Joint Utilities' Approach (JUA) to Risk Assessment

JUA Multi-Attribute Workshop – November 6-7, 2017

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

Objectives

There are two high-level questions driving the S-MAP discussions:

1. How can we identify and analyze the most important safety risks and mitigations at a common, statewide level?
2. How can we direct resources toward those risks in the most effective, efficient, and transparent means possible?

The JUA is a comprehensive risk management framework that:

- Identifies and assesses risks;
- Analyzes the effectiveness and efficiency of ways to reduce risks; and
- Incorporates quantitative risk assessments into decision-making.

Characteristics of the JUA

- Allows safety to be reviewed individually and compared across risks and entities as well as incorporated from a multi-attribute perspective
- Identifies risks for RAMP
- Provides meaningful risk scores and evaluation of risks
  - Is probabilistic/quantitative
  - Lends itself to further analysis (e.g., safety comparators, RSE, ALARP, optimization)
  - Can inform decision-making
- Allows the different levels of modeling sophistication to be used per risk
- Does not require a one-size-fits-all modeling

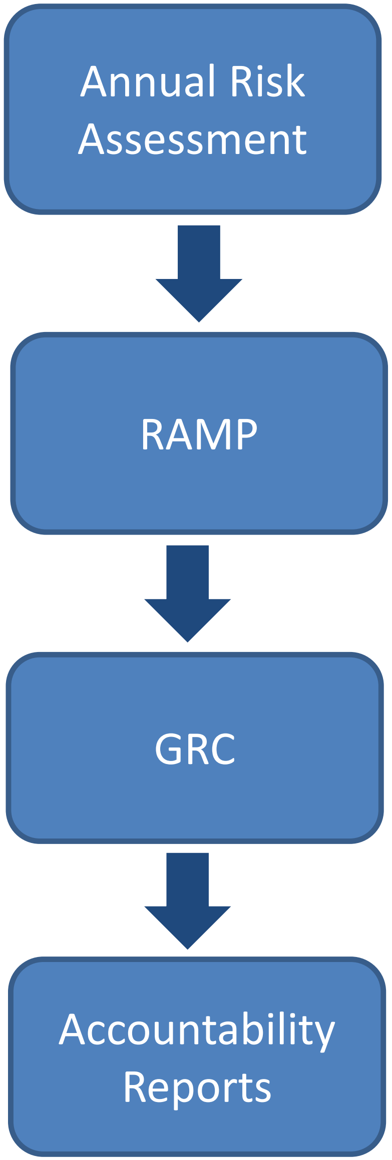
JUA Overview

JUA

- Scores based on probabilistic models
- Analysis produces scores for:
    - Safety
    - Other attributes - risk as a whole

- Risks for RAMP determined based on safety score and Commission input
- Granular data (e.g., segment or circuit level) is used, where appropriate, to evaluate mitigations using multi-attribute
- RSEs for mitigations & alternatives that can be compared across risks

- Safety focus of spending proposal considers RSE



CURRENT

- SMEs provide attribute scores based on 7x7 matrix

- RAMP threshold (e.g. safety attribute score of 4+)
- RSE concept and application needs to be further developed

- RAMP mitigations and stakeholder feedback are qualitatively integrated

Application of the JUA Methodology

Identify and Analyze Top Safety Risks → Evaluate Mitigations & Alternatives → Discussion: Mitigations, Risk Tolerance, Leading Practices → Input to Resource Decisions

Step 1
Utilities identify and categorize risks

Step 2
Utilities perform JUA Safety Attribute assessment to identify top safety risks and calculate safety comparators

Step 3
Utilities perform JUA Multi-Attribute evaluation of proposed mitigations and alternatives for the top safety risks

Step 4
Calculate Multi-Attribute Risk Spend Efficiency (RSE)

Various Decision-Making and GRC Process

- Asset Management Tools/Standards (ISO 55000/API 1173)
- PRISM (SCE)
- STAR (PG&E)
- WRRM (SDG&E)
- Hydro RIDM (FERC)
- Etc.

Cycla Evaluation Model

Step 1
Identify Threats

Step 2
Characterize Sources of Risk

Step 3
Identify Candidate Risk Control Measures (RCMs)

Step 4
Evaluate the Anticipated Risk Reduction for Identified RCMs

Step 5
Determine Resource Requirements for Identified RCMs

Step 6
Select RCMs Considering Resource Requirements and Anticipated Risk Reduction

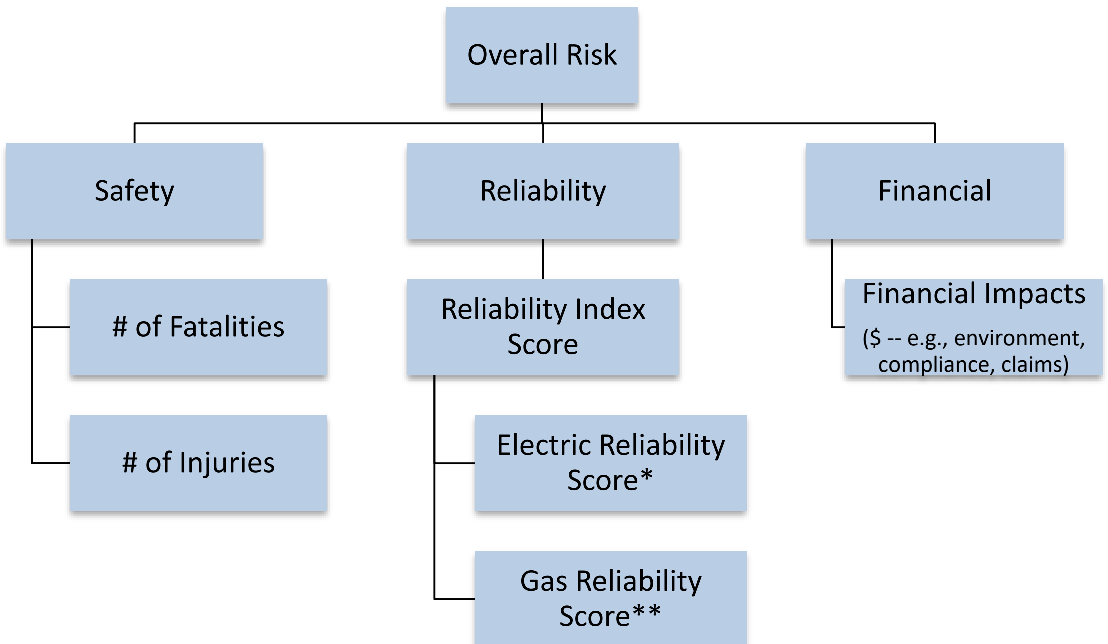
Step 7
Determine Total Resource Requirements for Selected RCMs

Step 8
Adjust the Set of RCMs to be Presented in GRC Considering Resource Constraints

Step 9
Adjust RCMs for Implementation following CPUC Decision on Allowed Resources

Step 10
Monitor the Effectiveness of RCMs

JUA: Multi-Attribute Test Drive Overview



- The **safety impact** of a risk event includes fatalities and injuries of the public, employees and contractors.
- The **reliability attribute** top measurement is the reliability index which is a composite of the gas reliability index and electric reliability index.
- The **financial impact** of a risk event may includes economic costs to the public, including recoverable costs for the utility.

