# ELECTRICAL UNDERGROUNDING PLAN DRAFT GUIDELINES

Workshop
May 15, 2024


# SAFETY MESSAGE

Take care of your posture and sit in a comfortable position

Take regular breaks to stretch, hydrate, and rest your eyes

Know the emergency exits and procedures in your physical location should the need arise

Be prepared for earthquakes

Feel something say something and we will find a way to help

# AGENDA

**Introduction, Housekeeping (1 to 1:15)**

**Portfolio Objective and Project Framework (1:15 – 2:15 pm)**

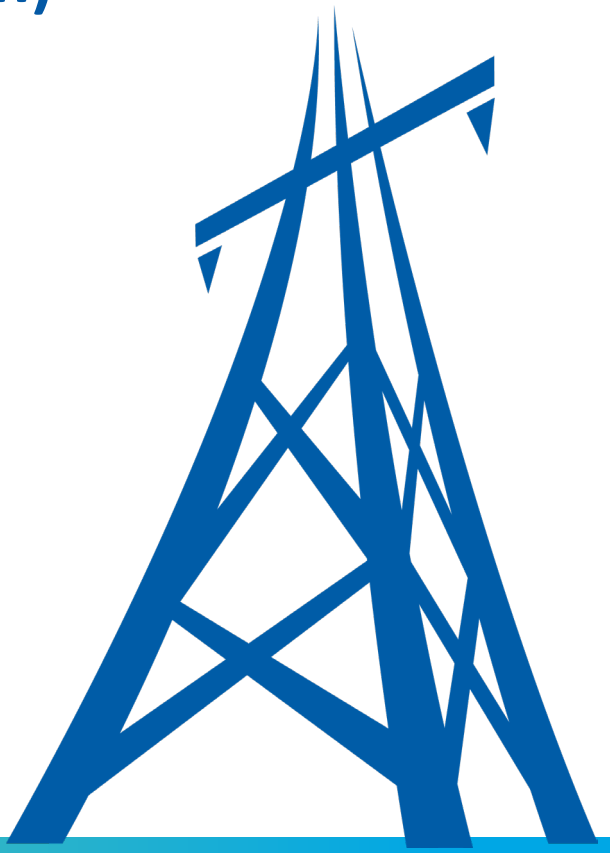
**BREAK (2:15 – 2:30)**

**Risk Modeling**

**BREAK (3:20 – 3:30)**

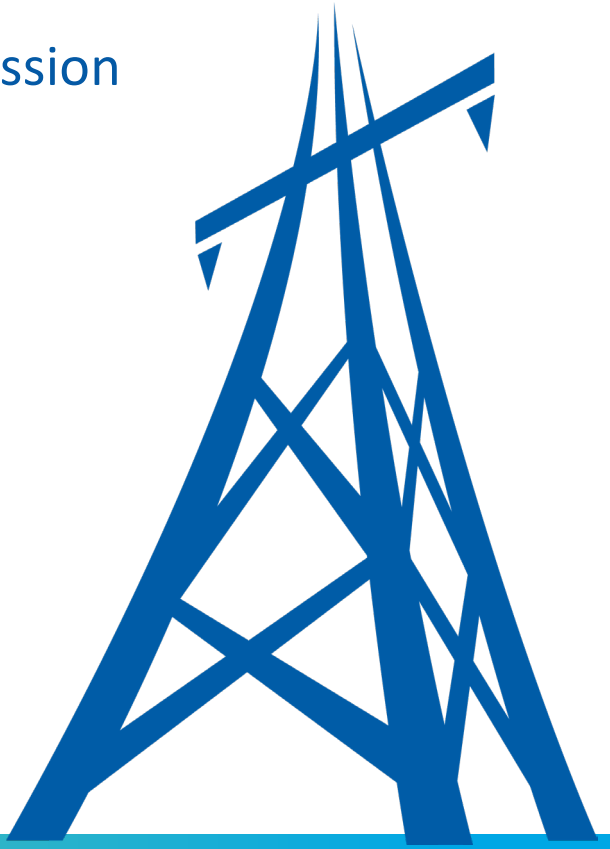
**Reporting (3:30 - 3:45)**

**Next Steps (3:45 – 4:00)**



# CHALLENGES AND OPPORTUNITIES

- **Flexibility**
  - Things will change over 10 years
  - We are not approving projects; we are approving a plan
  - Possibility that utilities won't have complete data at plan submission
- **Data Driven**
  - Show Substantial Increase/Decrease (8388.5(d)(2) standard)
  - Driving utilities to substantiate choices through modeled data
- **Multi-agency**
  - After a plan is approved by Energy Safety, the IOU must file an application with CPUC and receive "conditional approval"
  - Both agencies have a role in oversight




GUIDELINE
STRUCTURE

# VOCABULARY, DEFINITIONS, LINGO

**Circuit Segment** means an isolatable circuit segment or CPZ

**Project** means a Circuit Segment being considered for this program

**Portfolio** means a group of projects being considered at a point in time. For example, the Portfolio as of the date of EUP filing. Or the Portfolio of all the projects that are included in the plan at a specific time

