# Comparison of Joint Intervenor to Settlement Approach

TURN

Indicated Shippers

Energy Producers and Users Coalition

# Key Similarities

1. Calculate a risk score by multiplying Likelihood of Failure (LoF, or LoRE in the settlement) times the Consequences of Failure (CoF, or CoRE in the settlement)
   - Row 13
2. Develop a Multi-attribute Value Function to assess pre- and post-mitigation CoF (CoRE)
   - Rows 1-7
3. Use probabilities to determine pre- and post-mitigation LoF (LoRE) for each asset group
   - Rows 17 and 20
4. Develop probability distributions for the CoF (CoRE) for each asset group and use expected value for calculations
   - Rows 5 and 24
5. Determine the risk reductions from mitigations by taking the difference between the pre- and post-mitigation risk scores.
   - Rows 16-24
6. Analyze and rank risk mitigation alternatives based on Risk Spend Efficiency.
   - Row 25-26

# Other Similarities

The Settlement captures key JIA goals:

- Establishes uniform requirements across utilities for minimum required elements
- Requires mathematically correct and logically sound methodologies
  - Row 29
- Requires transparency and sufficient data for third parties to assess utility judgments
  - Rows 29-31
  - Row 28 (GRC backstop) will require the utilities to provide information needed to analyze certain mitigations in GRC even if not included in RAMP.
- Settlement provides for dynamic analysis when likelihoods and consequences are expected to change substantially over time
  - Row 27

# Key Differences

- JIA develops mitigation strategy from the bottom up, whereas the Settlement uses the utilities' risk registers (top down) as a starting point.
  - Settlement uses a different approach for identifying and limiting risks that should be subject to the methodology
  - Issue is flagged in Section I.E(2) of settlement agreement: JI advocate that next SMAP explore using Settlement Step 3 approach to identify and rank risks to be assessed in the RAMP

# Key Differences (cont.)

- JIA is more prescriptive and detailed than settlement, which establishes minimum required elements and allows issues about whether utilities have reasonably exercised their discretion to be addressed in RAMP/GRC

# SDG&E and SoCalGas S-MAP Settlement Comparisons to JUA


July 6, 2018

# *Comparison of JUA to Settlement*

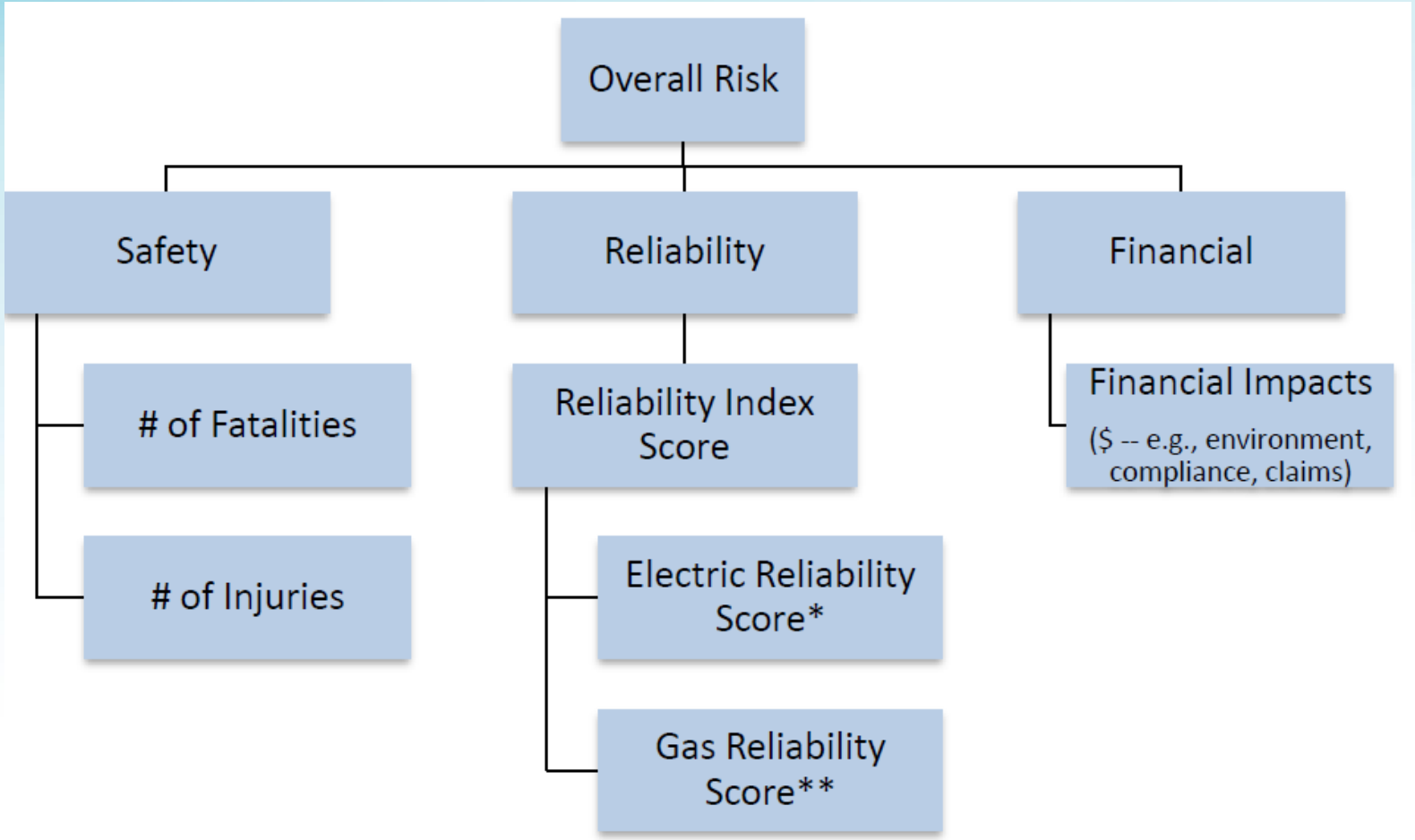
- Similarities
  - Risk Focused, Safety Focused
  - Multi-Attribute
  - Top-down
  - Implementability
  - Transparent
  - Uniformity

# *Comparison of JUA to Settlement*

- Similarities
  - Risk Focused, Safety Focused


# Comparison of JUA to Settlement

- Similarities
  - Multi-Attribute



# *Comparison of JUA to Settlement*

- Similarities
  - Top-down
    - Allows utilities to conduct preliminary assessment before more specific analysis


**Step 2A – Risk Assessment and Risk Ranking in Preparation for RAMP**

# Comparison of JUA to Settlement

- Similarities
  - Implementability*
    - Significant change in ways, and more work – but feasible

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Negligible | Minor | Moderate | Major | Extensive | Severe | Catastrophic |

$$\text{RSE} = \frac{\sum_{i=0}^{4}\left(\frac{\left(RS_{Pre,i} - RS_{Post,i}\right)}{1.05^{i}}\right)}{present\ value\ \$\ of\ project}$$

# Comparison of JUA to Settlement

- Similarities
  - Transparent

## JUA Proposal

| | 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 |

## Settlement

| | | |
|---|---|---|
| 26. | Mitigation Strategy Presentation in the RAMP and GRC | In the RAMP and GRC, the utility will clearly and transparently explain its rationale for selecting mitigations for each risk and for its selection of its overall portfolio of mitigations. The utility is not bound to select its mitigation strategy based solely on RSE ranking. |
| 29. | Transparency in RAMP and GRC – Results can be understood | The methodologies used by the utility should be mathematically correct and logically sound. The mathematical structure should be transparent. All algorithms should be identified. All calculations should be |

# *Comparison of JUA to Settlement*

- Similarities
  - Uniformity
    - JUA and Settlement move toward more uniformity
      - Same process, calculations
      - Similar attributes
      - Minimum requirements apply almost uniformly
    - Still allows customization (through MAVF, use of alternate calculations)

# *Comparison of JUA to Settlement*

- Differences
  - Granularity
  - Calculation of RSE
  - RAMP Workshop
  - GRC Backstop

