Risk Assessment and Mitigation Phase (RAMP) Workshop

I.18-11-006

Southern California Edison Company

12/14/18

Today's Agenda

Topic	Presenter	Time
Safety Moment	SED	10:00 – 10:05
Opening Remarks	SED	10:05 – 10:10
RAMP Overview	Joanne Tran	10:10 – 10:40
RAMP Risk Modeling Overview	Gary Cheng	10:40 – 11:10
Chapter Review: *Contact with Energized Equipment*	Bob Woods	11:10 – 11:40
Break: Lunch		***11:45 – 1:00***
Chapter Review: *Wildfire*	Brian Chen	1:00 – 1:30
Chapter Review: *Employee, Contractor & Public Safety*	Dean Yarbrough	1:30 – 2:00
Q&A	All	2:00 – 2:30
Power BI Demonstration	Gary Cheng	2:30 – 2:55
Concluding Remarks	SED	2:55 – 3:00

RAMP Overview

Joanne Tran
Director, Risk Management

SOUTHERN CALIFORNIA EDISON®

Key Events Leading up to SCE 2018 RAMP Report

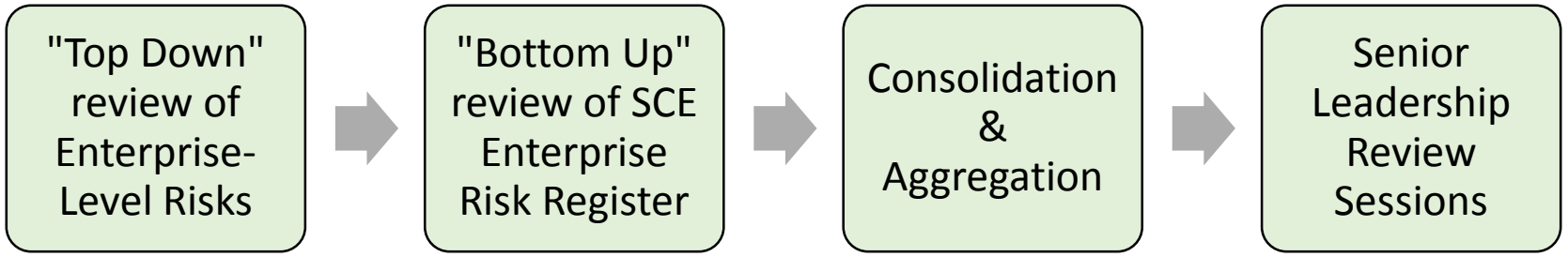
2013	• Rulemaking to incorporate a risk-based framework into the Rate Case Plan (R.13-11-006)
2014	• Rate Case Plan modified to include risk-based framework and provide transparent process to make safety of public and employees the top priority in GRC proceedings (D.14-12-025) • 2015 GRC supplemental testimony on risk management and safety matters
2015	• First Safety Model Assessment Application filed, presenting utility risk management practices
2016	• Risk-informed analysis included in 2018 GRC Application using then-available risk planning tools and processes • Interim S-MAP decision issued with further guidelines for RAMP reports (D.16-08-018)
2017	• Collaborative discussions with Commission staff, parties, and utilities to further develop consistent risk evaluation process and tools
2018	• Development of S-MAP Settlement • File 2018 RAMP report

Summary of SCE's 2018 RAMP Report

- RAMP is a "journey" – Our first RAMP report represents another step in an evolving risk management program
- Report represents a significant collaborative effort, both with external partners (Commission staff, parties, utilities) and internal staff (over 100 people from nearly every part of company, at every level)
- We built first-generation risk models, and designed an interactive reporting tool to evaluate and report results
- We developed a Multi-Attribute Risk Scoring (MARS) framework consistent with S-MAP settlement principles
- Our RAMP report complies with regulatory requirements
- Our RAMP report marks significant progress toward S-MAP Settlement principles
- We learned a lot and have identified opportunities for continued enhancement

Identification of Top Safety Risks for Inclusion in RAMP

- Top safety risks were determined using a combination of “top down” and “bottom up” review of safety risks



Top enterprise risks were evaluated based on safety impacts

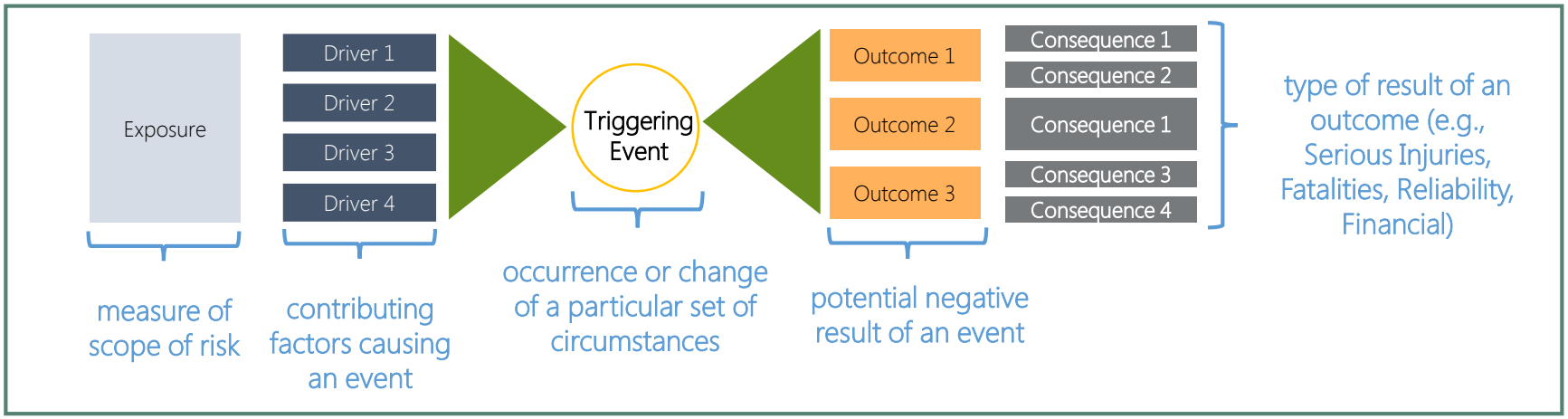
Risks that had reasonable potential for serious injury and/or fatality

Overlapping and duplicative risks were consolidated, and organized according to risk bowtie structure

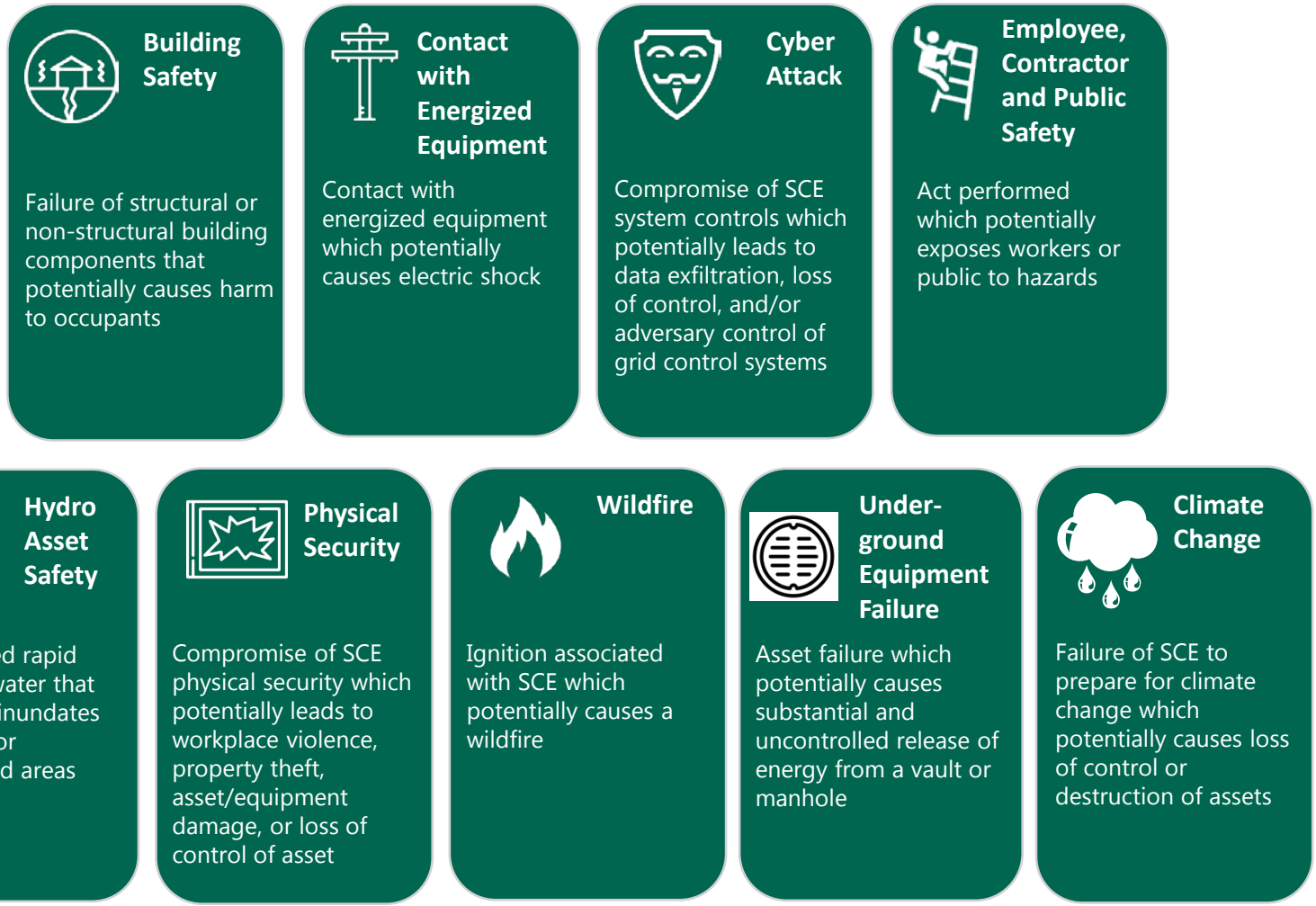
Iterative review process with senior leadership