* **Electric Reliability Score** is composed of SAIDI and SAIFI
** **Gas Reliability Score** is composed of Customers Affected and Customer Minutes

JUA: Multi-Attribute Illustration

- The attribute framework allows for utility-specific weights, sub-attributes, and top-end range boundaries.
- The natural units of each attribute are turned into risk units with the following process:
  - attribute natural unit value ÷ attribute top-end range value * attribute weight
- For example, assume a financial impact is identified as having financial EV of $2B:
  - $2B ÷ $5B = 0.4
  - 0.4 * 25% = 0.1
  - 0.1 + other attribute scores = total multi-attribute risk score

Multi-Attribute Methodology

Attribute	Unit	Top End (Scaler)	Weighting
Safety	SU	10	50%
Reliability	RU	1	25%
Financial	$	$5 Billion	25%

Reliability Unit Breakdown

Gas/Electric	Unit	Top End (Scaler)	Weighting
Gas	# of Customers	1.5 Million	50%
Electric	SAIDI Index	1,000	25%
Electric	SAIFI Index	5	25%

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JUA: Multi-Attribute Illustration

Risk XYZ, with 1 mitigation, with cost of $20 million

Attribute	EV (Current)	EV (Post-Mitigation)	Weighting	Top-End (Scaler)
Safety	1	0.8	50%	10
Reliability	0.115	0.08	25%	1
Financial	$40M	$20M	25%	$5 B

Reliability Sub-Attribute	EV (Current)	EV (Post-Mitigation)	Weighting	Top-End (Scaler)
Gas (# of customers)	0	0	50%	1.5 Million
Electric (SAIDI)	300	200	25%	1,000
Electric (SAIFI)	0.8	0.6	25%	5

Reliability Unit

Current: (0) * 50% + (300/1000) * 25% + (0.8/5) * 25% = ***0.115***

Post-Mitigation: (0) * 50% + (200/1000) * 25% + (0.6/5) * 25% = ***0.080***

Risk Score

Current: (1/10) * 50% + (0.115/1) * 25% + (40/5000) * 25% = ***0.08***

Post-Mitigation: (0.8/10) * 50% + (0.08/1) * 25% + (20/5000) * 25% = ***0.06***

RSE

(0.08 – 0.06) / $20M = ***0.1 per $100M***

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How Does the JUA Work?

- Quantifies, for each attribute, the likelihood of different consequences occurring for a given risk event.
  - What is the likelihood that a dig-in will occur that injures 5 people?
  - What is the likelihood that a dig-in will occur that will have a financial impact of $1 million?

Illustrative JUA Assessment Example

Risk Name	Catastrophic (10+)	Extreme (3-10)	High (1-3)	Moderate (0.1-1)	Low (0.0-0.1)	EV
Employee Safety	0.0006	0.0181	0.1500	0.7425	0.0888	0.68
Catastrophic Damage Involving Third-Party Dig-Ins	0.0000	0.0003	0.0037	0.0514	0.9426	**0.09**

Values in box represent likelihood that each consequence will occur.

For example, there is a 15% likelihood that 1-3 Safety Units will occur in a given year, for the Employee Safety risk.

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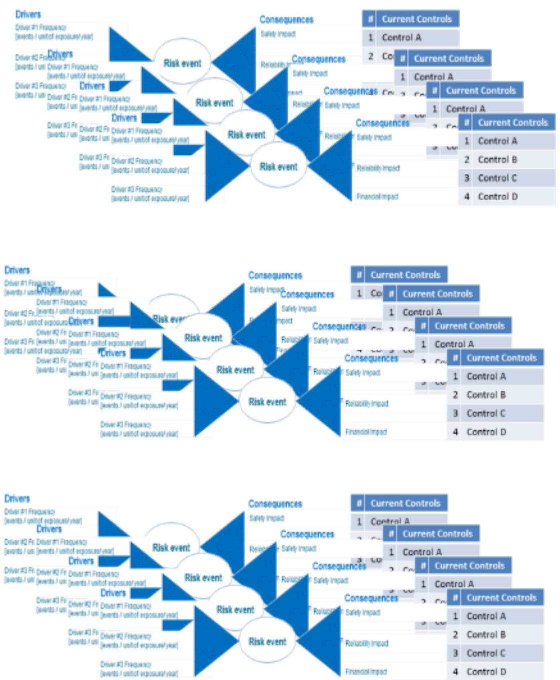
JUA RAMP Process



Baseline Risk Score (illustrative)

Risk Event	Fatality	Injury	SAIDI	SAIFI	Customer Minutes	Financial	Safety Unit*	Multi-Attribute Score**
Risk Event A	#	#	#	#	#	#	4	10
Risk Event B	#	#	#	#	#	#	2	9
Risk Event C	#	#	#	#	#	#	3	8
Risk Event D	#	#	#	#	#	#	1	7
Risk Event E	#	#	#	#	#	#	1	6
Risk Event F	#	#	#	#	#	#	0.5	6
Risk Event G	#	#	#	#	#	#	0.5	5
Risk Event H	#	#	#	#	#	#	0.3	1
Risk Event I	#	#	#	#	#	#	0.3	1
Risk Event J	#	#	#	#	#	#	0.3	1
Risk Event K	#	#	#	#	#	#	0.03	1
Risk Event L	#	#	#	#	#	#	0.03	0.1

Top Safety Risks for RAMP[1]

[1]As well as other risks from CPUC/ SED/Executives

Illustrative threshold

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Improvement Over Current Risk Methodology

Area of Improvement	Existing Risk Practices	JUA
Basis of Risk Assessment/ Score	Single point scenario (e.g. P95)	Complete probability distribution that considers various scenarios for a risk
Baseline Risk Assessment	Largely subject matter expert driven	More quantitative, providing a more-informed determination about which risks to focus on in the RAMP
Mitigation Effectiveness and Efficiency	Largely subject matter expert driven	More accurate given that it leverages the baseline assessment
Usefulness of Risk Assessment/Score	Relies on score from 7x7 matrix (i.e., 4 for reliability), internally understood	Risk scores can be understood internally and externally (i.e., CPUC, intervenors) alike
Attributes & Measurement	Attributes differ among the utilities, definitions in 7x7 matrix are similar	Standardized attributes while allowing for additional attributes (if needed) to represent each utility's uniqueness, attributes measured consistently

Validating Using the S-MAP Success Criteria

Success Criteria	JUA Meets Criteria?	How Does the JUA MAUT Satisfy This Goal
Risk Focused	✓	The starting point for JUA is risk identification and analysis, which provides an understanding of the magnitude of the top risks (safety and otherwise) for the utility.
Safety Focused	✓	The JUA would like to use the safety attribute to identify the top safety risks for the Risk Assessment Mitigation Phase (RAMP). The JUA analyzes risk mitigations in a multi-attribute context of safety, along with other risk impacts, e.g. financial and reliability impacts.
Probabilistic	✓	The JUA allows risks to be quantified as a distribution of probability and impact.
Simple / Clear / Transparent	✓	The JUA is based on simple and intuitive concepts that can be understood and evaluated by experts and non-experts alike.
Uniform	✓	The JUA was developed by the four large California utilities to measure top safety risks and mitigations in a consistent fashion.
Comparable	✓	The JUA Risk Spend Efficiency scores are a significant first step that provides insight into cross-utility comparability.
Cost-effective modeling	✓	The JUA does not require substantial effort to implement across all four large California utilities, and allows the utilities to grow and innovate their respective approaches to risk management.
Accurate	✓	The JUA provides risk and mitigation analysis that can provide meaningful input into decision making, alternative analysis, and General Rate Case (GRC) resource requests.