# *Comparison of JUA to Settlement*

- Differences
  - Granularity versus feasibility

- Tranches (8 combinations)
  - Large wire, urban, non-high wind
  - Large wire, urban, high wind
  - Large wire, rural, non-high wind
  - Large wire, rural, high wind
  - Small wire, urban, non-high wind
  - Small wire, urban, high wind
  - Small wire, rural, non-high wind
  - Small wire, rural, high wind

# *Comparison of JUA to Settlement*

- Differences
  - Calculations of RSE
    - Different steps to calculate risk score
      - JUA: Expected Value or Tail Value
      - Settlement: LoRE * CoRE
    - In JUA, present value not used, no need to project the stream of benefits

# Comparison of JUA to Settlement

- Differences
  - RAMP Workshop:

Top 40% of safety risks get Safety, Reliability, and Financial MAVF analysis

| | 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 | |
| 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 | Y |
| Insufficient Supply to the Natural Gas Transmission System | 0.0000 | 0.0000 | 0.0000 | 0.0026 | 0.9974 | 0.03 | |

# Comparison of JUA to Settlement

- Differences
  - GRC Backstop: For certain risks being analyzed even where not included in RAMP

| GRC Capital Projects | Cost |
|---|---|
| Acquisition Project | 300,000,000 |
| Gas Distribution funding project | 250,000,000 |
| Compressor Project Phase X | 200,000,000 |
| Installation service project | 175,000,000 |
| RAMP Project | 175,000,000 |
| RAMP Project | 140,000,000 |
| Project | 100,000,000 |
| Project | 96,000,000 |
| Project | 79,000,000 |
| RAMP Project | 70,000,000 |
| Project | 65,000,000 |
| RAMP Project | 55,000,000 |
| RAMP Project | 50,000,000 |
| Project | 25,000,000 |
| Project | 25,000,000 |
| Project | 25,000,000 |
| Project | 25,000,000 |

$75,000,000 threshold for 3 year cumulative cost for SoCalGas/PG&E/SCE

# SDG&E and SoCalGas S-MAP Settlement Illustrative Walkthrough

## Workplace Violence


July 6, 2018

# *Outline*

- Timing of SoCalGas/SDG&E process

- Risk Register
  - Safety Assessment
  - Ranking of risks by Safety Assessment, identifying top 40%
  - Workshop to communicate safety, reliability, and financial attributes for top 40%
  - Selecting RAMP risks

- RAMP
  - Discussion of Risk
  - Mitigation Identification
  - Mitigation Effectiveness

- GRC, Accountability Report

# *Overview of S-MAP Settlement*
# *High Level Overview of Minimum Requirements*

## Deliverables

## Key Steps

**Annual** — Enterprise Risk Register

- Safety Assessment for each risk
- SDGE/SCG recommend RAMP risk
- Safety, Reliability, Financial Assessment for top 40%
- Workshop to show S/R/F. Get feedback.
- Propose final RAMP risks

**November 30, 2019** — RAMP

- Identify Mitigations
- Calculate Risk Spend Efficiencies

**September 1, 2020** — GRC

- Seek funding. If RAMP-related ask, refer to RAMP output
- If GRC request is:
  a) Based on safety/reliability
  b) Elective
  c) Larger than (Cap/O&M);
  SCG: $75M/$15M,
  SDGE: $37.5/$7.5M
  → Calculate Risk Spend Efficiencies

**Each Year Beginning 2020** — Accountability Report

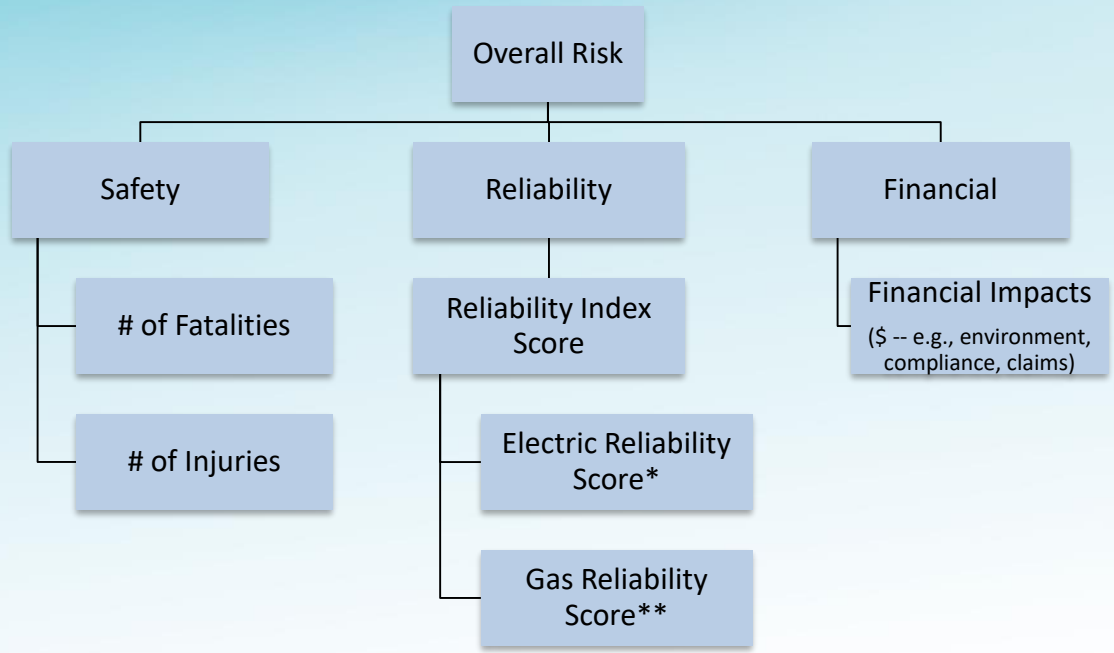
- Spending Report
- Risk Effectiveness

CURRENT NEW

# *RAMP*

- Risk Discussion
  - Risk Description
  - Current programs/mitigations
  - Risk Mitigations
    - Tranches
  - Risk Effectiveness at tranche level
- Examples to follow (illustrative)
  - Workplace Violence
  - Wire Down

# MAVF




- 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

# MAVF

| 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% |




# Explanation and Simplified Illustration of the Multi-Attribute Value Function

CONTINENTAL ECONOMICS

# Settlement Agreement Matrix Step 1A – Building a Multi-attribute Value Function

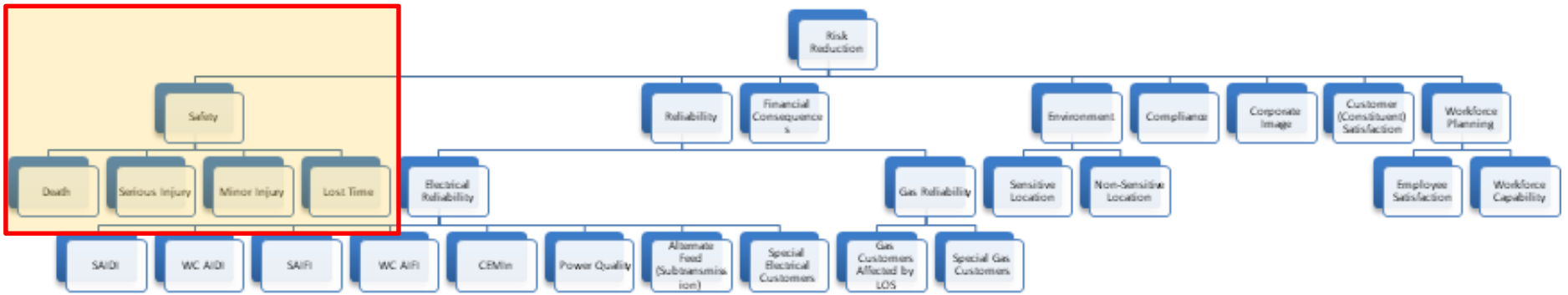
- The MAVF is used to estimate the CoRE (consequences of a risk event)
- The risk of an adverse event equals LoRE (likelihood of risk event) x CoRE
- S-MAP Participants (utilities, intervenors) developed an illustrative MAVF with eight high-level attributes:

| | |
|---|---|
| **Safety** | **Compliance** |
| **Reliability** | **Corporate Image** |
| **Financial Consequences** | **Customer Satisfaction** |
| **Environmental Quality** | **Workforce Planning** |