SCE used the risk bowtie to structure risk assessment

- Risk is defined as exposure to an event that could lead to a negative outcome with one or more risk consequences
- A Bowtie maps the progression of a risk from its drivers to the risk event; and to its outcomes and associated consequences
- A Bowtie helps delineate factors that may lead to the risk event, and the potential consequences that the outcome of the risk event may have



Nine Safety Risks Were Selected for RAMP[1]



[1] Seismic events, an identified top safety risk for SCE, are included as a driver within several risk chapters. Nuclear Decommissioning and Transmission / Substation safety risks are addressed qualitatively in appendices.

SCE's 2018 RAMP Report Structure

#	Chapter
1	RAMP Report Overview
2	Risk Model Overview
3	Safety Culture & Compensation Policies Tied to Safety
4	Building Safety
5	Contact with Energized Equipment
6	Cyber Attack
7	Employee, Contractor & Public Safety
8	Hydro Asset Safety *(including long-term analysis)*
9	Physical Security
10	Wildfire *(including appendix with long-term analysis of covered conductor)*
11	Underground Equipment Failure
12	Climate Change
13	Appendix A: Nuclear Decommissioning
14	Appendix B: Transmission & Substation
15	Appendix C: Seismic Events

Foundational Information

Quantitative Risk Analyses *(see next slide for structure)*

Supplementary Qualitative Risk Assessments

Background: Activities evaluated in RAMP

1. **Compliance:** Currently established measure that is modifying or reducing risk, which is required by law or regulation
   - E.g.: General Orders (e.g. 165), FERC and Dam Safety Division (DSOD) annual inspections, Federal & Cal OSHA Requirements
   - Risk modeled in RAMP: **No**

2. **Control:** Currently established measure that is modifying or reducing risk, which is not required by law or regulation
   - E.g.: Overhead Conductor Program
   - Risk modeled in RAMP: **Yes**

3. **Mitigation:** A new or incremental measure that will modify or reduce risk
   - E.g.: Covered conductor
   - Risk modeled in RAMP: **Yes**

SCE evaluated risk reduction and costs of controls and mitigations over the 2018 – 2023 time period.

Structure of Each Top Safety Risk Chapter

Sec	Title	Description
I	Executive Summary	Risk overview, scope, summary results
II	Baseline Risk Assessment	Baseline risk background, risk bowtie, and identification and analysis of drivers, outcomes, and consequences
III	Compliance and Controls	Identification of existing compliance and control activities that address risk, 2017 recorded costs, and discussion of how each control affects the risk bowtie
IV	Mitigations	Identification of new mitigation activities that address risk, and discussion of how each control affects the risk bowtie
V	Proposed Plan	Risk reduction, cost, and risk spend efficiency (RSE) of each control and mitigation contained in each Plan, as well as for each Plan overall. Discussion of why each Plan was selected as the proposed one or not, including execution feasibility, affordability, resource constraints, technological feasibility, etc.
VI	Alternative Plan #1	
VII	Alternative Plan #2	
VIII	Lessons Learned, Data Observations, Metrics	Discussion of lessons learned, challenges with data analysis, and potential metrics to measure performance

Lessons Learned and Opportunities for Growth

Topical Area	Lessons Learned
Time Period Evaluated	SCE evaluated mitigation costs and benefits over the 2018 – 2023 period • For mitigations that persist beyond 2023, risk reduction and costs were not fully captured, resulting in artificially lower RSE scores for some mitigations
Risk Impacts Measured	SCE only measured the immediate primary impacts of a risk • As secondary risk impacts were not quantifiable with a reasonable degree of confidence for this RAMP report, the full range of risk impacts presented may be understated
Mitigations in Multiple Chapters	Mitigations that benefit multiple risks were accounted for separately in each chapter, while full costs included in each chapter • This approach potentially understates the risk reduction and RSE of these mitigations by not showing the combined impact across risks
MARS	MARS framework provides an essential complement to measuring risk from the perspective of natural units • However, applying MARS requires concerted efforts to educate internal stakeholders

RAMP Timeline

Develop RAMP Report

- Engage external partners (Commission staff, parties, utilities)

File RAMP

SED / SCE Public Workshop *(today)*
SCE provides overview of RAMP report

SED Report *(by 3/15)*
SED files report on SCE's RAMP report

SED Workshop *(by 3/29)*
SED reviews SCE's RAMP report

Party Review (by 4/19)
Parties serve comments on SCE's RAMP report; and on SED's staff report

Incorporation of RAMP into 2021 GRC

For reference: Magnitude of RAMP cost estimates would account for approximately 15-20% of GRC request

File GRC

SCE's 2018 RAMP Report Results

- To access SCE 2018 RAMP report:
  1. www.sce.com/applications
  2. Click on "SCE 2018 RAMP"
  3. Select document

- SCE will furnish the risk models used to perform risk analyses upon request
  - To request the risk models, please send an email to Case.Admin@sce.com and reference the 2018 RAMP report in the transmittal

- Due to the amount of data produced in each model, SCE has developed a more intuitive reporting interface for stakeholders to view and evaluate the inputs and outputs of the risk models, using Microsoft's Power BI tool
  - Only an internet connection is required; no software installation needed
  - To gain access, please fill out form and send to Case.Admin@sce.com:
    - Please refer to Workpapers Ch. 1, pp. 1.5 – 1.8 *(RAMP Power BI Access Form & Sign-up Instructions)*
    - Please refer to Workpapers Ch. 1, pp. 1.9 – 1.40 *(RAMP Power BI User Guide)*

RAMP Risk Modeling Overview

Gary Cheng
Senior Advisor, Risk Management

SOUTHERN CALIFORNIA EDISON®

The Risk Model Built for RAMP has Advanced our Capabilities and Progress Toward S-MAP Principles

- Risk model quantifies risk, and the effect of risk mitigations, using a probabilistic approach
  - Uses Monte Carlo simulation, a widely used modeling technique
  - Models distributions of data and not single data points
  - Enables use of different distributions to best represent data
- Risk model utilizes Multi-Attribute Value Function principles (referred to as MARS in our RAMP Model) used in S-MAP
- Risk model quantifies the impacts of risk mitigation activities
- Data and assumptions used for risk model inputs are provided throughout the RAMP report and workpapers in a transparent manner

Risk Attributes Measured in RAMP

- While RAMP is initially focused on key safety risks, the risk evaluation and mitigation analysis is "multi-attribute," meaning it quantifies risk and mitigation impacts beyond just safety impacts.