Example of RAMP Using JUA

Outline

- Selecting Risks for RAMP
- RAMP
  - Comprehensive discussion of risk
  - Numerical representations
  - Recommendations

  - Overview and Detail View
    - Overview methodology, give illustrative example for each step (indicated with blue type)

Overview – Selecting Risks for RAMP

- Perform JUA safety assessment for each risk
- Risks above certain threshold to go to RAMP
  - Many techniques available when JUA safety assessment data present
- Additional risks at CPUC discretion to be included
  - Climate Change
  - Gas Storage

Detail View – Selecting Risks for RAMP

Risk Name	Catastrophic (10+)	Extreme (3-10)	High (1-3)	Moderate (0.1-1)	Low (0.0-0.1)	EV
Wildfires Caused by SDG&E Equipment (including Third Party Pole Attachments)	0.0050	0.1500	0.4922	0.3525	0.0003	1.88
Employee Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0006	0.0181	0.1500	0.7425	0.0888	0.68
Electric Infrastructure Integrity	0.0000	0.0167	0.0840	0.1985	0.7008	0.30
Inadequate Knowledge Transfer	0.0006	0.0031	0.0130	0.1479	0.8354	0.10
Catastrophic Damage Involving Third Party Dig-Ins	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Customer Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Contractor Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Physical Security of Critical Electric Infrastructure	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Climate Change Adaptation	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Catastrophic Damage Involving a Medium Pressure Gas Pipeline Failure	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Unmanned Aircraft System (UAS) Incident	0.0000	0.0003	0.0023	0.0500	0.9474	0.08
Distributed Energy Resources (DERs)	0.0000	0.0006	0.0044	0.1520	0.8430	0.07
Aviation Incident	0.0000	0.0006	0.0044	0.1520	0.8430	0.07
Catastrophic Damage Related to Inadequacy of Operational Asset Records (previously combined as Records Management risk in 2015)	0.0000	0.0006	0.0044	0.1520	0.8430	0.07
Electric Grid Failure and Restoration (Blackout/Failure to Black Start)	0.0000	0.0006	0.0044	0.1520	0.8430	0.07
Catastrophic Damage Involving a High Pressure Gas Pipeline Failure	0.0000	0.0001	0.0009	0.0075	0.9915	0.04
Insufficient Supply to the Natural Gas Transmission System	0.0000	0.0000	0.0000	0.0026	0.9974	0.03
Workplace Violence	0.0000	0.0000	0.0149	0.0000	0.9851	0.03
Management of Emergency Spares for Major Electric Equipment	0.0000	0.0000	0.0000	0.0192	0.9808	0.02
Violation of Environmental Policies/Procedures	0.0000	0.0000	0.0000	0.0192	0.9808	0.02
IT System Compliance	0.0000	0.0000	0.0000	0.0030	0.9970	0.01
Insurance Coverage Issue	0.0000	0.0000	0.0000	0.0030	0.9970	0.01
PSEP Execution and Reasonableness Review Outcome	0.0000	0.0000	0.0000	0.0030	0.9970	0.01
Negative Customer Impacts Caused by Outdated Systems (new risk for 2016)	0.0000	0.0000	0.0000	0.0001	0.9999	0.01
Customer Privacy	0.0000	0.0000	0.0000	0.0001	0.9999	0.01
Regulatory Compliance	0.0000	0.0000	0.0000	0.0001	0.9999	0.01
Departing Load including Direct Access (DA) and Community Choice Aggregation (CCA)	0.0000	0.0000	0.0000	0.0001	0.9999	0.01
Flawed Electric Rate Design	0.0000	0.0000	0.0000	0.0006	0.9994	0.01
Capacity Restrictions or Disruptions to the Natural Gas Transmission System	0.0000	0.0000	0.0000	0.0000	1.0000	0.01
Massive Smart Meter Outage	0.0000	0.0000	0.0000	0.0000	1.0000	0.01
Cyber Security	0.0000	0.0000	0.0000	0.0000	1.0000	0.01
Major Project Delays (e.g. CNF, SOCRE, PSRP)	0.0000	0.0000	0.0000	0.0000	1.0000	0.01
IT Critical Infrastructure Risk (Natural Disasters)	0.0000	0.0000	0.0000	0.0000	1.0000	0.01
Gas Pipeline Safety Regulatory Compliance	0.0000	0.0000	0.0000	0.0000	1.0000	0
Untimely and Unfavorable Regulatory Decisions	0.0000	0.0000	0.0000	0.0000	1.0000	0
Access to Capital Markets	0.0000	0.0000	0.0000	0.0000	1.0000	0

Quantification of all risks

- SDG&E and SoCalGas will model all risks with stochastic approaches
- Can present outputs in various forms
  - JUA safety assessment buckets are an approach

Don't attempt to read numbers. We are not responsible for blurred vision.

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Detail View – Selecting Risks for RAMP

JUA safety assessment primer

Risk Name	Catastrophic (10+)	Extreme (3-10)	High (1-3)	Moderate (0.1-1)	Low (0.0-0.1)	EV
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Values in box represent likelihood that each consequence will occur.

For example, there is a 15% likelihood that 1-3 Safety Units will occur in a given year, for the Employee Safety risk

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Detail View – Selecting Risks for RAMP

	0.01	0.02	0.05			0.100	
Risk Name	**Catastrophic (10+)**	**Extreme (3-10)**	**High (1-3)**	**Moderate (0.1-1)**	**Low (0.0-0.1)**	**EV**	**RAMP ?**
Wildfires Caused by SDG&E Equipment (including Third Party Pole Attachments)	0.0050	**0.1500**	**0.4922**	0.3525	0.0003	**1.88**	**Y**
Employee Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0006	0.0181	**0.1500**	0.7425	0.0888	**0.68**	**Y**
Electric Infrastructure Integrity	0.0000	0.0167	**0.0840**	0.1985	0.7008	**0.30**	**Y**
Inadequate Knowledge Transfer	0.0006	0.0031	0.0130	0.1479	0.8354	**0.10**	**Y**
Catastrophic Damage Involving Third Party Dig-Ins	0.0000	0.0003	0.0037	0.0514	0.9426	**0.09**	**Y**
Customer Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	
Contractor Safety (previously combined as Employee, Contractor & Public Safety risk in 2015)	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	
Physical Security of Critical Electric Infrastructure	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	
Climate Change Adaptation	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	**SED**
Catastrophic Damage Involving a Medium Pressure Gas Pipeline Failure	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	
Unmanned Aircraft System (UAS) Incident	0.0000	0.0003	0.0023	0.0500	0.9474	0.08	
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Catastrophic Damage Involving a High Pressure Gas Pipeline Failure	0.0000	0.0001	0.0009	0.0075	0.9915	0.04	**Y**
Insufficient Supply to the Natural Gas Transmission System	0.0000	0.0000	0.0000	0.0026	0.9974	0.03	

Potential Thresholds. Above which the Risk would be included into RAMP

Based on feedback, can adjust method of identification, or level of thresholds.

