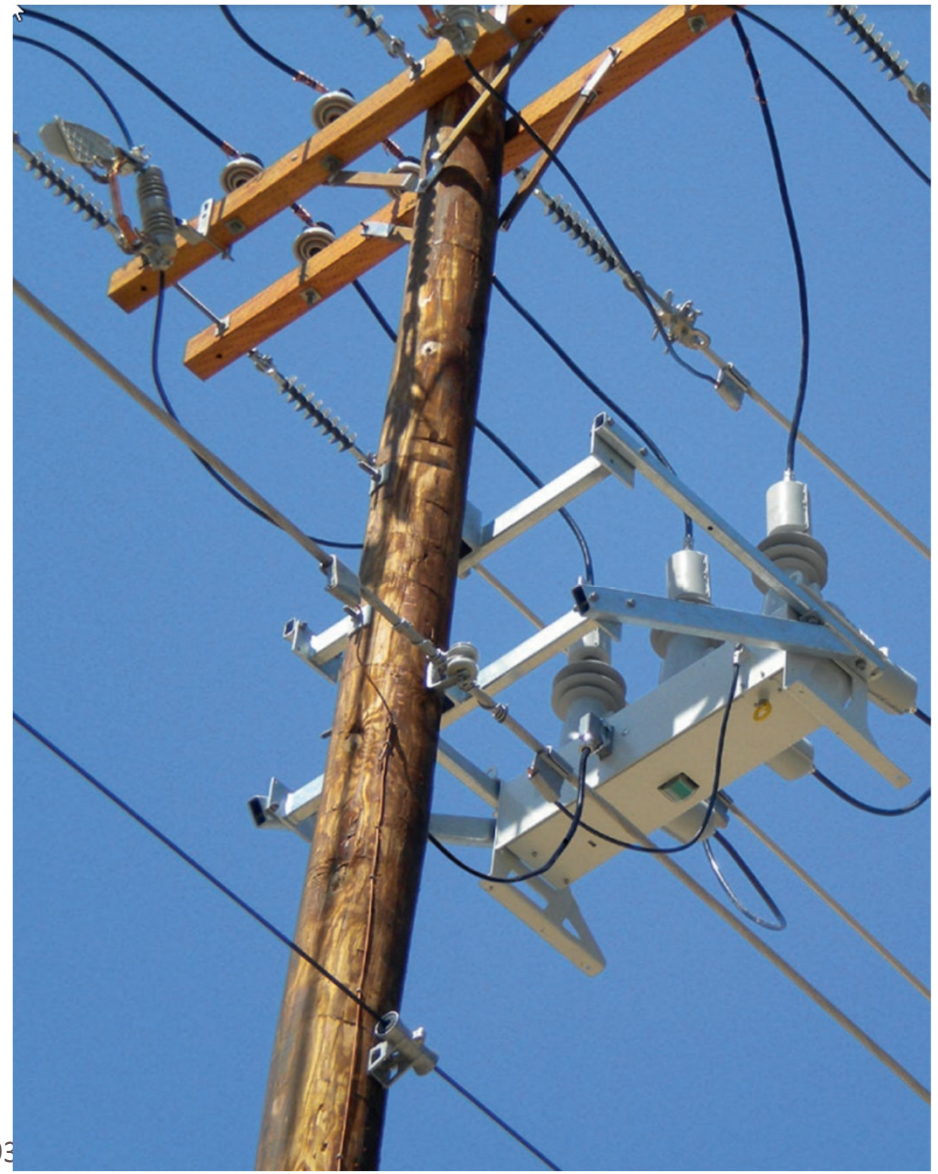
$z = (p - P) / \sigma$

Z calculated =Numerator/ Denominator = -3.98822/1.5712 = 2.53833
Comparing P-value with the level of significance, we can see that: P-value = 0.00557 $< \alpha = 0.05$
therefore the results are significant

Recloser Sensitive Setting Efficacy

Background Information

- Recloser is a device on the distribution system designed to detect and isolate faults
- Sensitive relay settings (Profile 3) are applied to improve the detection of faults, and the speed at which faults are cleared
  - Reduces the energy of the fault, reducing heat generation, reducing ignitions
- When fire risk is present (Extreme FPI and/or Red Flag Warning) sensitive settings are applied to reclosers within the impacted area
  - These settings are not optimal for reliability, and are used for public safety and wildfire risk reduction