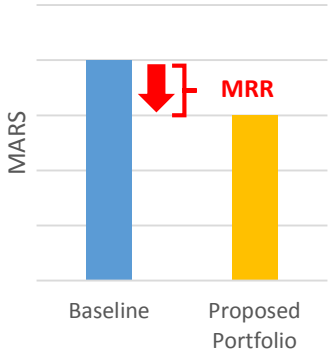
- SCE included four consequence attributes in this RAMP:

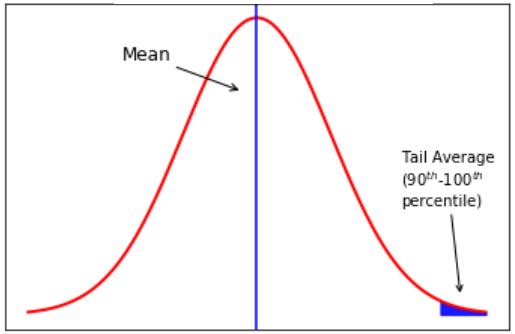
	Serious Injuries	Fatalities	Reliability	Financial
Description	The potential impact of a risk event on **public or worker safety**	The potential impact of a risk event on **public or worker safety**	The potential impact of a risk event on **service reliability**	The potential impact of a risk event on a **financial consequence** to customers and/or third parties
Natural Unit of Measurement	Serious Injuries (#)	Fatalities (#)	Customer Minutes of Interruption (CMI)	Dollars

Key Analytical Concepts for Risk Modeling in RAMP

(1) Mitigation Risk Reduction (MRR)

- The Baseline measures risk before controls and mitigations are applied
- MRR is the reduction to risk after controls and mitigations are applied
- The baseline minus the MRR shows the remaining risk after a mitigation or given portfolio of mitigations is applied





(2) Mean vs. Tail-Average

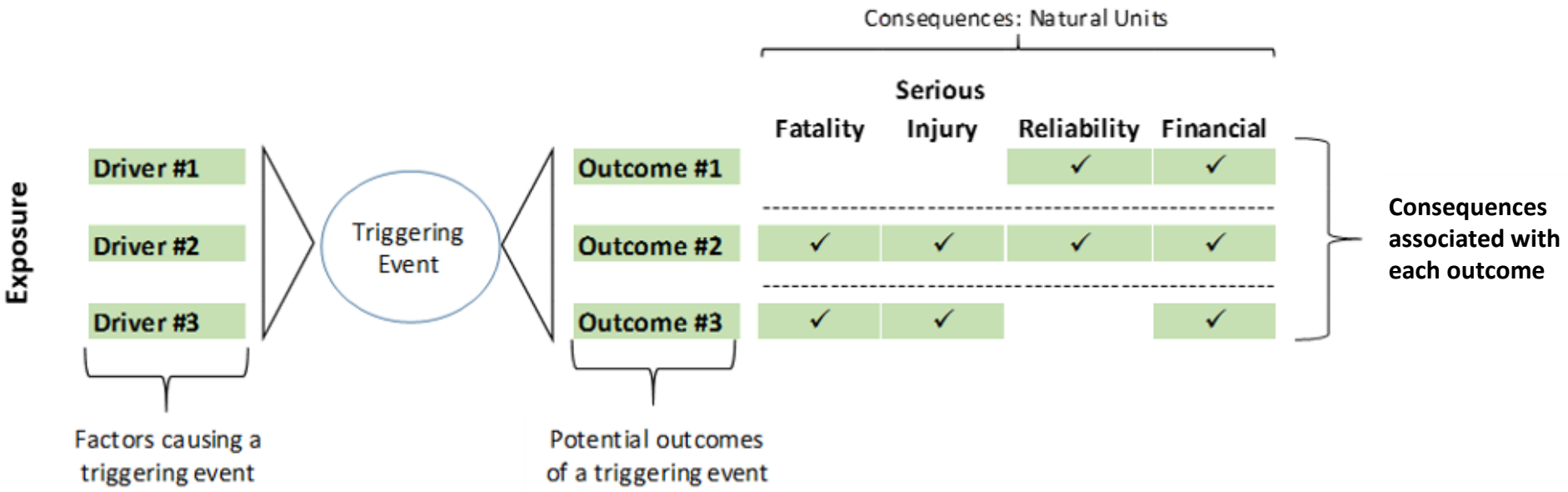
- The model simulates 10,000 scenarios given the parameters of the bowtie
- The mean is the average of all 10,000 simulation results
- The tail-average is the average of the worst 10% of all 10,000 simulation results

(3) Risk Spend Efficiency (RSE)

- Measures the effectiveness of each mitigation or mitigation plan (Proposed, Alternative 1 , Alternative 2)

$$RSE = \frac{Baseline\ MARS - Post\ Mitigation\ MARS}{Expenditures\ (Millions)}$$

SCE Used the Risk Bowtie to Structure Risk Assessment



- **Baseline Risk:** Quantify the value of each bowtie parameter
  - Driver frequency (# of occurrences per year)
  - Outcome likelihood (% of time triggering event leads to each Outcome)
  - Consequence impacts (in natural units when Outcome occurs)

- **Mitigation Effects:** Quantify how each control/mitigation affects bowtie parameters
  - Reduce exposure, driver frequency, outcome likelihood, or consequence impacts

Model Architecture Overview

Model Input

Baseline Data
- Exposure
- Driver Frequency
- Outcome Probability
- Consequence Distribution

Mitigations Data
- Cost
- Mitigation Reduction Percentages
- Mitigation Exposure
- Mitigation Portfolios

Simulation Engine

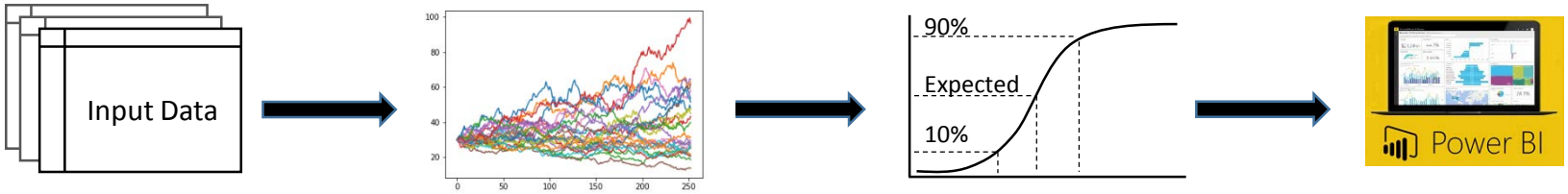
Monte Carlo Simulation
- Random draws from driver, outcome and consequence distributions
- Iterate 10,000 times for each year
- Perform above steps for Baseline and each mitigation portfolio

Model Outputs

Output
- Distribution of consequences by outcome in natural units
- Mean and Tail Average
- MARS
- Risk Spend Efficiency for portfolio and mitigations

Reporting

Power BI
- Cloud-based visualization tool
- Review input and output data



SCE used the @RISK software from Palisade to perform risk modeling and simulation efforts

SCE Developed a Multi-Attribute Risk Score (MARS) Approach for Measuring Risk in RAMP

Why do we need a MARS?

- In order to assess risk across multiple attributes (i.e. Serious Injuries, Fatalities, Reliability, Financial), and to compare risks from different parts of the business (e.g. T&D Asset Risk vs. Worker Safety), we developed an appropriate methodology for comparison.

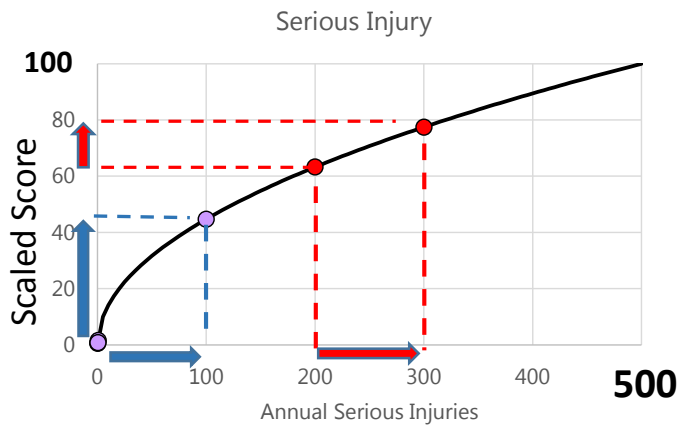
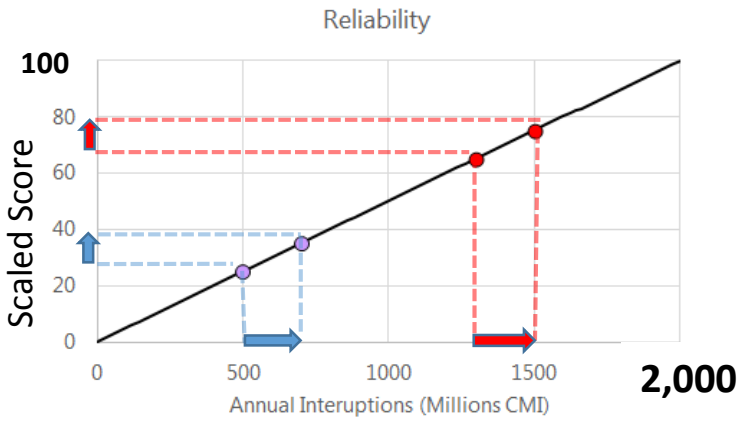
- MARS is aligned to the Multi-Attribute Value Function in the S-MAP settlement

MARS Framework has Three Primary Components[1]