  - Attribute structure contained 22 total lower-level, measurable attributes (MAVF Principle 1 Attribute Hierarchy, Row 2 of Settlement Matrix)

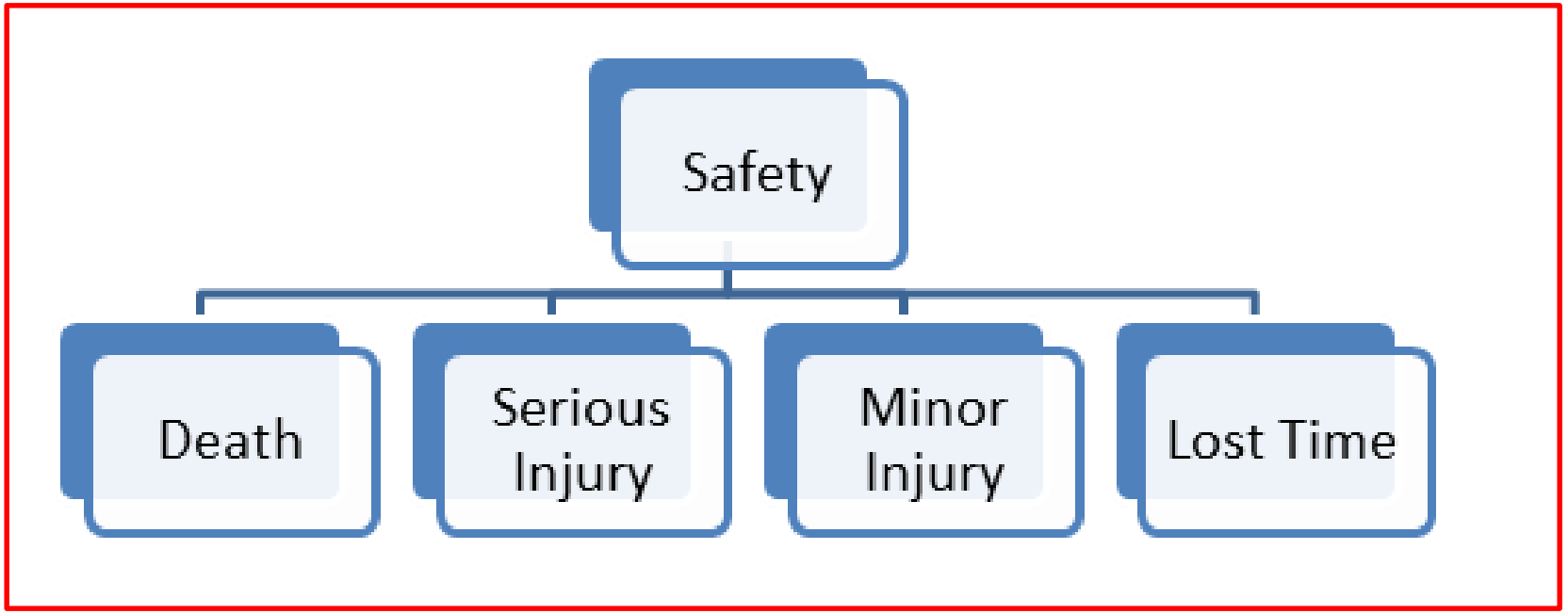
# JI Test-Drive Illustrative MAVF Attribute Structure (MAVF Principle 1 – Attribute Hierarchy, Row 2 of Settlement Matrix)

Safety Attribute structure



# Test Drive Safety Attribute Structure Detail

- Participants determined that Safety was comprised of four measurable sub-attributes (MAVF Principle 1 - Attribute Hierarchy, Row 2 of Settlement Matrix)



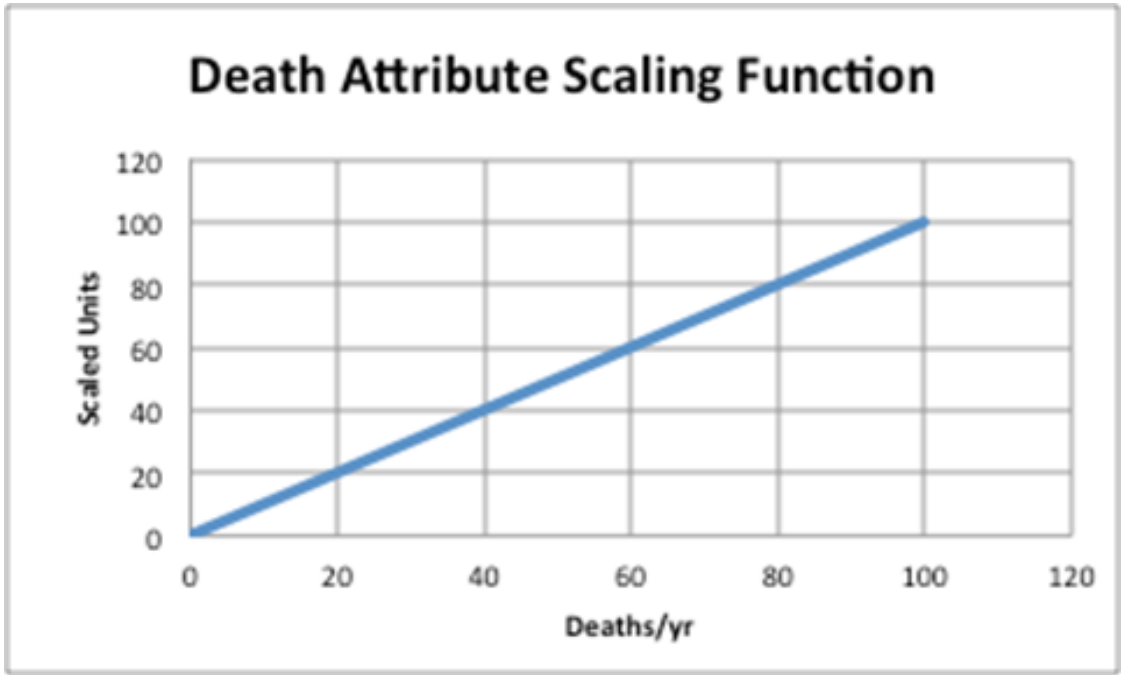
# Safety Attribute Ranges (MAVF Principle 2 – Measured Observations, Row 3 of Settlement)

- Each measurable Safety sub-attribute has its own observable range in its own natural units.

| Sub-Attribute | Range |
|---|---|
| Deaths | 0 – 100 |
| Serious Injuries | 0 – 1,000 |
| Minor Injuries | 0 – 10,000 |
| Lost Time (Days Lost) | 0 – 1,000 |

# MAVF Principle 5 – Scaled Units (Settlement Matrix Row 6)

- Scaling Function for Deaths:
  - 0 deaths –scale value of 0; 100 deaths – scale value of 100.
  - Participants determined a linear scale was appropriate