Thresholds need not be identical across all utilities.

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Overview – RAMP Discussion

- RAMP
  - Discussions for each risk:
    - Current programs / mitigations in place
    - Quantitatively describe risk
      - Bow-tie; drivers, consequences
      - Multi-Attribute scoring
    - Constraints
    - Interactions with other risks
    - Goals
    - Possible mitigations
      - Safety – Effectiveness
      - Multi-Attribute – Efficiency
  - Propose mitigations

Detail view – RAMP (Electric Infrastructure)

- Discussion of current efforts
  - Standards in place
    - Backcountry Design Guide (Construction standards in SDG&E's Fire Threat Zone (FTZ))
    - CPUC rules and General Orders
    - Wind loading (known local conditions)
  - Practices in place
    - Reliability reports and analysis
    - High SAIDI outage analysis
    - Reliability Director's Council
    - Fire Director's Steering Committee
    - Substation Reliability team with CBM
    - WRRM modeling
    - Wires down analysis
    - LiDAR

Detail view – RAMP (Electric Infrastructure)

- Quantitatively Describe Risk
  - JUA safety assessment output

Risk Name	Catastrophic (10+)	Extreme (3-10)	High (1-3)	Moderate (0.1-1)	Low (0.0-0.1)	EV
Electric Infrastructure Integrity	0.0000	0.0167	0.0840	0.1985	0.7008	0.30

  - Historical Events
  - Bow-tie
    - Drivers
      - Aging infrastructure
      - Over-utilized equipment (above capacity)
      - Equipment failure
      - System Protection issues
    - Consequences
      - Serious injury or fatality
      - Environmental impacts
      - Reliability
      - Customer Satisfaction

In future RAMP, all modeling will be stochastic, incorporating as much actual data as possible.

Modeling techniques will be described in detail in RAMP.

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Detail view – RAMP (Electric Infrastructure)

- Quantitatively Describe Risk
  - Demonstrate baseline MAUT scores
    - Electric Infrastructure EV
      - Safety: 0.3
      - Reliability: SAIDI 20 minutes, SAIFI 0.3 outages, no gas concerns
      - Finance: $80M
    - Electricity Infrastructure score
      - Reliability Unit = (0) * 50% + (20/1000) * 25% + (0.3/5) * 25% = 0.02
      - Overall Risk EV: (0.3/10) * 50% + (0.02/1) * 25% + ($80/$5000) * 25% = 0.024
        - » Risk Score: **24,000**
          - Risk Score = Risk EV * 1,000,000.

Overview - RAMP

- Constraints
  - Discuss things that can slowdown or prevent implementation of mitigating efforts
    - Environmental
    - Permits
    - Labor/technology
- Interactions with other risks
  - Does the risk and/or its mitigations have an impact on other risks
    - Example: Converting from OH to UG electric construction can reduce fire risk and public safety risk from wires down

Detail view – RAMP (Electric Infrastructure)

- Constraints
  - Substation Transformers have significant lead time, and can require modification of substation layouts. Substation configuration changes can have environmental reviews.
  - Distribution work can require traffic permits, environmental permits
  - System Protection: Significant changes in technology can require testing and pilot studies prior to a full scale roll-out
- Interactions with other risks
  - Overlap with several initiatives including wildfire risk, employee risk, electric grid failure, etc.

Detail View – RAMP (Electric Infrastructure)

- Possible mitigations
  - Transformer replacements
  - Transformer monitoring equipment
  - OH Conductor and pole hardening
  - System Protection upgrades or new installations

Detail View – RAMP (Electric Infrastructure)

- Illustrative Mitigations
  - Mitigation 1 (Transformer Replacements)
    - Primarily improves Reliability – Long term impacts
  - Mitigation 2 (Large Scale OH hardening)
    - Improves Reliability and Safety – Long term impacts
  - Mitigation 3 (Transformer Monitors)
    - Improves Reliability – Shorter term impacts

Detail View – RAMP (Electric Infrastructure)

	Current	Mitigation 1	Mitigation 2	Mitigation 3
Safety Units	0.30	0.23	0.22	0.29
Reliability Units	0.02	0.016	0.016	0.013
Finance	$80M	$60M	$60M	$70M
Risk Score	24000	18562	18062	21125
RSE per $1M		2175	1188	**5750**
Safety Comparator per $1M (Safety Efficiency)		**0.028**	0.016	0.02
Safety Unit Improvement (Safety Effectiveness)		0.07	**0.08**	0.01

Illustrative conclusions

- Mitigation discussion
  - Mitigation 2 has more constraints due to permitting and resource issues.
  - Mitigation 1 and 3 are relatively less complicated
- SDG&E recommends Mitigation 1 and Mitigation 3
  - Mitigation 1 has nearly the same amount of Safety Improvement as Mitigation 2, but does so more efficiently.
  - The RSE for Mitigation 3 fares well not only against other Electric Infrastructure mitigations but against other risk mitigations as well.
  - Mitigations 1 and 3 also match company and Commission objectives of modernizing the grid with technology.

Overview – GRC

- Unless the situation has changed since RAMP filing
  - GRC to seek funding based on discussions and recommendations in RAMP
  - Specific levels of funding to be viewed across enterprise with strongest recommendations most likely to remain in GRC

High-Pressure Gas Pipeline Test Drives

JUA Test Drive – PG&E Gas Transmission Pipeline Failure

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Rupture of transmission pipeline may result in loss of containment and/or uncontrolled gas flow leading to potential public safety issues, prolonged outages, property damages and/or significant environmental damage.	Historical company data and PHMSA data on number of incidents occurred with and without ignition by the nine ASME B31.8S threat categories (hereafter known as risk drivers); subject matter expert judgement regarding the effectiveness of the mitigations.	0.0547	0.0005

	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Risk Reductions: Δ EV: Safety	Risk Reductions: Δ EV: All Attributes Combined	Safety Comparator	RSE*
Mitigation	Valve Automation	Company Data and SME Judgement	~8.2% (Exposure of ~540 approximate miles of automated pipe); ~14.1% approximation of onshore ignited incidents; 600% effectiveness	$89.2M. ~180 miles per year at $0.2M per miles	65	(0.0011)	(0.0000110)	0.00077	0.0000080
	Vintage Pipe	Company Data and SME Judgement	~0.3%(Exposure of 22.5 miles, 3 years worth); ~14.1% approximation of onshore ignited incidents; 600% effectiveness	$181.69M. ~7.5 miles per year at $8.1M per miles	65	(0.0008)	(0.0000050)	0.00029	0.0000018
	Strength Testing	Company Data and SME Judgement	~5%(Exposure of 325 miles, 3 years worth); ~14.1% approximation of onshore ignited incidents; 600% effectiveness	$358.79M. ~108 miles per year at $1.1M per miles	7	(0.0015)	(0.0000098)	0.00003	0.0000002
	ILI	Company Data and SME Judgement	~13.9%(Exposure of 906 miles, 3 years worth); ~14.1% approximation of onshore ignited incidents; 600% effectiveness	$984.54M. ~302 miles per year at $1.09M per mile	7	(0.0023)	(0.0000210)	0.00002	0.0000001