Step 1: **Ranges**	• Establish a **range** of potential impacts for each attribute that can accommodate the worst reasonably possible impact for each risk over the course of a year: ➢ Fatality: **0 – 100** ➢ Serious Injury: **0 – 500** ➢ Reliability: **0 – 2 billion CMI** ➢ Financial: **0 – $5 billion**
Step 2: **Weights**	• Determine appropriate **weights** for each attribute that portray importance of each attribute relative to each other ➢ Set weights for each attribute equal at 25% (i.e., **50% for safety**)
Step 3: **Scales**	• Develop a **scaling function** aligns the natural units of each attribute to a generic unit-less range from 0-100 ➢ Fatality: **Square Root** ➢ Serious Injury: **Square Root** ➢ Reliability: **Linear** ➢ Financial: **Linear**

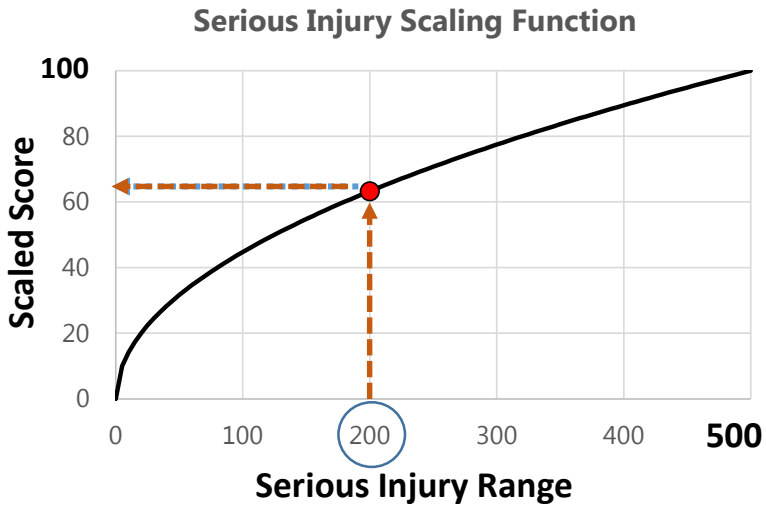
[1] Values assigned to MARS components within the 2018 RAMP report may change in the future

Scaling Functions Used in SCE's 2018 RAMP

	Serious Injury & Fatality	Reliability & Financial
Scale	***Square Root***	***Linear***
Rationale	• Steep initial curves reflect low tolerance for serious injuries or fatalities • Scales amplify the impact of safety versus the other two attributes (financial and reliability)	• Maintain simplicity of measurement in absence of data showing relative level of aversion to impacts at the lower and upper bounds of financial range • Does not presume a level of customer tolerance to short or long duration outages
Example Curve	 Serious Injury Range	 Reliability Range

Illustrative Example of MARS Calculation

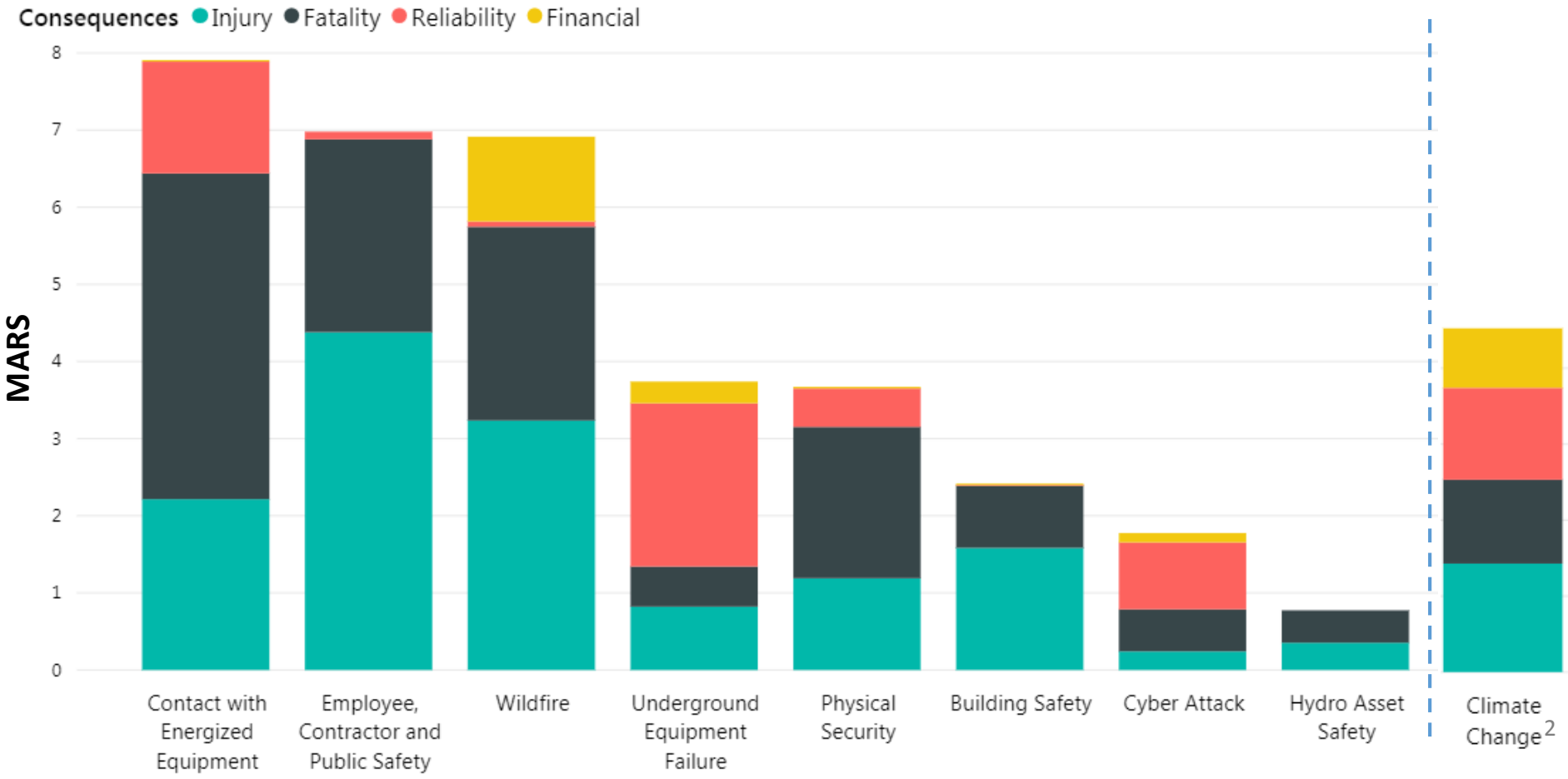
Step	Action	Value
(a)	Identify Natural Unit Value	200
(b)	Determine Scaled Score	63.25
(c)	Identify Attribute Weight	25%
(d) = (b) * (c)	Apply Weights	15.81
(e)	**Risk Score** *(Serious Injury only)*	**15.81**



- **Step (a):** 200 represents the expected value from the Monte Carlo simulations in natural units.
- **Step (b):** X-axis is the range defined for Serious Injuries. The value of 200 serious injuries intersects the square root scaling function at 63.25 (See red dot). 63.25 is the scaled score.
- **Step (c):** Weight assigned to Serious Injury.
- **Step (d):** Multiply the scaled score by the weight determined for Serious Injuries .
- **Step (e):** The Risk Score for Serious Injury.

- This calculation is repeated for each attributes. The summation of MARS values for each attribute results in the overall MARS.
- *Maximum MARS is 100*