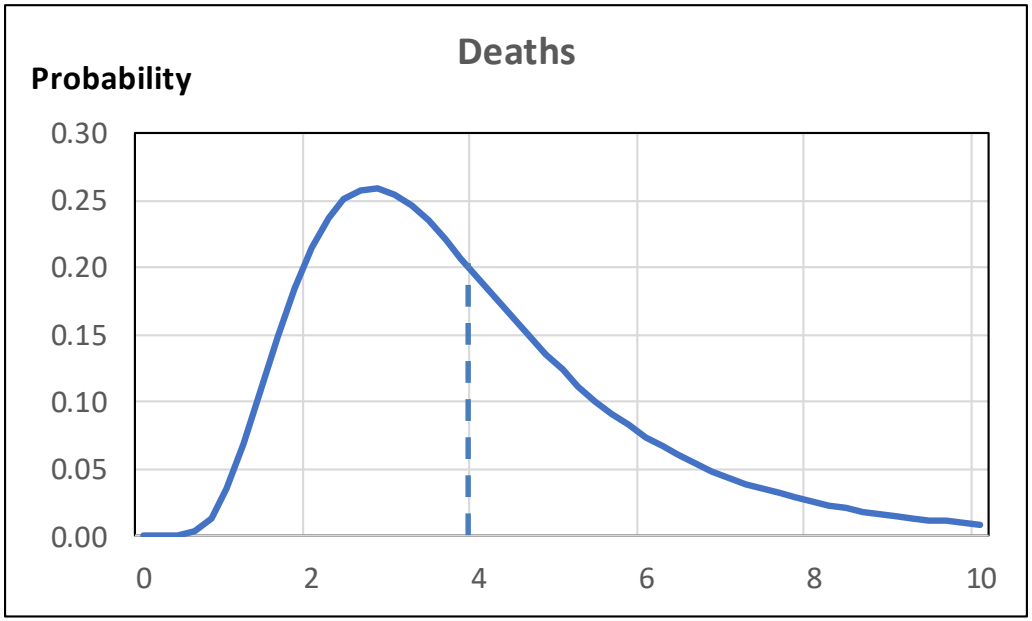
# MAVF Principle 6 – Relative Importance (Settlement Matrix Row 7)

- Weights determined by natural unit ranges of the attributes and the tradeoffs made by the participants
  - Ranked relative importance of moving from worst to best cases

| Attribute | Attribute Range | Normalized Weight |
|---|---|---|
| SAFETY | | |
| Death | 0-100 | 0.1636 |
| Serious Injury | 0-1,000 | 0.1636 |
| Minor Injury | 0-10,000 | 0.0818 |
| Lost Time | 0-1,000 | 0.0082 |

# MAVF Principle 4 – Risk Assessment (Settlement Matrix Row 5)

- For a defined risk event, estimate deaths based on (i) a probability distribution or (ii) 10-50-90 percentile values
- Examples:
  - Probability distribution lognormal (approx. mean = 4 deaths)



# MAVF Principle 4 – Risk Assessment (Settlement Matrix Row 5) (cont.)

- Example (using 10-50-90 percentile ranges)

| Percentile | Number of Deaths |
|---|---|
| 10 | 1 |
| 50 | 5 |
| 90 | 10 |

- Use 10-50-90 values to calculate expected value:

  = 0.3015 x (10$^{th}$ Percentile value) + 0.397 x (50$^{th}$ Percentile Value) +
  0.3015 x (90$^{th}$ Percentile value) = 5.45

# JI Test Drive Example – Attributes, Ranges, and Weights

| ATTRIBUTE | RANGE | WEIGHT |
|---|---|---|
| **SAFETY** | | |
| Deaths | 0 - 100 | 16.359% |
| Serious Injuries | 0 - 1,000 | 16.359% |
| Minor Injuries | 0 - 10,000 | 8.180% |
| Days Lost | 0 - 1,000 | 0.818% |
| **RELIABILITY** | | |
| Electric | | |
| SAIDI | 0 - 600 min/yr | 4.090% |
| SAIFI | 0 - 6 int./cust/year | 4.090% |
| WC AIDI | 0 - 2,000 min/yr | 0.041% |
| WC AIFI | 0 - 10 int./cust/year | 0.041% |
| CEMI | 0 - 100,000 | 0.041% |
| Power Quality | 100 - 140 volts | 0.001% |
| Subtransmission | Not Solved or Solved | 0.082% |
| Special Elec. Customers | Not Solved or Solved | 0.001% |
| Gas Reliability | | |
| Customers Affected | 0 - 1 million | 4.090% |
| Special Gas Customers | Not Solved or Solved | 0.001% |

| ATTRIBUTE | RANGE | WEIGHT |
|---|---|---|
| **FINANCIAL** | 0 - $1 billion | 4.090% |
| **ENVIROMENT** | | |
| Sensitive Location | 1 - 21 | 12.270% |
| Non-Sensitive Location | 1 - 21 | 1.227% |
| **COMPLIANCE** | 1 (no conseq.) - 7 (out of business) | 16.359% |
| **CORPORATE IMAGE** | Pos - Neutral - Neg | 0.409% |
| **CUSTOMER SATISFACTION** | 0% - 100% | 4.090% |
| **WORKFORCE PLANNING** | | |
| Employee Satisfaction | 0% - 100% | 2.454% |
| Workforce Capability | Pos - Neutral - Neg | 4.908% |
| | **TOTAL WEIGHT** | **100.000%** |

# *Workplace Violence*

- Description: The risk of a workplace incident involving a disgruntled former/current employee or customer who takes action, which results in emotional or physical harm to employees or customers.
- Drivers/Triggers:
  - Extremist ideologies, personal issues or conflict, and mental health issues
  - Human errors
  - Process failure of programs/procedures
  - System failure of security systems intended to prevent the risk from occurring
- Consequences
  - Life threatening injuries or fatalities
  - Emotional abuse
  - Disruption to business operations
  - Citations and related financial impacts
  - Lawsuits or violations
  - Costs associated with litigation or policy/procedure changes

# *Workplace Violence*

- Current mitigations:
  - Physical security: fences, locks, badge access, cameras, secure parking
  - Employee focused: drills, computer-based, psychological services
  - Personnel: security guards, HR specialists
  - Social media monitoring
- Tranches
  - Identify situations with similar CoRE and LoRE
  - For this example, work locations with similar risk profiles
  - Assume only 5 work locations
    - Tranche 1: SDG&E main facility
    - Tranche 2: Three operating districts with similar CoRE/LoRE
    - Tranche 3: One operating district with unique CoRE/LoRE

# *Workplace Violence*

## Tranche-level information: Pre-Mitigation

Step 17

Step 18

Step 19

| | Tranche 1 | Tranche 2 | Tranche 3 |
|---|---|---|---|
| **LoRE** | **1 in 3 years (0.33)** | **1 in 5 years (0.2)** | **1 in 10 years (0.1)** |
| Safety | 2 | 1 | 0.5 |
| Reliability | 0 | 0.017 | 0.0075 |
| Finance | $40M | $10M | $5M |
| Reliability (Gas) | 0 | 5000 | 0 |
| Reliability (SAIDI) | 0 | 20 | 10 |
| Reliability (SAIFI) | 0 | 0.2 | 0.1 |
| **CoRE** | **102,000** | **54,667** | **27,125** |
| **Risk Score** | **34,000** | **10,933** | **2,713** |

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

# Workplace Violence

## Step by Step Calculation of Tranche 2 - CoRE

| Attribute | EV (Current) | Weighting | Top-End |
|---|---|---|---|
| **Safety** | 1 | 50% | 10 |
| **Reliability** | 0.017 | 25% | 1 |
| **Financial** | $10M | 25% | $5 B |

| Reliability Sub-Attribute | EV (Current) | Weighting | Top-End |
|---|---|---|---|
| **Gas (# of customers)** | 5000 | 50% | 1.5 Million |
| **Electric (SAIDI)** | 20 | 25% | 1,000 |
| **Electric (SAIFI)** | 0.2 | 25% | 5 |

**Reliability Unit** Current: (5000/1.5M) * 50% + (20/1000) * 25% + (0.2/5) * 25% = ***0.0166***

**CoRE** Current: (1/10) * 50% + (0.017/1) * 25% + (10/5000) * 25% = 0.055

***CoRE = 54,667***

Multiply by 1,000,000

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

# Workplace Violence
## Mitigation

- Potential mitigations:
  - Physical security: More robust security, fencing, cameras
  - Personnel: Additional security guards for different locations, full-time risk analyst
  - Other: Increased social media monitoring

- Assume mitigation has 5 year life.

- Assess impact to LoRE and CoRE
  - LoRE – Does the mitigation reduce likelihood of event?  Yes
  - CoRE – Does the migitation reduce the consequence if the event were to occur? Yes, financial consequence for illustrative purposes.