Illustrative Data Developed for the Purposes of JUA Test Drive

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

JUA Test Drive – SoCalGas High Pressure Gas Pipeline

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Pipeline incident on a high pressure pipeline, excluding dig-ins	National PHMSA data from 2010 to present was used to identify the frequency and consequences of high pressure gas incidents. SCG separated out third-party dig-ins from this analysis, due to that cause being included in a separate risk.	0.062	0.0819

	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Risk Reductions: Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Targeted Replacements – 30 mile	1.9% Estimated Reduction in Likelihood	SCG Pipe Replacement (30 miles of worst performing). SME input for illustrative study.	$150M Project Cost	80	(0.0012)	(0.0003)	0.0006	0.0002
Mitigation	Targeted Replacements – 300 miles	10.1% Estimated Reduction in Likelihood	SCG Pipe Replacement (300 miles of worst performing). SME input for illustrative study.	$1,500M Project Cost	80	(0.0063)	(0.0044)	0.0003	0.0002

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

JUA Test Drive – SDG&E High Pressure Gas Pipeline

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Pipeline incident on a high pressure pipeline, excluding dig-ins	National PHMSA data from 2010 to present was used to identify the frequency and consequences of high pressure gas incidents. SDG&E separated out third-party dig-ins from this analysis, due to that cause being included in a separate risk.	0.004	0.0069

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Targeted Replacements – 30 mile	14.4% Estimated Reduction in Likelihood	SDG&E Pipe Replacement (30 miles of worst performing). SME input for illustrative study.	$150M Project Cost	80	(0.0006)	(0.0002)	0.0003	0.0001

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Overhead Conductor Test Drives

JUA Test Drive – SCE Distribution OH Conductor

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Overhead conductor down in service leading to public contact with the conductor, a wildfire, or property damage.	860 Annualized wire down events has varied over the years that it has been recorded.	1.15	0.058

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator	RSE*: All Attributes Combined
Mitigation	Reconductoring the highest-RSE circuits at a $100M per year pace.	SME-calibrated model	Based on the expected reduction in wire down events by reconductoring small conductor on the highest RSE circuits.	$300M 40 years	669 miles @ $447K per mile	(0.131)	(0.007)	0.0524	0.0027
	Reconductoring the highest-RSE circuits at a $150M per year pace.	SME-calibrated model	Based on the expected reduction in wire down events by reconductoring small conductor on the highest RSE circuits.	$450M 40 years	998 miles @ $447K per mile	(0.161)	(0.008)	0.0430	0.0022
	Reconductoring the highest-RSE circuits at a $200M per year pace.	SME-calibrated model	Based on the expected reduction in wire down events by reconductoring small conductor on the highest RSE circuits.	$600M 40 years	1,340 miles @ $447K per mile	(0.213)	(0.011)	0.0425	0.0022

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

SCE OH Conductor Test Drive Results Overview

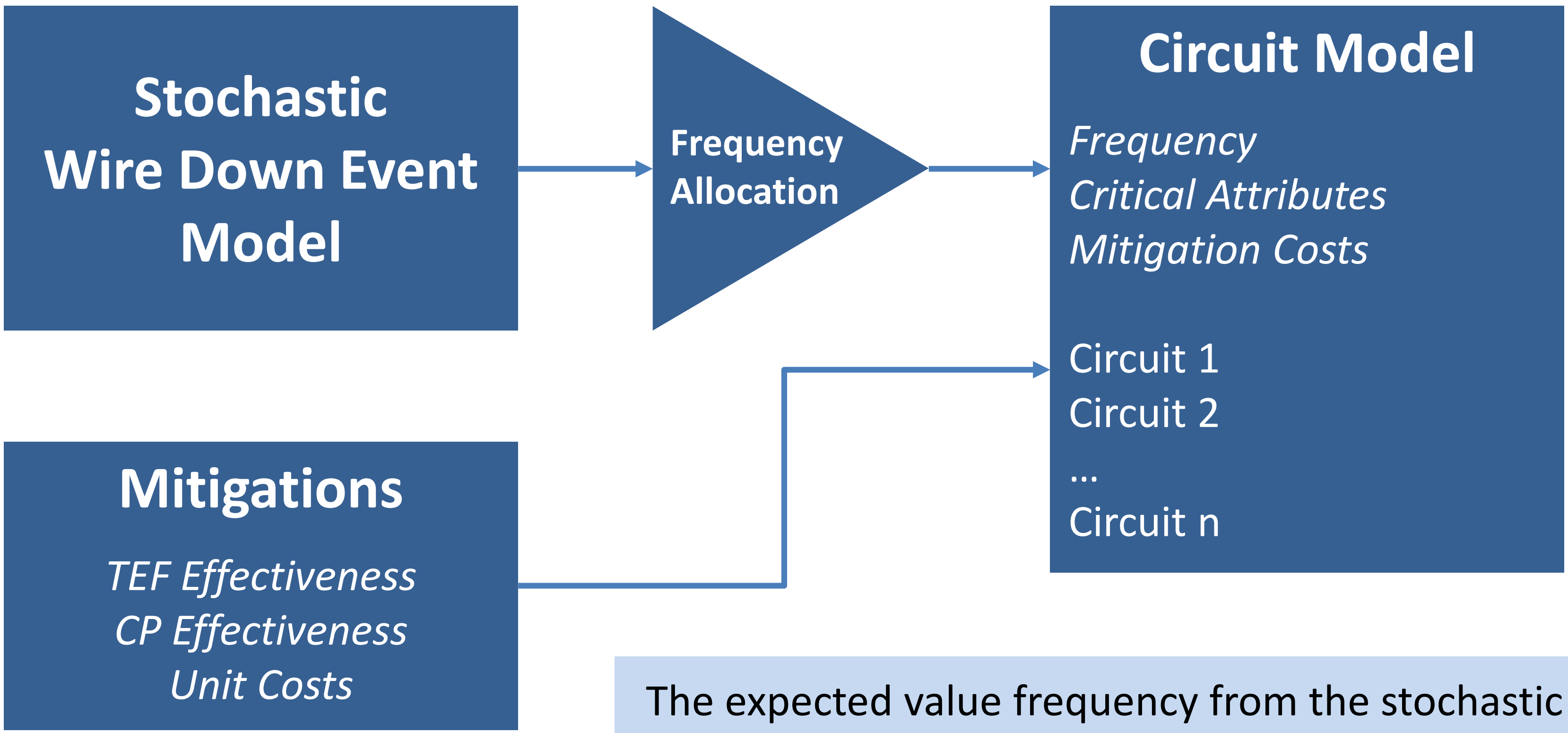
SCE was the only utility to participate in the OH conductor test drive process with the Joint Intervenors.

All comparisons will be between the JUA and JIA Static Analysis; the JIA Dynamic Analysis was a hypothetical exercise for which SCE provided no input.

<u>Comparison of Approaches</u>

- SCE OH conductor modeling approach
- Commonalities across the JUA and JIA
- Differences between the JUA and JIA
- Summary of results

SCE OH Conductor Test Drive Results
SCE OH Conductor Modeling Approach



The expected value frequency from the stochastic model is allocated across distribution circuits using critical attributes and SME judgment.

The circuit model is used to estimate expected costs and benefits of mitigations.

SCE OH Conductor Test Drive Results Commonalities

Both approaches utilize the same circuit and mitigation data.