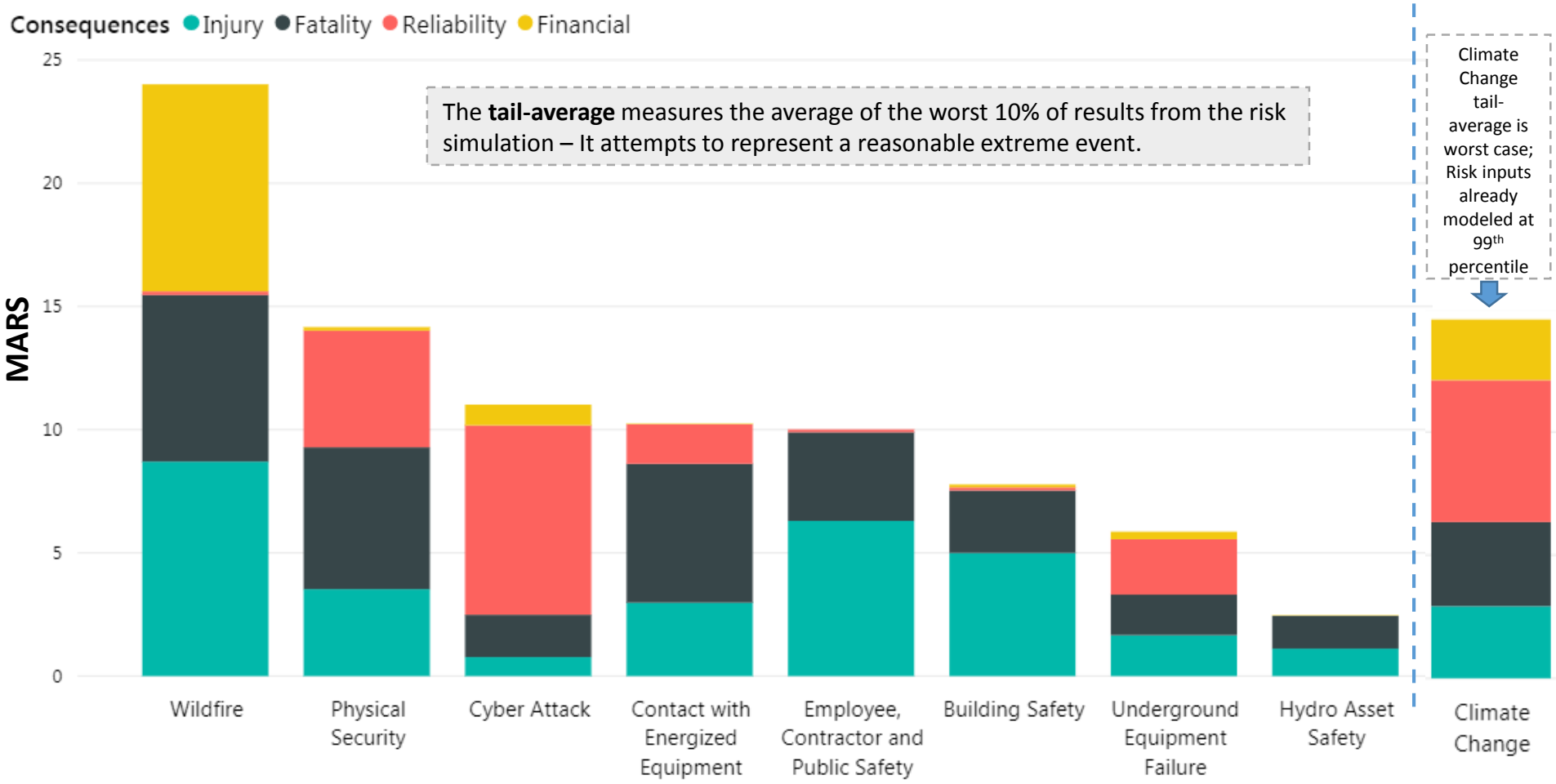
Results: Baseline MARS for the 9 Risks (**Mean**)[1]



[1] Modelled results reflect the annual average mean results over the 2018-2023 time period

[2] Note: Climate Change data inputs modelled for 99th percentile events, and as such, the results are not directly comparable

Results: Baseline MARS for the 9 Risks (**Tail-Average**)[1]



[1] Modelled results reflect the annual average tail-average results over the 2018-2023 time period

Chapter Review:
Contact with Energized Equipment

Bob Woods
Managing Director, T&D Asset Management
and Operational Support

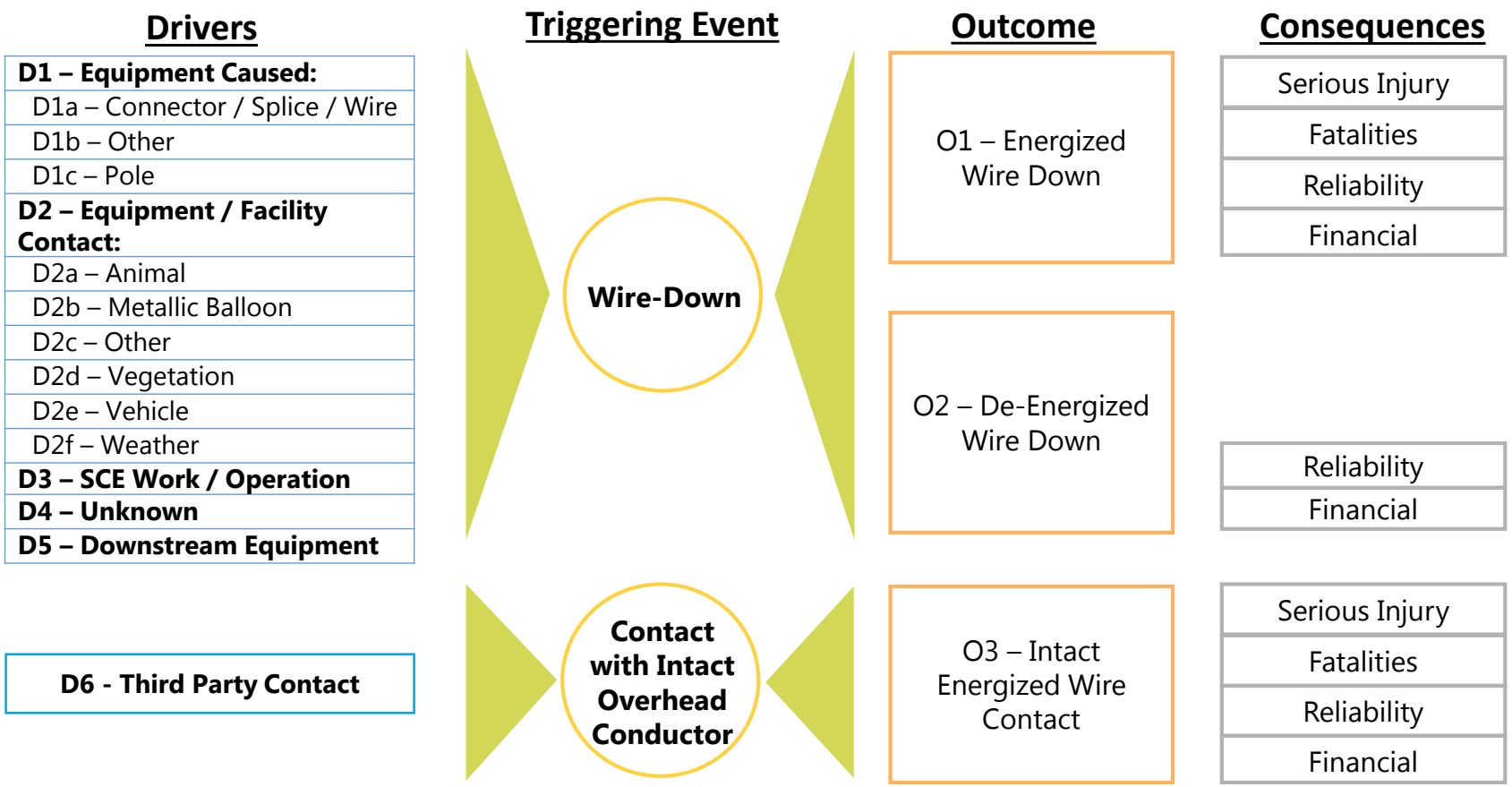
Contact with Energized Equipment

Overview

Risk Statement	**Contact with energized equipment which potentially causes electric shock**
In Scope	• Public contact with energized overhead distribution primary conductor, whether that conductor is intact or downed
Out of Scope	• SCE employee or contractor contact with energized overhead conductor *(in scope for Employee, Contractor & Public Safety chapter)* • Public contact during attempted theft *(addressed in Physical Security chapter)* • Contact with substation or transmission equipment or conductor • Fire ignition associated with SCE Overhead Distribution Equipment *(addressed in Wildfire chapter)*
Key Chapter Insights / Takeaways	• SCE has approximately 106,000 conductor miles of primary distribution overhead conductor • SCE experiences over 1,000 wire down events per year, and several contact with intact events, due to various factors • SCE's Overhead Conductor Program (OCP), which began in 2015, is the primary control to mitigate safety impacts from these events • Alternatives were evaluated to analyze benefits of expanded use of covered conductor or undergrounding, and expanded branch line fusing

Contact with Energized Equipment

Risk Bowtie



Data sources used to populate baseline risk bowtie parameters:

- SCE internal Wire-Down database, Outage Database and Reliability Metrics (ODRM) system, estimated equipment repair costs resulting from wire-down events