  - Determine new LoRE and Core for 5 years.
  - Assume current mitigations still in place during 5 years

- Risk scores can vary year to year as situations occur.
  - Inflation causes financial costs to rise
  - Known changes in laws, regulations, etc. could account for known changes to risk

# *Workplace Violence*

## Tranche-level information: Post-Mitigation

Step 20

Step 21

Step 22

| | Tranche 1 | Tranche 2 | Tranche 3 |
|---|---|---|---|
| **LoRE** | **1 in 5 years (0.2)** | **1 in 8 years (0.12)** | **1 in 14 years (0.07)** |
| Safety | 2 | 1 | 0.5 |
| Reliability | 0 | 0.017 | 0.0075 |
| Finance | $20M | $5M | $3M |
| Reliability (Gas) | 0 | 5000 | 0 |
| Reliability (SAIDI) | 0 | 20 | 10 |
| Reliability (SAIFI) | 0 | 0.2 | 0.1 |
| **CoRE** | **101,000** | **54,417** | **27,025** |
| **Risk Score** | **20,200** | **6,802** | **1,930** |

# *Workplace Violence*

Tranche 1

Step 23

| Year | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| Pre-Mitigation Risk Score | 34,000 | 34,020 | 34,041 | 34,062 | 34,084 |
| Post-Mitigation Risk Score | 20,200 | 20,206 | 20,212 | 20,219 | 20,225 |
| Risk Reduction | 13,800 | 12,814 | 13,828 | 13,843 | 13,859 |

# Workplace Violence

Step 25

| | | Risk Reductions | | | | | |
|---|---|---|---|---|---|---|---|
| Year | PV Cost | 2018 | 2019 | 2020 | 2021 | 2022 | RSE* |
| Tranche 1 | $80M | 13,800 | 13,814 | 13,828 | 13,843 | 13,859 | 786 |
| Tranche 2 | $15M | 4,131 | 4,133 | 4,135 | 4,138 | 4,140 | 1,253 |
| Tranche 3 | $10M | 782 | 783 | 783 | 784 | 784 | 356 |

- RSE = discounted value of the risk reductions, for life of mitigation, divided by cost of mitigation
- Suppose discount rate is 5%.
- RSE shown “per $million”

$$\text{RSE} = \frac{\sum_{i=0}^{4}\left(\frac{\left(RS_{Pre,i} - RS_{Post,i}\right)}{1.05^{i}}\right)}{PV\ (\$\ of\ project)}$$

Results:
- Tranche 2 has best RSE
- Tranche 1 has largest risk score reduction

# *Wire Down*

- SDG&E doesn't have a "Wire Down" risk. Wires down are part of the **Electric Infrastructure Integrity (EII)** risk.
- **EII Description:** The risk of an asset failure, caused by degradation, age, operation outside of design criteria due to unexpected events or field conditions (e.g., force of nature), or an asset no longer complying with the latest engineering standards, which results in a safety, environmental, or reliability incident.
- For purposes of workshop, provide illustrative example of a **Wire Down** risk
- Drivers/Triggers:
  - In-service equipment past its useful life or becomes obsolete
  - In-service equipment overloaded beyond specifications
  - In-service equipment catastrophically failing prematurely
  - Active in-service equipment and associated components failing to operate as designed
  - In-service equipment failing with lack of or delayed company insight
  - In-service equipment contacted by customers or third-parties
  - In-service equipment failing in large volume to acute climates
- Consequences
  - Life threatening injuries or fatalities
  - Significant, short-term environmental impacts
  - Operational and reliability impact
  - Findings and penalties of non-compliance
  - Penalties and Fines
  - Adverse litigation
  - Loss of shareholder value
  - Erosion of public confidence

# *Wire Down*

- Current mitigations:
  - Corrective Maintenance Program (CMP)
  - Distribution Inspection and Repair Program
  - Focus on spans of wire that have splices in them
- Tranches
  - Identify situations with similar CoRE and LoRE
  - For this example:
    - type of wire (i.e. material and thickness of wire.)
      - Data shows smaller wire has higher failure rates
    - Location of wire
      - Rural vs Urban
      - High wind areas vs non-high wind areas

# *Wire Down*

- Tranches (8 combinations)
  - Tranche 1: Large wire, urban, non-high wind
  - Tranche 2: Large wire, urban, high wind
  - Tranche 3: Large wire, rural, non-high wind
  - Tranche 4: Large wire, rural, high wind
  - Tranche 5: Small wire, urban, non-high wind
  - Tranche 6: Small wire, urban, high wind
  - Tranche 7: Small wire, rural, non-high wind
  - Tranche 8: Small wire, rural, high wind

## Impacts to LoRE/CoRE

**Large Wire**: Higher reliability, less likelihood
**Urban**: Higher safety, higher financial
**Wind**: Higher likelihood

## Tranche-level information; Pre-Mitigation

| | Tranche | Tranche 1 | Tranche 2 | Tranche 3 | Tranche 4 | Tranche 5 | Tranche 6 | Tranche 7 | Tranche 8 |
|---|---|---|---|---|---|---|---|---|---|
| Step 17 | **LoRE** | **0.00005** | **0.0001** | **0.00005** | **0.0001** | **0.0002** | **0.0004** | **0.0002** | **0.0004** |
| Step 18 | Safety | 2 | 2 | 0.5 | 0.5 | 2 | 2 | 0.5 | 0.5 |
| | Reliability | 0.00075 | 0.00075 | 0.00075 | 0.00075 | 0.0001875 | 0.0001875 | 0.0001875 | 0.0001875 |
| | Finance | $40M | $40M | $5M | $5M | $40M | $40M | $5M | $5M |
| | Reliability (Gas) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Reliability (SAIDI) | 1 | 1 | 1 | 1 | 0.25 | 0.25 | 0.25 | 0.25 |
| | Reliability (SAIFI) | 0.01 | 0.01 | 0.01 | 0.01 | 0.0025 | 0.0025 | 0.0025 | 0.0025 |
| Step 19 | **CoRE** | **102,188** | **102,188** | **25,438** | **25,438** | **102,047** | **102,047** | **25,297** | **25,297** |
| | **Risk Score** | **5.1** | **10.2** | **1.3** | **2.5** | **20.4** | **40.8** | **1** | **10.1** |

# *Wire Down*

- Illustrative Mitigation:
  - Re-conductoring of wires that have splices
  - Suppose re-conductoring will diminish failures from splices by 100% (not realistic).
  - Assume mitigation has 30 year life

- Assess impact to LoRE and CoRE
  - LoRE – Does the mitigation reduce likelihood of event? Yes
  - CoRE – Does the mitigation reduce the consequence if the event were to occur? No

  - Determine new LoRE and Core for 30 years.
  - Assume current mitigations still in place during 30 years

- Risk scores can vary year to year as situations occur.
  - Inflation causes financial costs to rise
  - Known changes in laws, regulations, etc. could account for known changes to risk

# Wire Down

Tranche-level information; Post-mitigation

| | Tranche | Tranche 1 | Tranche 2 | Tranche 3 | Tranche 4 | Tranche 5 | Tranche 6 | Tranche 7 | Tranche 8 |
|---|---|---|---|---|---|---|---|---|---|
| Step 20 | **LoRE** | **0.0000225** | **0.000045** | **0.0000225** | **0.000045** | **0.00009** | **0.00018** | **0.00009** | **0.00018** |
| Step 21 | Safety | 2 | 2 | 0.5 | 0.5 | 2 | 2 | 0.5 | 0.5 |
| | Reliability | 0.00075 | 0.00075 | 0.00075 | 0.00075 | 0.0001875 | 0.0001875 | 0.0001875 | 0.0001875 |
| | Finance | $40M | $40M | $5M | $5M | $40M | $40M | $5M | $5M |
| | Reliability (Gas) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Reliability (SAIDI) | 1 | 1 | 1 | 1 | 0.25 | 0.25 | 0.25 | 0.25 |
| | Reliability (SAIFI) | 0.01 | 0.01 | 0.01 | 0.01 | 0.0025 | 0.0025 | 0.0025 | 0.0025 |
| Step 22 | **CoRE** | **102,188** | **102,188** | **25,438** | **25,438** | **102,047** | **102,047** | **25,297** | **25,297** |
| | **Risk Score** | **2.3** | **4.6** | **0.6** | **1.1** | **9.2** | **18.4** | **2.3** | **4.6** |