Circuit-level data

- Expected frequency
- Critical Attributes
  - Count of wire down events
  - Historical circuit breaker operations
  - Available fault duty
  - Miles of overhead conductor at risk
  - Visual inspection results
- Mitigation costs

Mitigation data

- TEF Effectiveness
- CP Effectiveness
- Unit Costs

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

SCE OH Conductor Test Drive Results Differences

The major difference between the approaches for the OH conductor test drive is the value framework.

JUA Multi-Attribute Risk Score vs JIA Multi-Attribute Value Function

The JIA analysis also diverged from the JUA analysis at the TEF Allocation step.

The JUA analysis used SME judgment to correlate critical attributes to expected wire down events

Frequency Allocation

The JIA analysis used a regression analysis and a Poisson distribution to translate expected wire down events into a hazard rate.

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

SCE OH Conductor Test Drive Results
Summary of Results

Key Similarities

Both approaches shared the same source data and resulted in a list of circuits prioritized by Risk Spend Efficiency.

Key Difference

These lists vary in order based off of the relative weight of different attributes in each value framework.

Key Finding

The power and value of both approaches is borne out of the circuit model that provides the ability to differentiate risk at a granular level.

JUA Test Drive – PG&E
Electric Distribution Overhead Conductor

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Failure of or contact with, energized electric distribution primary conductor results in public safety issues, significant environmental damage, prolonged outages, or significant property damage.	Company data on wire down events by cause; Failure rates by conductor size and type in corrosion zones; Count of PUC reportable 3rd party events related to Distribution OH Primary conductor; assumption based on historical Distribution engineer investigations on Wire Down events that 30% of Wire Down events may remain energized.	1.0211	0.0136

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator	RSE*
Mitigation	Targeted Conductor Replacement (4 ACSR) in Corrosion zone ($110.8M/yr)	Company Data	0.8% (Exposure 630 miles (3 years) / system) * 25.5% (Equipment failure conductor connector / total wires down) * 1060% (effectiveness in reducing Equipment failure caused wire down events related to Conductor or Connector assets: 10.6x multiplier applied since WD/100 mile rate in corrosion zones are 5.3 compared to .5 in non-corrosion zone areas)	$332.64M. Replace 210 Miles a year at $100/ft ($528k/mile)	40	(0.0235)	(0.0002915)	0.0028	0.00004
	Focus on highest risk circuits based on historical vegetation caused wire down events for underground conversion	Company Data	0.2% (Exposure 150 miles 3 years worth/ system) * 42.4% (Vegetation caused / total wires down) * 791% (effectiveness in reducing Vegetation caused wire down events per mile: 13 worse performing circuits make up 11.31% of Vegetation wire down events and only 1.43% of total miles - 11.31% / 1.43% = 791%)	$450.00M. 50 Miles a year at $3M/mile	200	(0.0073)	(0.0000968)	0.0016	0.00002
	Clear vegetation directly above OH Primary conductor	Company Data and SME Judgement	6% (Exposure 4950 miles 3 years worth / system) * 42.4% (Vegetation caused / total wires down) * 16.9% (effectiveness in reducing Vegetation caused Wire Down events: 70% reduction on branch outage on circuit miles worked (per historical PS&R analysis), 24.18% of Vegetation wires down events are from branch caused outages (other categories included full tree failures, trunk failures, etc.), 70%*24.18% = 16.9%)	$17.82M. 1650 miles in top 40% REAX = 1650 miles a year at $3,600/mile	5	(0.0048)	(0.0000606)	0.0014	0.00002

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Illustrative Data Developed for the Purposes of JUA Test Drive

JUA Test Drive – SDG&E OH Conductor (Wire Down)

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Wires down on Distribution system from any cause (except wildfire)	SDG&E considered the number of wire down events as the main trigger. The value of 80 per year is the number of wire down events. The mitigations shown only impact the reduction of wire down events, as opposed to any reduction in consequence given a wire down.	0.302	0.0227

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	SDGE Targeted Reconductor - $50M/yr	15% (from 80 down to 68/year)	15% reduction is estimated based upon replacing 100 miles of system, and using subject matter expertise to determine how many fewer wires down there would be with that much OH replacement.	$150M Project Cost	40	(0.038)	(0.0031)	0.0101	0.0008
Mitigation	SDGE Targeted Reconductor - $150M/yr	30% (Down to 56/year)	30% reduction is estimated based upon replacing 300 miles of system, and using subject matter expertise to determine how many fewer wires down there would be with that much OH replacement.	$450M Project Cost	40	(0.085)	(0.0065)	0.0076	0.0006

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Workplace Violence Test Drives

JUA Test Drive – SDG&E Workplace Violence

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	A violent incident occurs at a workplace site	Data used: Fatalities from OSHA; non-fatal injuries from BLS; number of private industry workers from FRED; SME (riskier than national average)	0.026	0.0013

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Mitigation 1	8% Estimated Reduction in Likelihood	Implementation of all mitigations and new programs (Risk Analyst, Incident Management Database improvements, social media monitoring)	$15.18M Project Cost	7	(0.0026)	(0.0001)	0.0012	0.0001

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Illustrative Data Developed for the Purposes of JUA Test Drive

JUA Test Drive – SoCalGas Workplace Violence

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	A violent incident occurs at a workplace site	Data used: Fatalities from OSHA; non-fatal injuries from BLS; number of private industry workers from FRED; SME (riskier than national average)	0.056	0.0028

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Mitigation 1	9% Estimated Reduction in Likelihood	Implementation of all mitigations and new programs (Risk Analyst, Incident Management Database improvements, social media monitoring)	$4.62M Project Cost	5	(0.0054)	(0.0003)	0.0059	0.0003

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Illustrative Data Developed for the Purposes of JUA Test Drive

JUA Test Drive – SCE
Active Shooter

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	Deliberate violent actions of current or former worker leading to serious injuries and/or fatalities to self or others which can potentially have safety and financial impacts	Active Shooter events over a 16-year period matching the defined risk statement occurring at a Fortune 500 or similar organization	0.012	0.001

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator	RSE*: All Attributes Combined
Mitigation	Security personnel assigned to populated facilities	SME-estimate	Based on the expected deterrence level provided by security personnel presence	$7M	Estimated annual cost.	(0.012)	(0.001)	0.0017	0.0035
	Active Shooter training		Based on the expected response to an Active Shooter event	$0.05M	One-time cost for training development.				