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Recloser Sensitive Setting Efficacy

Results

- Analyze the last 5 years of reliability, ignition, and Profile 3 status data

Goal

- Quantify the effectiveness of sensitive settings at reducing ignitions

Data Cleanup and Parameters

- Only include overhead distribution data
- Eliminate data when enable/disable status of Profile 3 was missing. Eliminated 2% of the records.
- Compare the location of devices with Profile 3 enabled to reliability/ignition data

Recloser Sensitive Setting Efficacy

Profile 3 Analysis

From our data model, we analyzed the occurrence of faults and ignitions downstream of Profile 3 enabled devices to determine the total faults/ignitions

Total Faults:	**62**
Faults isolated by fuses	**22**
Faults isolated by profile 3 enabled devices	**40**
Total Ignitions* :	**0**
%Ignition	**0.00%**

System Analysis

Then we analyzed the occurrence of all other distribution system faults and ignitions to determine the total faults/ignitions

Total Faults:	**6124**
Total Ignitions:	**146**
% Ignition:	**2.38%**

Change in ignition rate

Comparing the profile 3 and system-wide fault to ignition rates we calculated the decrease in ignition rate from enabling Profile 3 settings

% Decrease in ignition	**100.00%**

*Note: There were two secondary ignitions downstream of profile 3 enabled devices indicating this may not be an effective mitigation for that application.

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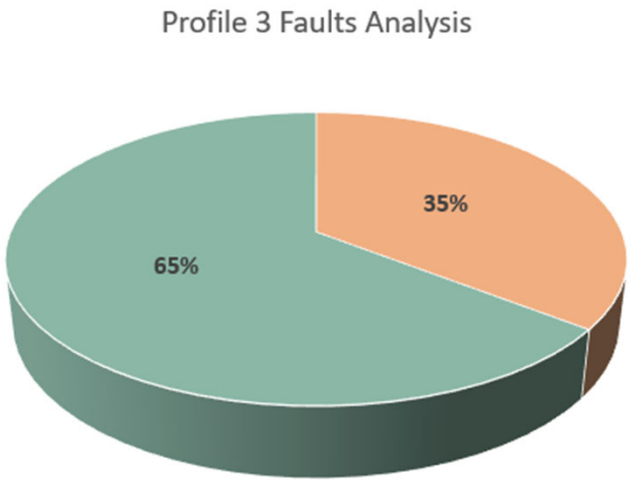
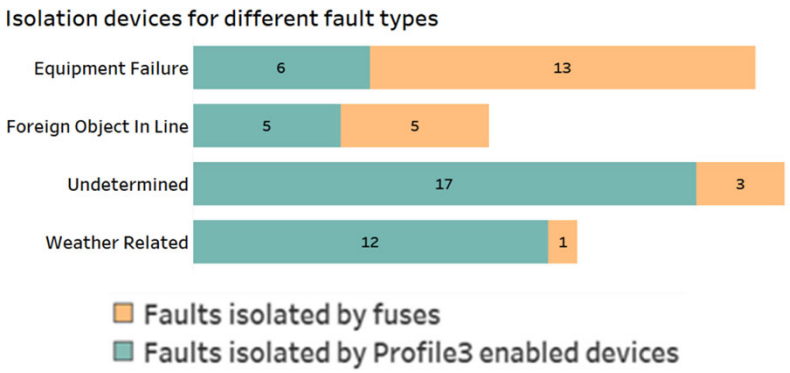
Recloser Sensitive Setting Efficacy

Conclusions

- Based on data from the last five years, Profile 3 settings are effective at reducing the fault to ignition rate
- Between 2015-2019, we experienced zero ignitions caused by primary faults downstream of profile 3 enabled devices
- In addition, 65% of faults downstream of profile 3 enabled devices were isolated by those devices
- Due to the size of the datasets analyzed, these findings are not statistically significant. However, this mitigation is still promising considering there were zero primary ignitions while enabled





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CLOSING REMARKS AND NEXT STEPS