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

# *Workplace Violence*

Tranche 1

Step 23

| Year | 2018 | 2019 | 2020 | … | 2046 | 2047 |
|---|---|---|---|---|---|---|
| Pre-Mitigation Risk Score | 5.109 | 5.112 | 5.115 | | 5.238 | 5.245 |
| Post-Mitigation Risk Score | 2.299 | 2.301 | 2.302 | | 2.357 | 2.360 |
| Risk Reduction | 2.810 | 2.812 | 2.814 | | 2.881 | 2.885 |

# Workplace Violence

Step 25

| | | | Risk Reductions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year | PV Cost per span | 2018 | 2019 | 2020 | … | 2021 | 2022 | RSE* |
| | Tranche 1 | $100K | 2.810 | 2.812 | 2.814 | | 2.881 | 2.885 | **128** |
| | Tranche 2 | $100K | 5.620 | 5.624 | 5.627 | | 5.762 | 5.770 | **256** |
| | Tranche 3 | $100K | 0.700 | 0.700 | 0.700 | | 0.708 | 0.709 | **32** |
| | Tranche 4 | $100K | 1.399 | 1.399 | 1.400 | | 1.417 | 1.418 | **64** |
| | Tranche 5 | $50K | 11.225 | 11.232 | 11.239 | | 11.509 | 11.524 | **1022** |
| | Tranche 6 | $50K | 22.450 | 22.464 | 22.477 | | 23.017 | 23.047 | **2044** |
| | Tranche 7 | $50K | 2.783 | 2.783 | 2.784 | | 2.818 | 2.820 | **253** |
| | Tranche 8 | $50K | 5.565 | 5.567 | 5.569 | | 5.636 | 5.640 | **506** |

# Questions?

# Gas Transmission Pipeline Failure

July 6th, 2018

Together, Building
a Better California

# Step 3 – Mitigation Analysis for Risks in RAMP

** Row 14 and 15 from Appendix A*

- **Definition of Risk Event**: Rupture of a transmission pipeline resulting in loss of containment and/or uncontrolled gas flow

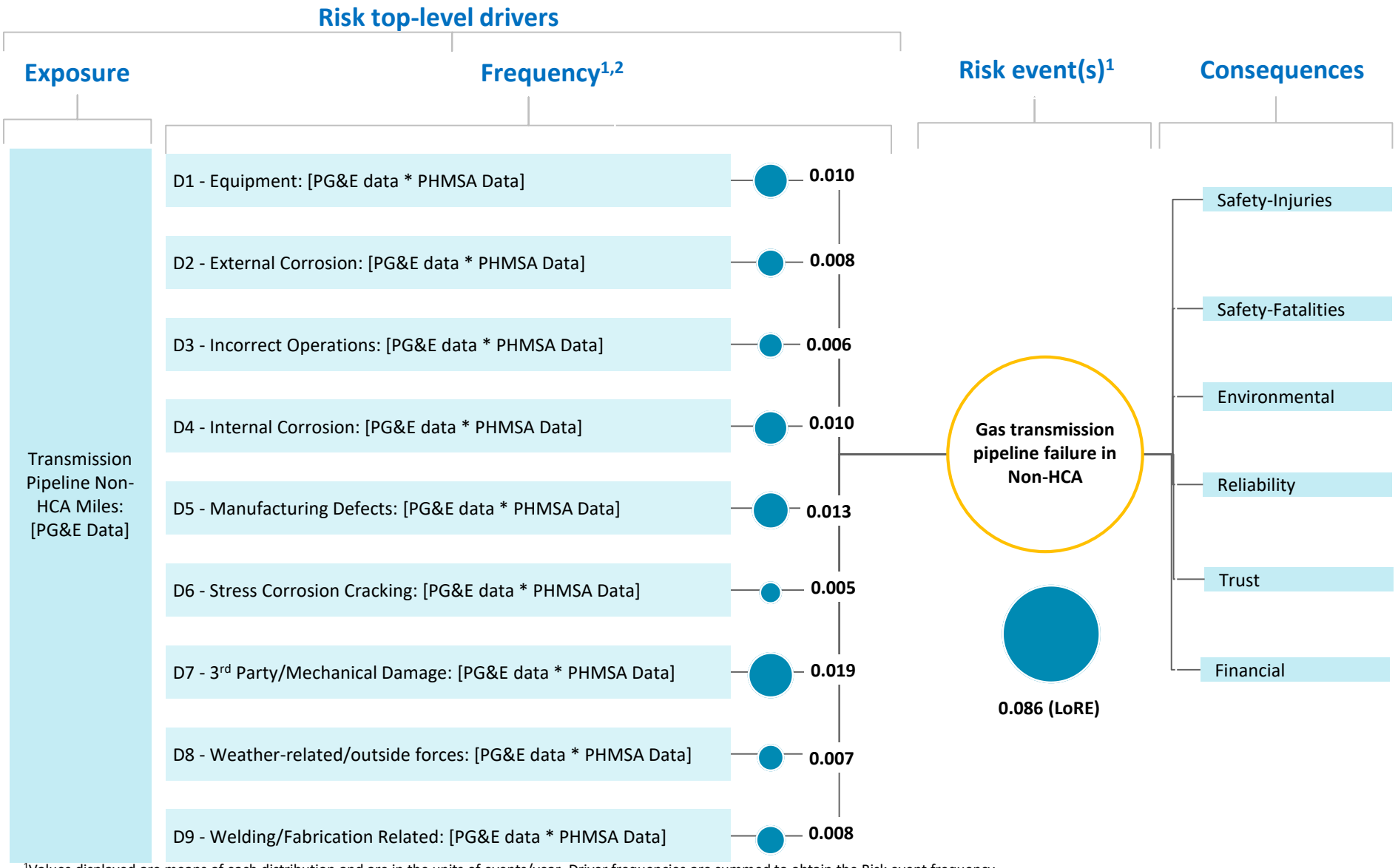
- **Determination of Tranches:** PG&E will split up this risk event into two tranches (subdivision of assets) defined by HCA and non-HCA pipeline failures. For each tranche, the risks are assessed over the same nine ASME B31.8S risk drivers.

- **Bow Tie:** The exposure for the risk, drivers for the risk as well as the probability of a risk event related to each risk driver are depicted in the Bow Tie in the next slide.

# Step 3 – Mitigation Analysis for Risks in RAMP: Non-HCA

*Bow Tie*

**Row 15 and 17 from Appendix A*




[1]Values displayed are means of each distribution and are in the units of events/year. Driver frequencies are summed to obtain the Risk event frequency.