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

Illustrative Data Developed for the Purposes of JUA Test Drive

Inadequate Workforce/Skilled and Qualified Workforce Test Drives

JUA Test Drive – PG&E
HR Skilled and Qualified Workforce

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	The risk of Employees performing work for which they are not skilled or qualified presents to PG&E and the public related to safety, reliability, affordability and security.	The baseline likelihood and consequence for this risk is a composite of the data attributable to employee error from PG&E's asset based RAMP risks. Those risks are Gas Storage Wells, Gas Maintaining system capacity, Gas Compression & Processing facility, Gas Measurement & Control facility, Gas Measurement & Control downstream, Gas Distribution - Non-cross bore, Gas Transmission pipeline, Electric Distribution OH conductor, and Electric Transmission OH conductor.	0.185	0.0010

	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Risk Reductions Δ EV: Safety	Risk Reductions Δ EV: All Attributes Combined	Safety Comparator	RSE*
Mitigation	Portable Technology--Technical Access--Provide to All Field Employees	SME Judgement	Based on expertise and assessment data	1.43M	2	(0.0379)	(0.0002139)	0.054	0.00030
	Portable Technology--Technical Access--Provide to Supervisors Crew Leads	SME Judgement	Based on expertise and assessment data	1.43M	2	(0.0288)	(0.0001626)	0.041	0.00023
	Portable Technology--Qualification Status	SME Judgement	Based on expertise and assessment data	0.50M	2	(0.0196)	(0.0001087)	0.078	0.00043
	24/7 Technical Support Desk	SME Judgement	Based on expertise and assessment data	2.00M	2	(0.0296)	(0.0001664)	0.030	0.00017

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

JUA Test Drive – SCE Unqualified Workforce

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	SCE Employee and/or Contractor actions that led to serious injuries and/or fatalities to self, other employees and/or contractors and the public.	The data needed for this test drive has been kept in manual documents before May 2014. Due to lack of time and resources, we chose to only include Employee and/or Contractor serious injuries to self or other employee and/or contractor that have been transferred to a database from 5/2014-11/2016. The data for Employee and/or Contractor incidents that led to injury and/or fatality to the public included all incidents over a 2 year period (Years 2015 and 2016) and does not assume or infer that an SCE Employee and/or Contractor was found at fault for the incident.	3.913	0.196

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator	RSE*: All Attributes Combined
Mitigation	The mitigation for this risk is training for T&D employees.	SME-calibrated model	Based on SCE's year over year Days Away, Restricted, Transfer (DART) rate trend	$37M	Cost per year	(0.692)	(0.035)	0.0187	0.0375

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

JUA Test Drive – SoCalGas Workforce Planning

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	A safety incident occurs due to inadequate knowledge transfer to new utility employees	Data used: SME data (for safety impact and frequency). This is the risk of not having an appropriate workforce with the right skills to meet business needs due to the acceleration of workforce attrition and changing business needs.	0.099	0.0069

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Mitigation 1 – Improve Job proficiency	20.2% Estimated Reduction in Likelihood	Data used: SME provides the percentage reduction of incident rate, which is then converted into a reduction in likelihood.	$2.34M Project Cost	2	(0.0201)	(0.0012)	0.0172	0.0010

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

JUA Test Drive – SDG&E Workforce Planning

	Description	Comments/Notes	Pre-Mitigation EV Safety	Pre-Mitigation EV All Attributes Combined
Risk	A safety incident occurs due to inadequate knowledge transfer to new utility employees	Data used: SME data (for safety impact and frequency). This is the risk of not having an appropriate workforce with the right skills to meet business needs due to the acceleration of workforce attrition and changing business needs.	0.099	0.0054

						Risk Reductions			
	Description	Effectiveness and Data Sources		Total Project Cost and Useful Life		Δ EV: Safety	Δ EV: All Attributes Combined	Safety Comparator: Safety Only	RSE*: All Attributes Combined
Mitigation	Mitigation 1 – Improve Job proficiency	48.5% Estimated Reduction in Likelihood	Data used: SME provides the percentage reduction of incident rate, which is then converted into a reduction in likelihood.	$3.93M Project Cost	2 yr O&M	(0.0479)	(0.0029)	0.0244	0.0015

* RSE is Risk Spend Efficiency. This is the measure of risk reduction per $1 million cost for the mitigation that also reflects the useful life of the project.

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An End-to-End Process

Pre RAMP: Baseline Risk Assessment

1. **[Cycla Step 1] Identify Threats →Risk Event identification (Center of the bow tie)**
2. **[Cycla Step 2] Characterize Sources of Risk**
   - **Risk Driver identification and quantification (Left-hand side of bow tie)**
   - **Risk Consequence identification and quantification (Right-hand side of the bow tie)**
3. **List current controls that are embedded in the current state quantification**

#	Current Controls
1	Control A
2	Control B
3	Control C
4	Control D

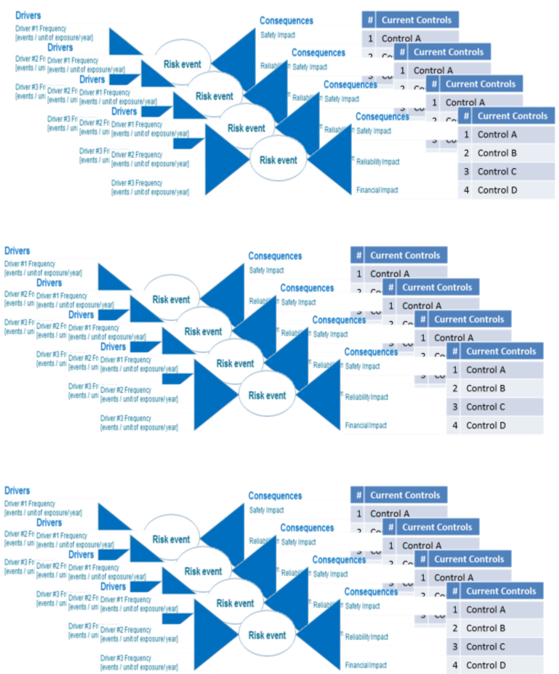
4. **Repeat Steps 1-3 for another risk to assess the company risk register**

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

PG&E

RAMP Risk Identification

After baseline risk assessment is completed, outcomes of the risks per consequence attribute are obtained
These outcomes are aggregated and tabulated using a multi-attribute and safety filter to determine the Risks for the RAMP filing



Baseline Risk Score (illustrative)

Risk Event	Fatality	Injury	SAIDI	SAIFI	Customer Minutes	Financial	Safety Unit*	Multi-Attribute Score**
Risk Event A	#	#	#	#	#	#	4	10
Risk Event B	#	#	#	#	#	#	2	9
Risk Event C	#	#	#	#	#	#	3	8
Risk Event D	#	#	#	#	#	#	1	7
Risk Event E	#	#	#	#	#	#	1	6
Risk Event F	#	#	#	#	#	#	0.5	6
Risk Event G	#	#	#	#	#	#	0.5	5
Risk Event H	#	#	#	#	#	#	0.3	1
Risk Event I	#	#	#	#	#	#	0.3	1
Risk Event J	#	#	#	#	#	#	0.3	1
Risk Event K	#	#	#	#	#	#	0.03	1
Risk Event L	#	#	#	#	#	#	0.03	0.1

Top Safety Risks for RAMP[1]

[1]As well as other risks from CPUC/ SED/Executives

Illustrative threshold

* JUA Safety Unit $= \#\text{ of fatality} * (1) + \#\text{ of injuries} * (0.01)$

** JUA Multi Attribute Score $=$

$$\frac{[\text{Safety Score}]}{\text{Range}^{\text{Safety}}}\text{Weight}^{\text{Safety}} + \frac{\left[\frac{\text{SAIDI}}{\text{Range}^{\text{SAIDI}}} * \text{WeightSAIDI} + \frac{\text{SAIFI}}{\text{Range}^{\text{SAIFI}}} * \text{WeightSAIFI} + \frac{\text{CMin}}{\text{Range}^{\text{CMin}}} * \text{WeightCMin}\right]}{\text{Range}^{\text{Reliability}}}\text{Weight}^{\text{Reliability}} + \frac{[\mathit{Sum\ of\ consequences\ measured\ in\ USD}]}{\text{Range}^{\text{Financial}}}\text{Weight}^{\text{Financial}}$$