Contact with Energized Equipment

Risk Reduction Activities and Mitigation Plans

	Name	ID	Description	Prop	Alt 1	Alt 2
Compliance	**Distribution Deteriorated Pole Remediation Program and Pole Loading Program**	CM1	Replaces or stubs poles which fail intrusive inspections and/or applied wind-loading measurement			
	Vegetation Management	CM2	Prunes and removes trees in proximity to high-voltage lines in accordance with applicable regulation			
	Overhead Detailed Inspections, Apparatus Inspections, Preventative Maintenance	CM3	Proactively identifies and remediates overhead asset conditions in accordance with GO 95, 128, and 165			
	Intrusive Pole Inspections and Pole Loading Assessments	CM4	Inspects and assesses existing distribution poles.			
Controls	**Overhead Conductor Program (OCP)**	C1	Reconductoring using bare wire and installation/replacement of branch line fuses	**X**		**X**
		C1a	Starting in 2021, reconductoring using covered conductor for small, targeted portion (~10%) of OCP work	**X**		
	Public Outreach	C2	Education and outreach of the dangers of contact with SCE equipment	**X**	**X**	**X**
Mitigations	**OCP Utilizing Covered Conductor**	M1	OCP reconductoring using only covered conductor		**X**	
	Comprehensive Branch Line Fusing	M2	Installation of BLFs on unfused branch (tap) lines in non-HFRA[1]		**X**	**X**
	Targeted Underground Conversion	M3	Akin to C1a, underground a small portion of OCP work			**X**
	Infrared Inspections	M4	Identifies "hot spots" in splices, connectors, switches, transformers, etc.	**X**	**X**	**X**
	Wildfire Covered Conductor Program	M5	Reconductoring circuits in HFRA with covered conductor	**X**	**X**	**X**

[1] HFRA: High Fire Risk Area

Annual average expected value (mean) results over 2018-2023

	Prop	Alt 1	Alt 2
MARS Mitigation Risk Reduction (MRR)	**0.89**	**0.93**	**0.93**
Cost ($M)	**$324**	**$338**	**$345**
Risk Spend Efficiency (RSE)	**.0027**	**.0028**	**.0027**

Contact with Energized Equipment

Proposed Mitigation Plan

- Remediates largest volume of overhead circuit miles in the most efficient manner, building upon existing OCP by adding targeted options
- Continues public outreach to customers and contractors
- Adds new efforts to further reduce safety risk, including infrared inspections to proactively target equipment nearing end of life
- Balances risk reduction, execution feasibility, and cost

Proposed Plan, including Relation to Alternative Plans	
Feasible to Execute	Yes
Technology Constraints	No
Resource Constraints	No
Affordability	1st
Risk Reduction	3rd
Risk Spend Efficiency	2nd

Proposed Plan		**Cost Estimate ($M)**	**Expected Value (MARS)**	
ID	**Name**		**MRR**	**RSE**
C1	Overhead Conductor Program (OCP)	$ 715	3.22	0.0045
C1a	Overhead Conductor Program (OCP) Utilizing Targeted Covered Conductor	$ 34	0.10	0.0029
C2	Public Outreach	$ 33	0.42	0.0130
M4	Infrared Inspections	$ 3	1.04	0.3627
M5	Wildfire Covered Conductor Program	$ 1,161	0.54	0.0005
		$1,946	**5.32**	**0.0027**

Results reflect the total expected value (mean) results over the 2018-2023 time period

Chapter Review: Wildfire

Brian Chen
Principal Manager, Grid Resiliency

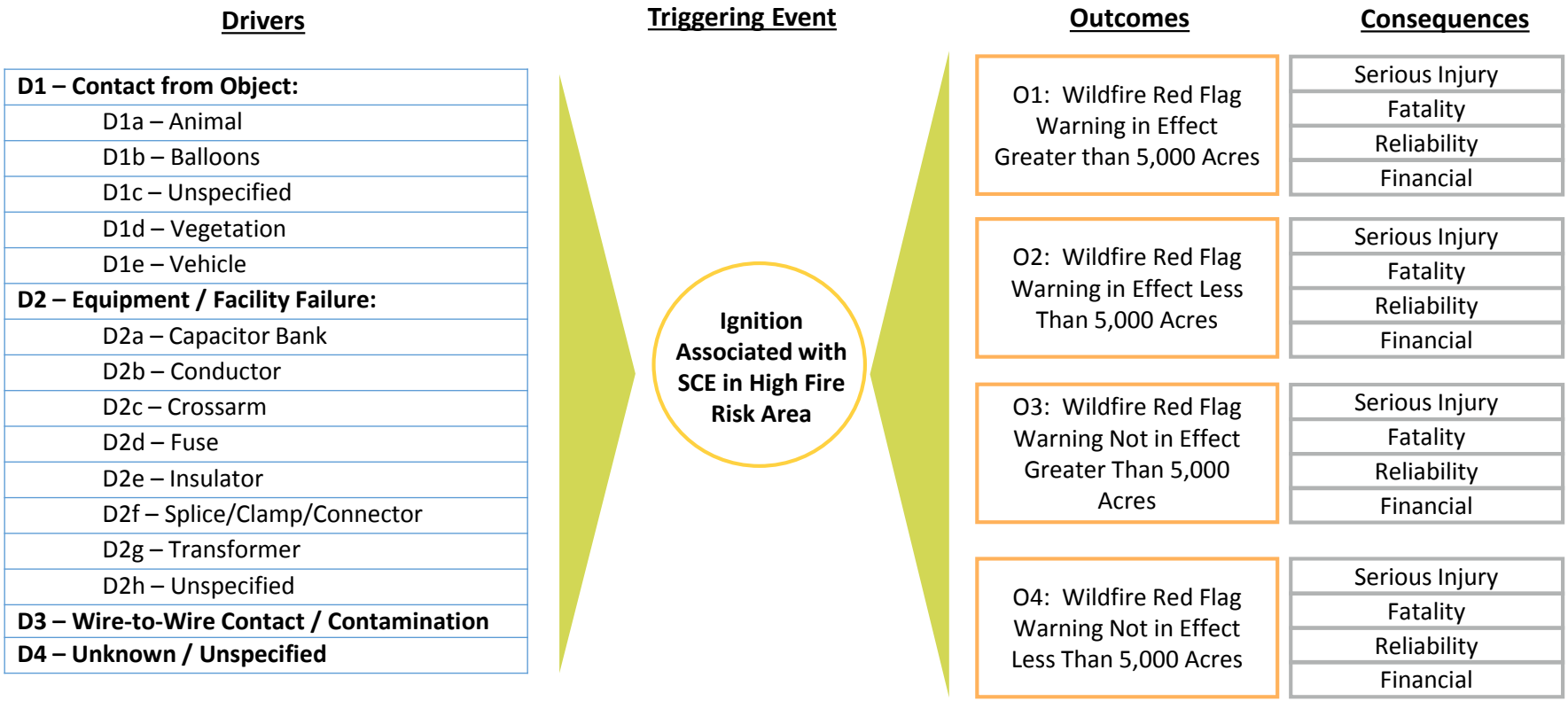
SOUTHERN CALIFORNIA EDISON®

Wildfire
Overview

Risk Statement	**Ignition associated with SCE in High Fire Risk Area**
In Scope	• Ignition associated with SCE overhead distribution equipment
Out of Scope	• Ignition associated with SCE transmission or substation equipment[1] • Ignition associated with third parties
Key Chapter Insights / Takeaways	• Focus is on "High Fire Risk Areas" (HFRA), which refers to locations with Tier 2 or Tier 3 designation from most recent CPUC High Fire Threat District maps, and SCE non-tier areas • Approximately 35% of our 50,000 square mile service area is in HFRA • Proposed risk mitigation plan includes both operational and grid hardening activities

[1] Appendix B of the RAMP report provides further discussion of potential transmission and substation asset safety risks

Wildfire
Risk Bowtie



Data sources used to populate baseline risk bowtie parameters include:
•SCE's CPUC reported ignition data (per Decision 14-02-015), Outage Database and Reliability Metrics (ODRM) system, historic red flag warning records, CalFire Redbook data, CalFire investigation reports and press releases, estimated wildfire financial costs from industry, government, and insurance sources

Wildfire

Risk Reduction Activities and Mitigation Plans

	Name	ID	Description	Prop	Alt 1	Alt 2
Comp	**Vegetation Management**	CM1	Prunes and removes trees in proximity to high-voltage lines in accordance with applicable regulation			
Controls	**Overhead Conductor Program (OCP)**	C1	Reconductors using bare and covered conductor	X		X
		C1a	Reconductors using bare conductor only		X	
	FR3 Overhead Distribution Transformer	C2	Uses transformers filled with ester fluid for replacement of overhead distribution transformers	X	X	X
Mitigations	**Wildfire Covered Conductor Program** *(and variants)*	M1	Deploys covered conductor for SCD[1] and CFO[2]	X		
		M1a	Deploys bare conductor for SCD and covered conductor for CFO		X	
		M1b	Deploys covered conductor for SCD and undergrounds lines for CFO			X
	RARs[3] & Fast Curve Settings	M2	Install RARs and update relay/settings with fast curve operating settings	X	X	X
	PSPS Protocol and Support Functions	M3	De-energizes selected distribution circuits during most extreme and potentially dangerous conditions	X	X	X
	Infrared Inspection Program	M4	Identifies "hot spots" in splices, connectors, switches, transformers, etc.	X	X	X
	Expanded Vegetation Mgmt	M5	Expands vegetation management efforts beyond required work	X	X	X
	Microgrids	M6	Deploys generation to provide resiliency and continuity of service			X
	Enhanced Situational Awareness	M7	Deploys weather stations, HD cameras, high resolution weather model, and a computing platform for fire potential index modeling	X	X	X
	Fusing Mitigation	M8	Installs or replaces current limiting fuses on branch circuits	X	X	X
	Fire Resistant Poles *(and variants)*	M9a, b,c	Installs fire-resistant composite poles commensurate with deployment of covered conductor, where existing poles require replacement	X	X	X