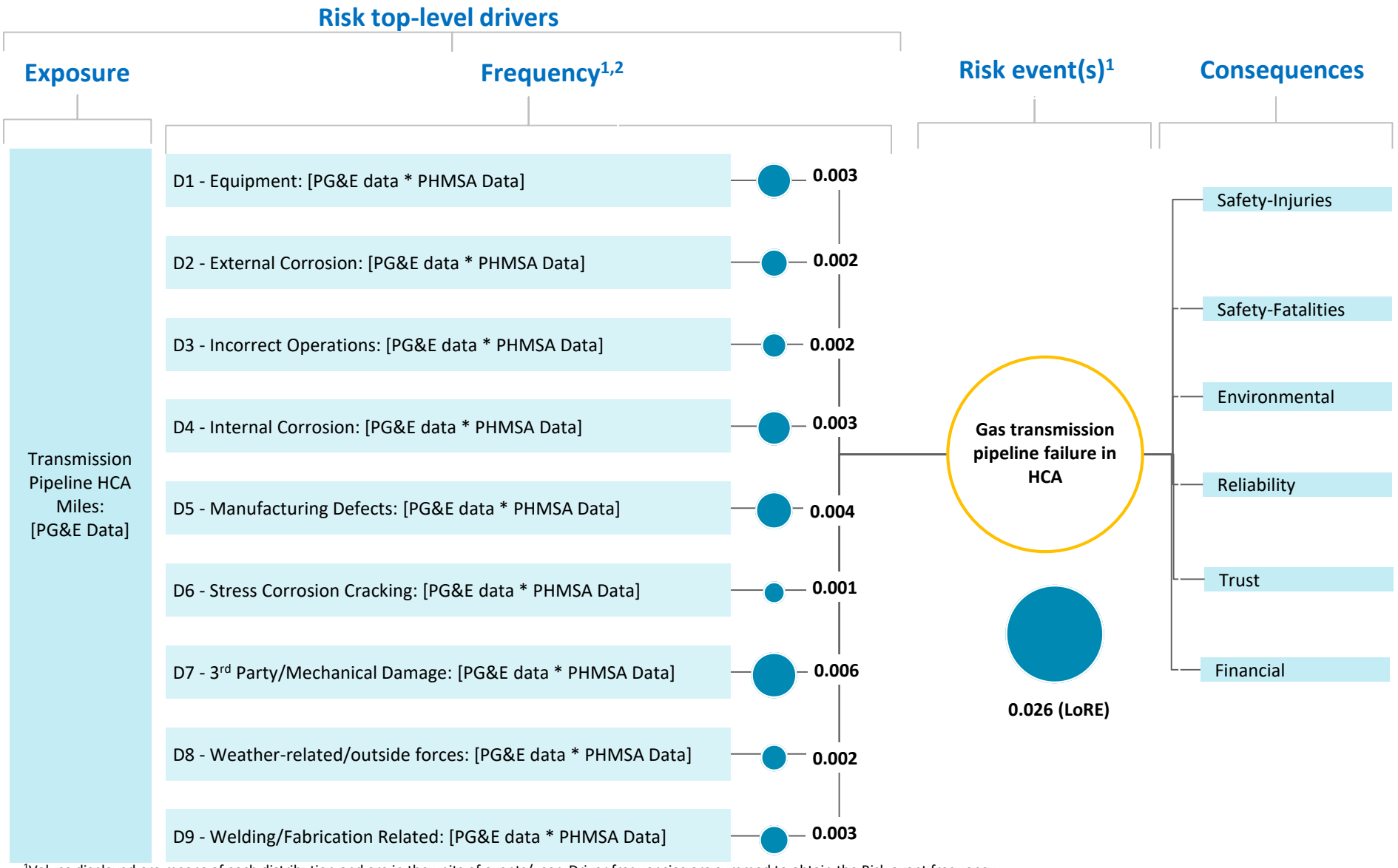
[2]Drivers are modeled using Poisson and Binomial distributions.

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP: HCA

*Bow Tie*

**Row 15 and 17 from Appendix A*




[1]Values displayed are means of each distribution and are in the units of events/year. Driver frequencies are summed to obtain the Risk event frequency.

[2]Drivers are modeled using Poisson and Binomial distributions.

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP: Non-HCA

***Determination of pre-mitigation CoRE***

****Row 18 of Appendix A***

| | Safety-Injuries | Safety-Fatalities | Environmental | Reliability | Trust | Financial |
|---|---|---|---|---|---|---|
| **Source** | PHMSA | PHMSA | PG&E Data | PG&E Data | PG&E Data and SME Input | PHMSA |
| **Consequence** | Percent of onshore, ignited incidents with injury or fatality | Percent of onshore, ignited incidents with injury or fatality | Min=$0<br>Max=$1M<br>(Uniform) | System likelihood of customer outage =12%<br>x Customers (Normal):<br>Ave=22k<br>Std Dev=23k<br><br>x Customer minutes (Uniform):<br>Min=0 days *24*60<br>Max=2 days *24*60 | Dependent on Safety outcomes.<br><br>If there are any fatalities= High severity brand favorability change<br><br>If there are injuries without fatalities, 50/50 chance of Low or Severe<br><br>High severity=12-20%<br>Severe=5-12%<br>Low=0-5%<br>(Uniform) | Average and Standard Deviation derived from PHMSA data |
| **Outcome-NU** | 1.00 | 0.20 | $ 600,000 | 6,000,000 | 2.0% | $ 10,000,000 |
| **Outcome-MAVF** | 0.30 | 6.00 | 0.06 | 16.00 | 10.00 | 6.00 |
| | | | | | **MAVF (CoRE) Total** | **38.36** |

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP: HCA

***Determination of pre-mitigation CoRE***

****Row 18 of Appendix A***

| | Safety-Injuries | Safety-Fatalities | Environmental | Reliability | Trust | Financial |
|---|---|---|---|---|---|---|
| **Source** | PHMSA | PHMSA | PG&E Data | PG&E Data | PG&E Data and SME Input | PHMSA |
| **Consequence** | Percent of onshore, ignited incidents with injury or fatality | Percent of onshore, ignited incidents with injury or fatality | Min=$0<br>Max=$1M<br>(Uniform) | System likelihood of customer outage =12%<br>x Customers (Normal):<br>Ave=22k<br>Std Dev=23k<br><br>x Customer minutes (Uniform):<br>Min=0 days *24*60<br>Max=2 days *24*60 | Dependent on Safety outcomes.<br><br>If there are any fatalities= High severity brand favorability change<br><br>If there are injuries without fatalities, 50/50 chance of Low or Severe<br><br>High severity=12-20%<br>Severe=5-12%<br>Low=0-5%<br>(Uniform) | Average and Standard Deviation derived from PHMSA data |
| **Outcome-NU** | 2.00 | 0.40 | $ 800,000 | 10,000,000 | 5.0% | $ 15,000,000 |
| **Outcome-MAVF** | 0.60 | 12.00 | 0.10 | 20.00 | 18.00 | 9.00 |
| | | | | | **MAVF (CoRE) Total** | **59.70** |

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

*Determination of pre-mitigation risk score*

**Row 19 of Appendix A*

**Pre-Mitigation Risk Score =** Pre-Mitigation LoRE x Pre-Mitigation CoRE

## Gas Transmission Pipeline in non-HCA

- Pre-Mitigation Risk Score = 0.0879 x 38.36 = 3.371

## Gas Transmission Pipeline in HCA

- Pre-Mitigation Risk Score = 0.0263 x 59.70 = 1.570

***Calculate risk score as necessary over the life of the benefit period***

| Risk Score | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
|---|---|---|---|---|---|---|---|---|
| LoRE x CoRE[1] (Risk Units) | | 3.371 | 3.371 | 3.371 | 3.371 | 3.371 | 3.371 | 3.371 |
| PV at Y0[2] (Risk Units) | | 3.210 | 3.058 | 2.912 | 2.773 | 2.641 | 2.515 | 2.396 |
| PV[3] (Risk Units) | 19.51 | | | | | | | |

[1]Assumed risk does not change over time for illustrative purposes
[2]Assumed 5% discount rate for illustrative purposes
[3]PV is the sum of the present value at year 0 for years 1-7

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

***Expressing effects of a mitigation in non-HCA***

****Row 16 of Appendix A***

**Mitigation In-line Inspections (ILI)**

| | | **Justifications** |
|---|---|---|
| Exposure this applies to in the first year | 40 | Annual average for miles of first inspections to be completed in rate case period |
| Percent of base year exposure | 1% | |
| **Risk Drivers** | | |
| Equipment | 0% | |
| External corrosion | 95% | Rare to miss something that would fail by rupture, finding and assessing proactively, with safety factors. Slightly less than 100% to account for tool tolerances |
| Incorrect operational procedure | 0% | |
| Internal corrosion | 95% | IC is more difficult to detect growth rates, thus less effective than EC. Effective at finding IC. |
| Manufacturing related defects | 10% | Lower overall effectiveness because it only applies to subset of total mileage. 75% effective at detecting gross defects. Applies to 15% of mileage. EMAT + circumferential mfl. 15% effective. .15x.75=11.25 rounded to 10% effective. |
| Stress corrosion cracking | 10% | Lower overall effectiveness because it only applies to subset of total mileage. 75% effective at detecting gross defects. Applies to 15% of mileage. EMAT + circumferential mfl. 15% effective. .15x.75=11.25 rounded to 10% effective. |
| Third party/mechanical damage | 5% | Only 4% of 3rd party incidents (PHMSA database) were due to prior (latent) damage. Effective only for latent damage. 95% effective at finding 4% of rupture potential damage, 3.8% rounded up to 5%. |
| Weather-related and outside force | 5% | WROF is interactive threat with multiple factors– run geo pigs for strain. WROF is interactive with Welding/fabrication. Not highly effective. Considered exposure & effectiveness. Less effective than welding/fabrication. 80% effective due to subset of WROF that ILI can detect. PHMSA land movement incidents subset, 80% effective, applies to 25% of WROF |
| Welding/fabrication related | 25% | Identifies many features. Exposure is approximately 48.2% of incidents attributed to Defective Girth Welds, and 16.9% of incidents attributed to construction damage. 80% effective at identifying and preventing. 25% effective overall. |
| | | |
| Safety1_Injury | N/A | This mitigation does not impact any of the consequence categories. |
| Safety1_Fatality | N/A | |
| Environmental | N/A | |
| Reliability | N/A | |
| Trust | N/A | |
| Financial | N/A | |