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

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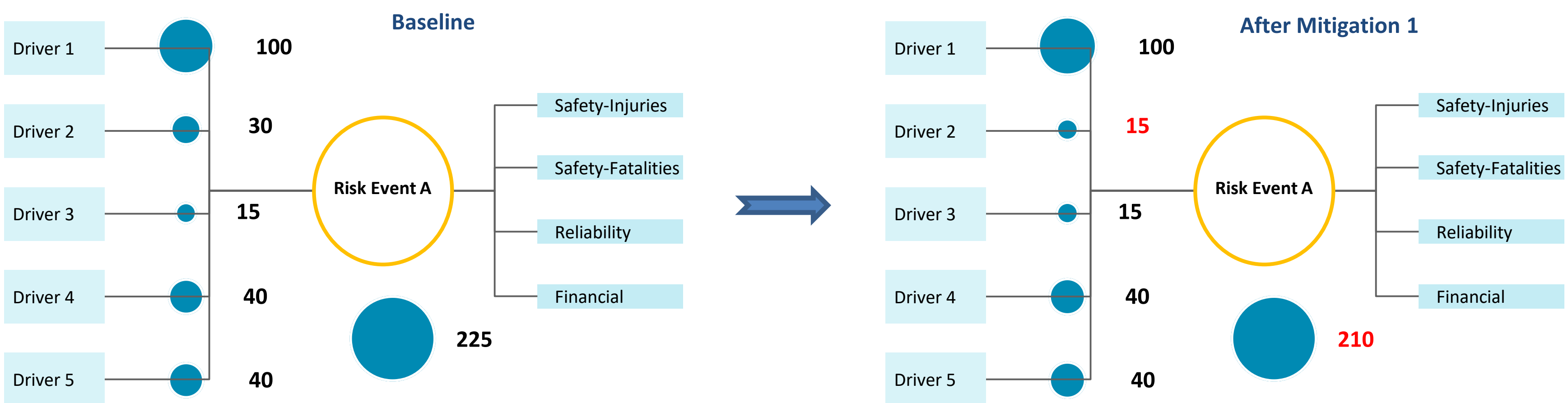
RAMP Risk Mitigation Identification

[Cycla Step 3] Mitigation identification

- **[Cycla Step 4] Evaluate the anticipated risk reduction for identified mitigations (mitigation effectiveness)**
- **[Cycla Step 5] Determine resource requirements for identified mitigations (cost for mitigation)**
- **Calculate risk spend efficiencies (RSE) for each mitigation**

Example: Mitigation 1 risk reduction: Driver 2 is reduced by 50% = (15/30) →Overall risk reduction of 7% = (15/225); cost: $10,000,000



Risk Event A Mitigations	Fatality Reduction	Injury Reduction	SAIDI Reduction	SAIFI Reduction	Customer Minutes Reduction	Financial Reduction	Multi-Attribute Risk Reduction	Cost	RSE
Mitigation 1	#	#	#	#	#	#	#	#	#
Mitigation 2	#	#	#	#	#	#	#	#	#
Mitigation 3	#	#	#	#	#	#	#	#	#
Mitigation 4	#	#	#	#	#	#	#	#	#

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RAMP and GRC Risk Proposals

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[Cycla Step 6 and Step 7] Identify proposed, alternative plans, and total cost

Baseline Risk Score (illustrative)

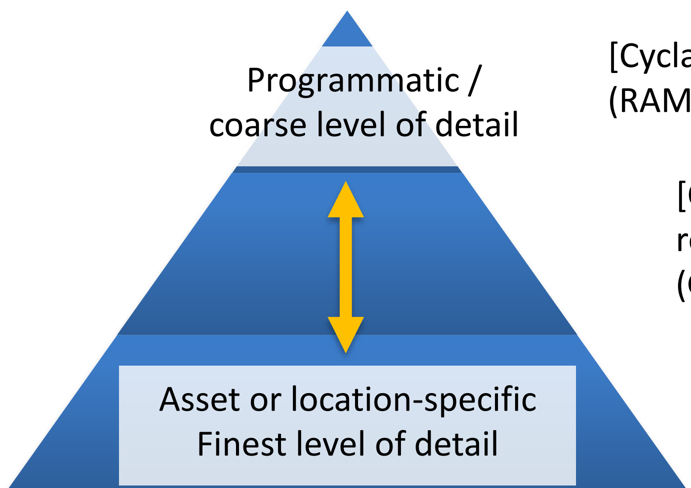
Top Safety Risks for RAMP*

*As well as other risks from CPUC/ SED/Executives

Risk Event	Safety Score*	Multi-Attribute Score**
Risk Event A	4	10
Risk Event B	2	9
Risk Event C	3	8
Risk Event D	1	7
Risk Event E	1	6

Risk Event E Mitigations	Multi-Attribute Risk Reduction	Cost	RSE	Proposed Plan	Alternative 1	Alternative 2
Mitigation 1	#	#	#	X		X
Mitigation 2	#	#	#		X	
Mitigation 3	#	#	#	X		X
Mitigation 4	#	#	#			
Mitigation 5	#	#	#		X	
Mitigation 6	#	#	#	X	X	
Mitigation 7	#	#	#			X

PG&E Risk Quantification Vision (RAMP → GRC →GRC Implementation)



[Cycla Step 1-7] Comparative Programmatic, probabilistic risk evaluation (RAMP Filing)

[Cycla Step 8] Enterprise-wide risk program evaluation considering resource constraints
(GRC Filing)

[Cycla Step 9-10] Individual-asset class, relative risk evaluation (Project allocation GRC implementation and monitoring)

All data and materials in this document are illustrative and not meant to represent actual risk assessments.

Discussion of Test Drives

Comparison of Different Methods

	Existing Risk Processes	JUA	JIA
Risk Quantification	Single Point	Probabilistic, entire distribution	
Risks in RAMP	Use 7x7 matrix (e.g., >=4 Safety Score)	Use JUA methodology	
Source of Mitigations identification	Utility-specific	Utility-specific	
Mitigation Scoring	Risk-spend efficiency; based upon movement of results in 7x7 matrix	Risk reduction effectiveness / efficiency	
Attributes / Weights / Scales	Utility-specific	Common attributes with utility-specific weighting	
Probabilistic Emphasis	7x7 matrix	Distribution (Expected value; may include tail)	
# of mitigations	Multiple	Multiple	
Proposed Mitigations	Appropriate mitigations given: 1) constraints, 2) strategic goals of the utility	Appropriate mitigations given: 1) effectiveness / efficiency 2) constraints, 3) strategic goals of the CPUC and utility	
GRC	Need based	Need based	

JUA/JIA Comparison

Criteria	Explanation	JUA	JIA
Risk-based	Addresses both key enterprise-wide risks an operational risk management (top-down and bottoms-up)		
Safety-focused	Identification and mitigation of key safety risks		
Transparent	Data sources and decision drivers for risk analysis and mitigation selection be available		
Accurate	Accurately represents analysis		
Easy of implementation and understanding	Ability to fit into current processes		
Cost Effective	Does not require extensive additional investments to meet requirements		
Comparable	Results compared across utilities		
Probabilistic	Quantitative		
Used	Results can used by utilities, the CPUC, staff, and parties		

Questions?