[1] SCD: Short Circuit Duty
[2] CFO: Contact from Object
[3] RAR: Remote-Controlled Automatic Reclosers

Annual average expected value (mean) results over 2018-2023

	Prop	Alt 1	Alt 2
MARS Mitigation Risk Reduction (MRR)	**1.3**	**1.2**	**1.3**
Cost ($M)	**$343**	**$303**	**$1,037**
Risk Spend Efficiency (RSE)	**.0037**	**.0039**	**.0013**

Wildfire

Proposed Mitigation Plan

- Deploys controls and mitigations to reduce the frequency of ignitions associated with SCE, while balancing risk reduction, execution feasibility, and cost
- Focuses on activities that can reduce the Contact from Object driver, which drives the majority of faults that can potentially lead to wildfire ignition
- Addresses circuits with greater risk of damage during fault conditions:
    1. Spans with vintage small conductor (SCD)
    2. Spans susceptible to contact from objects (CFO)
- Covered conductor has ~3.4x greater RSE than bare wire, and ~4x greater RSE than undergrounding (for same length)

Proposed Plan, including Relation to Alternative Plans	
Feasible to Execute	Yes
Technology Constraints	No
Resource Constraints	No
Risk Reduction	1st
Affordability	2nd
Risk Spend Efficiency	2nd

Chapter Review:
Employee, Contractor & Public Safety

Dean Yarbrough
Director, Edison Safety

SOUTHERN CALIFORNIA EDISON®

Employee, Contractor & Public Safety

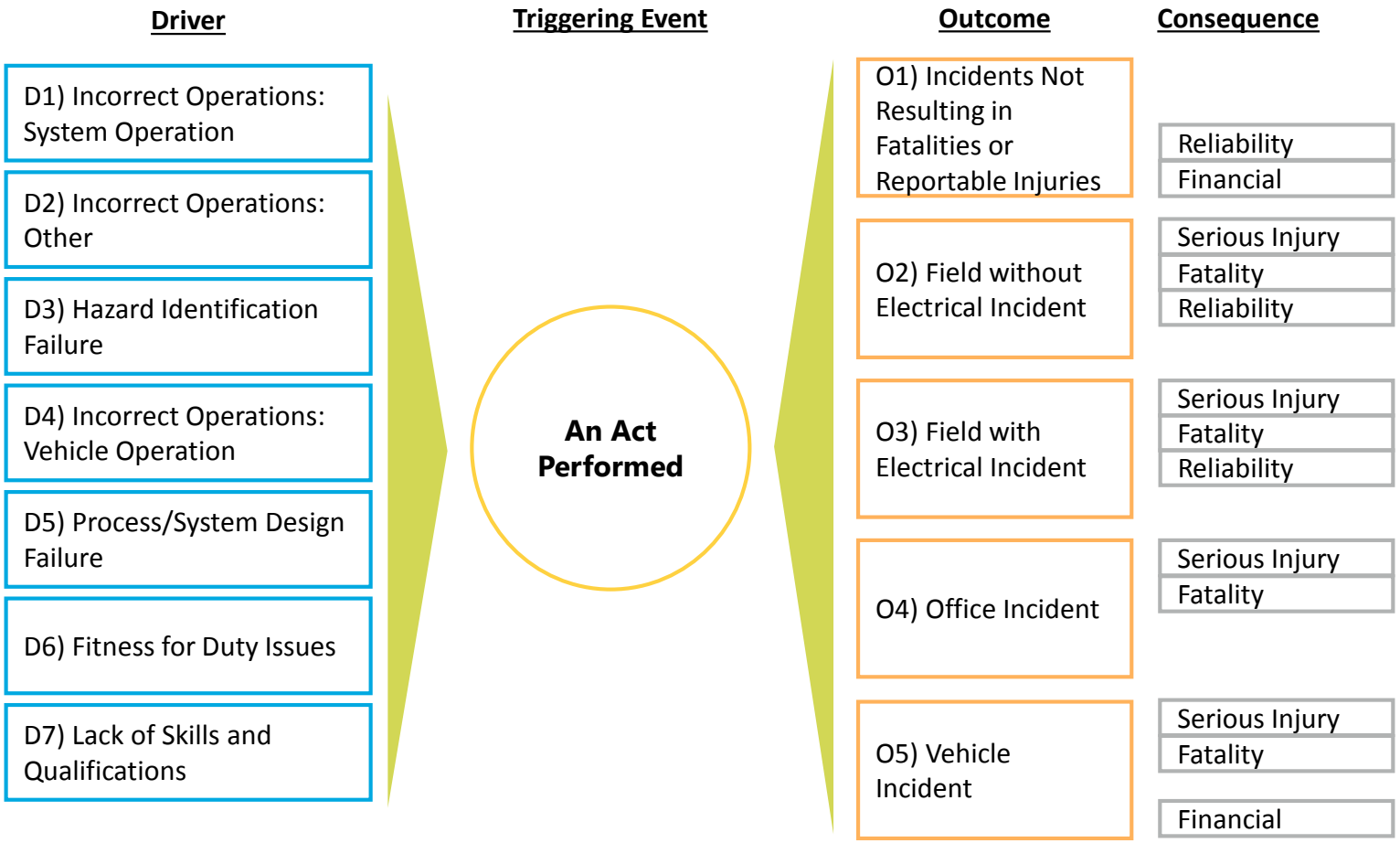
Overview

Risk Statement	**Act performed which potentially exposes SCE employees, contractors, or the public to hazards.**
In Scope	• Act performed by an SCE worker[1] leading to an adverse outcome for an SCE employee(s), contractor(s), or member of the public
Out of Scope	• Incidents that occur solely as a result of failed electrical and non-electrical assets and equipment *(in scope for other chapters)*. • Vehicle incidents attributable to human error by a member of the public. • Criminal and/or malicious acts performed by an SCE worker that bring harm to the worker, other workers and/or the public; example is workplace violence *(addressed in Physical Security chapter)*.
Key Chapter Insights / Takeaways	• RAMP model accounts for serious injuries, but activities in chapter provide benefits for both serious and other injuries • Culture transformation is a key element of SCE's safety mitigations • Improvements in data collection and tracking should improve SCE's ability to model and measure worker safety risk

[1] SCE workers are defined as SCE employees and contractors in this RAMP report

Employee, Contractor & Public Safety

Risk Bowtie



Data sources used to populate baseline risk bowtie parameters:

- SCE internal safety incident data (typically over the 2014-2017 period)

Employee, Contractor & Public Safety

Risk Reduction Activities and Mitigation Plans

	Name	ID	Description	Prop	Alt 1	Alt 2
Compliance	**Standards, Programs, & Policies**	CM1	Worker protection from falls, safely working in confined spaces and around electrical hazards, establishing company standards and programs, developing and implementing work practices and safety training.			
Compliance	**Technical Training**	CM2				
Controls	**Safety Programs**	C1	Includes Safety Recognition Program, Injury Assistance Program, and Functional Movement Screening.	**X**	**X**	**X**
Controls	**Contractor Safety Program**	C2	Range of activities related to establishing qualification requirements for contractors, continually evaluating contractor safety performance, and making field-based assessments and observations.	**X**	**X**	**X**
Mitigations	**Safety Culture Transformation**	M1a	Efforts to improve safety culture using a variety of tools, communications, and training.	**X**		**X**
Mitigations		M1b	Same as M1a, but adds in-person training to all employees, and electronic tablets in the field.		**X**	
Mitigations	**Industrial Ergonomics**	M2	Program for ergonomics for industrial or field activities.	**X**	**X**	**X**
Mitigations	**Office Ergonomics**	M3a	Provides each new office workstation with a sit-to-stand desk to improve ergonomics.	**X**	**X**	**X**
Mitigations		M3b	Provides employees with predictive data on how well they manage computer interactions such as keystrokes, mouse clicks, and regular breaks.		**X**	
Mitigations	**Driver Safety**	M4a	Implements a driver training program for approximately 4,200 SCE workers who are Class A license holders or who are assigned to SCE vehicles.		**X**	
Mitigations		M4b	Same as M4a, except training limited to the approximately 3,900 Class A license holders at SCE.			**X**

Annual average expected value (mean) results over 2018-2023

	Prop	Alt 1	Alt 2
MARS Mitigation Risk Reduction (MRR)	**0.53**	**0.59**	**0.54**
Cost ($M)	**$13.2**	**$15.1**	**$13.5**
Risk Spend Efficiency (RSE)	**0.0401**	**0.0389**	**0.0400**

Employee, Contractor & Public Safety

Proposed Mitigation Plan

- Reduces safety risk by implementing programs designed to shift the safety attitudes and behaviors of the entire organization.
- Builds on existing safety programs, while adding new efforts such as the Safety Culture Transformation Program and ergonomics programs.
- Addresses potential for "change fatigue" within organization related to training and communications.