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

***Expressing effects of a mitigation in HCA***

****Row 16 of Appendix A***

**Mitigation In-line Inspections (ILI)**

| | | **Justifications** |
|---|---|---|
| Exposure this applies to in the first year | 160 | Annual average for miles of first inspections to be completed in rate case period |
| Percent of base year exposure | 3% | |
| **Risk Drivers** | | |
| Equipment | 0% | |
| External corrosion | 95% | Rare to miss something that would fail by rupture, finding and assessing proactively, with safety factors. Slightly less than 100% to account for tool tolerances |
| Incorrect operational procedure | 0% | |
| Internal corrosion | 95% | IC is more difficult to detect growth rates, thus less effective than EC. Effective at finding IC. |
| Manufacturing related defects | 10% | Lower overall effectiveness because it only applies to subset of total mileage. 75% effective at detecting gross defects. Applies to 15% of mileage. EMAT + circumferential mfl. 15% effective. .15x.75=11.25 rounded to 10% effective. |
| Stress corrosion cracking | 10% | Lower overall effectiveness because it only applies to subset of total mileage. 75% effective at detecting gross defects. Applies to 15% of mileage. EMAT + circumferential mfl. 15% effective. .15x.75=11.25 rounded to 10% effective. |
| Third party/mechanical damage | 5% | Only 4% of 3rd party incidents (PHMSA database) were due to prior (latent) damage. Effective only for latent damage. 95% effective at finding 4% of rupture potential damage, 3.8% rounded up to 5%. |
| Weather-related and outside force | 5% | WROF is interactive threat with multiple factors– run geo pigs for strain. WROF is interactive with Welding/fabrication. Not highly effective. Considered exposure & effectiveness. Less effective than welding/fabrication. 80% effective due to subset of WROF that ILI can detect. PHMSA land movement incidents subset, 80% effective, applies to 25% of WROF |
| Welding/fabrication related | 25% | Identifies many features. Exposure is approximately 48.2% of incidents attributed to Defective Girth Welds, and 16.9% of incidents attributed to construction damage. 80% effective at identifying and preventing. 25% effective overall. |
| | | |
| Safety1_Injury | N/A | This mitigation does not impact any of the consequence categories. |
| Safety1_Fatality | N/A | |
| Environmental | N/A | |
| Reliability | N/A | |
| Trust | N/A | |
| Financial | N/A | |

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

***Determination of post-mitigation LoRE and CoRE in non-HCA***

****Row 20 , 21, and 22 of Appendix A***

## ILI Risk Reduction over Benefit Period:

Assumptions:

a) ILI benefit period is 7 years based on a 7 year assessment cycle
b) 5% discount rate assumed

## Calculate post-mitigation LoRE based on effects of mitigation:

| LoRE | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
|---|---|---|---|---|---|---|---|---|
| | | 0.0879 | 0.0835 | 0.0793 | 0.0754 | 0.0716 | 0.0680 | 0.0646 |

## Calculate post-mitigation CoRE based on effects of mitigation:

| CoRE | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
|---|---|---|---|---|---|---|---|---|
| | | 38.36 | 38.36 | 38.36 | 38.36 | 38.36 | 38.36 | 38.36 |

## Calculate post-mitigation risk score based on effects of mitigation:

| Risk Score | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
|---|---|---|---|---|---|---|---|---|
| LoRE x CoRE (Risk Units) | | 3.37 | 3.20 | 3.04 | 2.90 | 2.75 | 2.61 | 2.48 |
| PV at Y0 (Risk Units) | | 3.21 | 2.91 | 2.63 | 2.38 | 2.15 | 1.95 | 1.76 |
| PV (Risk Units) | 16.98 | | | | | | | |

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

***Determination of post-mitigation risk score and calculation of RSE in non-HCA***

****Row 23 and 25 of Appendix A***

Mitigation risk reduction benefit provided by ILI in non-HCA:

- NPV of pre-mitigation risk score – NPV of post-mitigation risk score = **19.51 - 16.98 = 2.53**

Mitigation cost estimate for ILI Costs over Benefit Period:

- Assumption: Capital $100M and Expense $50M at beginning.

Risk Spend Efficiency (RSE) is the ratio of the risk reduction benefit to mitigation cost estimate:

RSE = 2.53 / $150M = **0.0168/$M**

All values contained on this slide are purely for illustrative purposes

# Step 3 – Mitigation Analysis for Risks in RAMP

Note:

- Example is meant to be illustrative of the process required by the SMAP settlement.
- PG&E has not modeled this risk and run through the Gas Transmission Pipeline Failure risk per the SMAP settlement requirements.
- All data and results presented are illustrative including tranches and number of tranches used and bow-tie representation of the risk.

# Joint Intervenor Comments on Illustrative Examples

***Energy Producers and Users Coalition***

***Indicated Shippers***

TURN
THE UTILITY REFORM NETWORK
Lower bills. Livable planet.

# Utilities Have Provided Simplified Examples

- Designed to show the basics of how Step 3 of the settlement will be implemented.
- Not meant to show what full implementation of the settlement would look like.
- In a RAMP/GRC submission:
  - Much more information would be provided to allow the Commission and parties to understand how the numbers were derived. (Rows 29 and 30)
  - Analysis would be more detailed.

# Settlement Prescribes Minimum Elements (Row 33)

- Settling Parties expect that parties will be free to question and challenge utility submissions, including utility choices and judgments in addressing required elements.
- Examples of types of issues that could get raised:
  - Is utility's MAVF based on reasonable judgments? (Rows 1-7)
  - Is the analysis sufficiently granular (e.g., using sufficient number of "tranches")? (Definitions, Row 14)
  - Are LoRE and CoRE pre- and post-mitigation estimates reasonable and based on appropriate sources? (Rows 16-23, 31)
  - Are RSE calculations reasonable? E.g, using reasonable cost estimates, appropriate discount rate (Row 25)

# RAMP Risk Selection (data is illustrative)

## Step 2A, Row 9

1. 125 risks are on the Utility's Enterprise Risk Register (ERR)
2. 60 of the 125 have safety score greater than 0
3. The 60 risks are ranked in order from highest to lowest safety score
4. The top 40% of the 60 risks (24 risks) are then scored on safety, reliability, and financial attributes (scoring on other attributes is optional)

## Step 2B

1. Utility presents the results of Step 2A at a public workshop
   a. Safety score for the 60 ERR risks that have a safety impact
   b. Multi-attribute score for the 24 risks that represent the top 40% of the ranked list of the 60 ERR risks with a safety impact
2. Collaborative discussion on which risks make the cut for RAMP

## Does this change what ends up in RAMP?

- Selection of risks: more information is available and more opportunities for collaboration regarding how potential RAMP risks are evaluated
- Type of risks: potential for inclusion of risks that have major safety impact as well as reliability and financial impact(s)
- Mitigation selection: RSE calculations are independent of RAMP risk selection; determined by MAVF construction and nature of mitigations identified for each RAMP risk