Proposed Plan, including Relation to Alternative Plans	
Feasible to Execute	Yes
Technology Constraints	No
Resource Constraints	No
Affordability	1st
Risk Reduction	3rd
Risk Spend Efficiency	1st

Proposed Plan		**Cost Estimate ($M)**	**Expected Value (MARS)**	
ID	**Name**		**MRR**	**RSE**
C1	Safety Controls	$ 14.1	0.43	0.030
C2	Contractor Safety Program	$ 1.1	0.42	0.384
M1a	Safety Culture Transformation – Core Program	$ 46.5	2.06	0.044
M2	Industrial Ergonomics	$ 0.1	0.07	0.769
M3a	Office Ergonomics – Core Program	$ 17.6	0.21	0.012
		$ 79.4	**3.18**	**0.040**

Results reflect the total expected value (mean) results over the 2018-2023 time period

Question & Answer Session

Power BI Demonstration

RAMP Results Reporting Tool

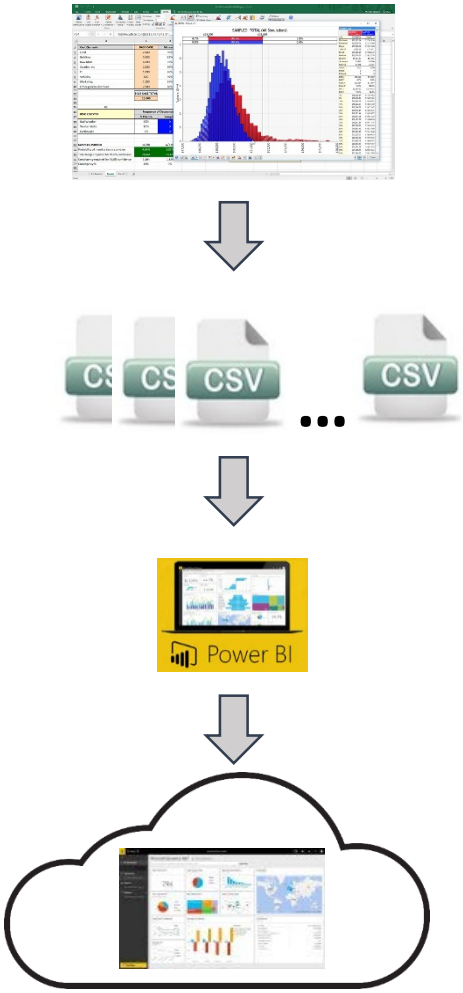
Gary Cheng
Senior Advisor, Risk Management

Power BI - RAMP Reporting Tool

Power BI harnesses the capabilities of Excel and PowerPoint, empowering the consumer to automate the distribution of and drive valuable insights from data.

- Microsoft Business Analytics Platform
  - Web-based: No special software to install
- Interactive Reports
  - “Slice and Dice” the data vs a static Excel results file
- Underlying data can be downloaded

General Data Flow From Risk Model to Power BI



Step 1:
Run simulations and calculate results for each risk using Palisade's @RISK engine
(27 different risk model files)

Step 2:
"Scrape"* relevant data fields from each risk model file into multiple CSV files

Step 3:
Import data files into Power BI framework and populate RAMP reporting tool

Step 4:
Publish RAMP Power BI report to the cloud to enable user access to updated results

*SCE used Python (an open source programming language)

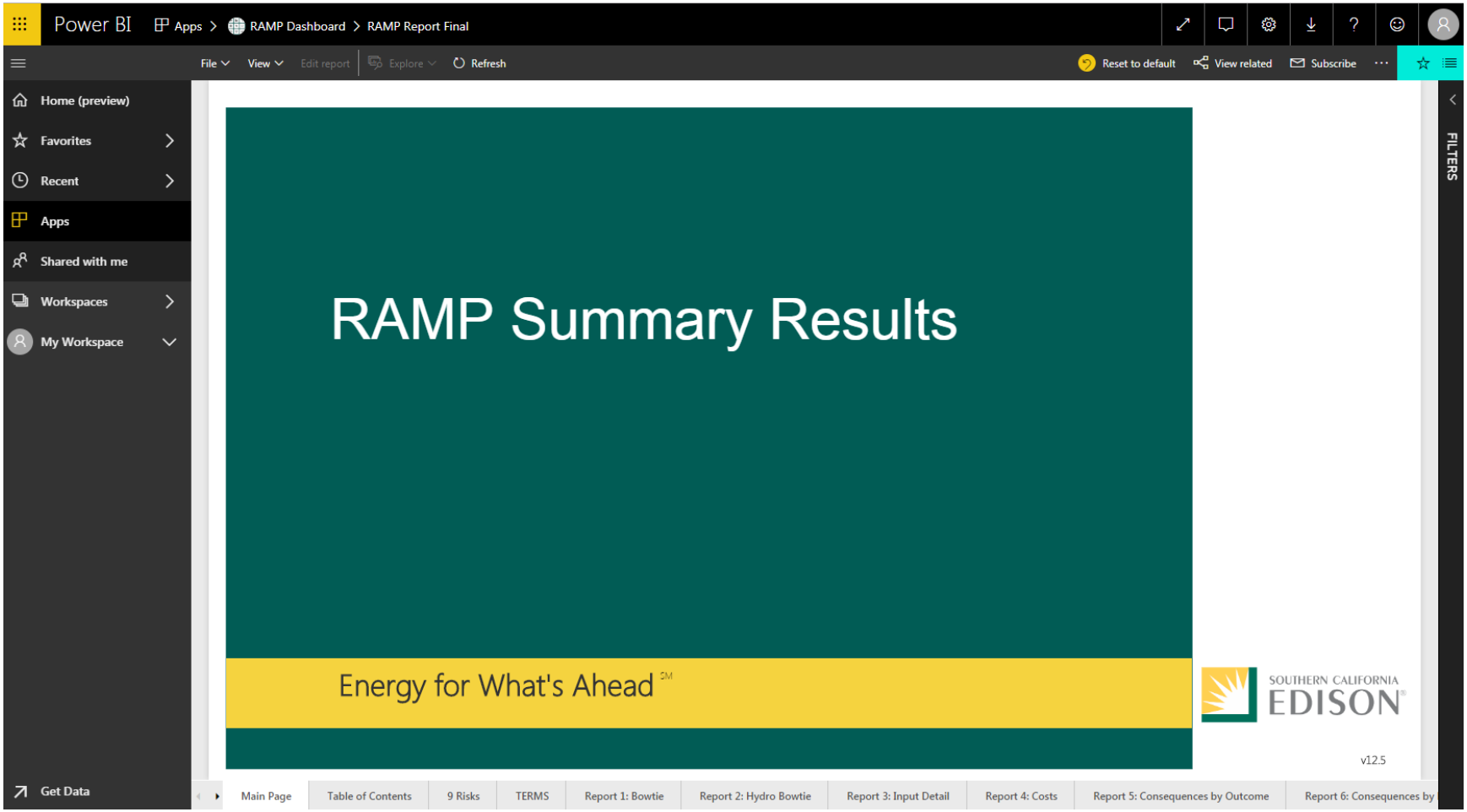
SCE's 2018 RAMP Report Results

- To access SCE 2018 RAMP report:
  1. www.sce.com/applications
  2. Click on "SCE 2018 RAMP"
  3. Select document

- SCE will furnish the risk models used to perform risk analyses upon request.
  - To request the risk models, please send an email to Case.Admin@sce.com and reference the 2018 RAMP report in the transmittal.

- Due to the amount of data produced in each model, SCE has developed a more intuitive reporting interface for stakeholders to view and evaluate the inputs and outputs of the risk models, using Microsoft's Power BI tool.
  - Only an internet connection is required; no software installation needed
  - To gain access, please fill out form and send to Case.Admin@sce.com:
    - Please refer to Workpapers Ch. 1, pp. 1.5 – 1.8 *(RAMP Power BI Access Form & Sign-up Instructions)*.
    - Please refer to Workpapers Ch. 1, pp. 1.9 – 1.40 *(RAMP Power BI User Guide)*.

RAMP Results Reporting Tool - Demonstration



Closing Comments