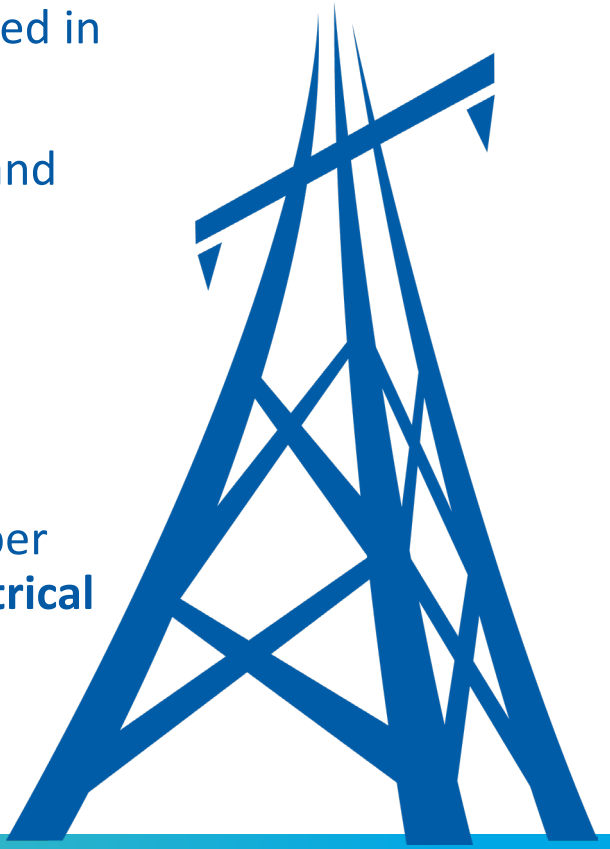
**Standards** and **Thresholds** are the levels set in the EUP to evaluate Circuit Segments and the Portfolio

**EUP** or **Electrical Undergrounding Plan** means the plan filed by an IOU

**Reliability Benefit** refers to reliability as used in CBR. The term "**reliability**" means reliability that meets the 8388.5(d)(2) standard

In this presentation we use "**IOU**" to refer to the Investor-Owned Utilities. Note that per SB 884 only electrical IOUs that meet the 250,000 customer requirement ("**large electrical corporations**") are eligible for the program

Please spend time with Appendix A Definitions

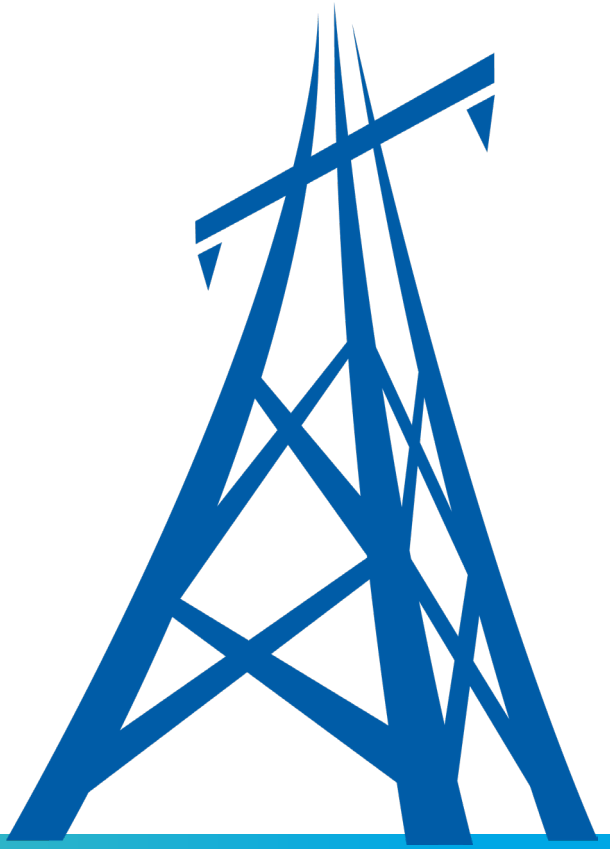


# GUIDELINE STRUCTURE: 3 MAIN COMPONENTS

1. Portfolio Mitigation Objective (aka the 8388.5(d)(2) standard) = what the plan as a whole must achieve to be “substantial”
2. Project Acceptance Framework = select projects in a way that achieves substantial risk reduction
3. Data, Modeling, Reporting = how we know the Portfolio Mitigation Objective and Framework are working

# 1. PORTFOLIO MITIGATION OBJECTIVE

- Section 8388.5(d)(2): *only approve the plan if the large electrical corporation has shown that the plan will substantially increase electrical reliability by reducing the use of PSPS, enhanced powerline safety settings, deenergization events, and any other outage programs, and substantially reduce the risk of wildfire.*
- The **Portfolio Mitigation Objective** is the overall risk reduction goal established for the plan. The Objective needs to satisfy 8388.5(d)(2)
- How is the Portfolio Mitigation Objective set:
  - Measure risk at the **System-Level** and **Portfolio-Level**
  - Key Decision-Making Metrics
  - Also set Project-Level standards. The **Project-Level** standards do not need to be met by every project in the Portfolio
  - The EUP will contain the proposed Portfolio Mitigation Objective, but Energy Safety can require changes



# 2. PROJECT ACCEPTANCE FRAMEWORK

EC identifies a circuit

## Screen #1

### Circuit Segment Eligibility

Procedure for EC to create List of Eligible Circuit Segments

Is it in HFTD/Rebuild area?
Does risk score show need?

"Eligible Circuit Segment"

## Screen #2

### Project Information and Comparison

Alternative Mitigation Comparison + CPUC CBR info

Per circuit segment, but may use aggregated data, estimates.
Project Information Table

Circuit Segment can be an "Undergrounding Project"

## Screen #3

### Project Risk Analysis

Procedure to evaluate individual Undergrounding Project

Project-specific risk data
Project Reference Sheet

Undergrounding Project is a "Confirmed Project"

## Screen #4

### Project Prioritization

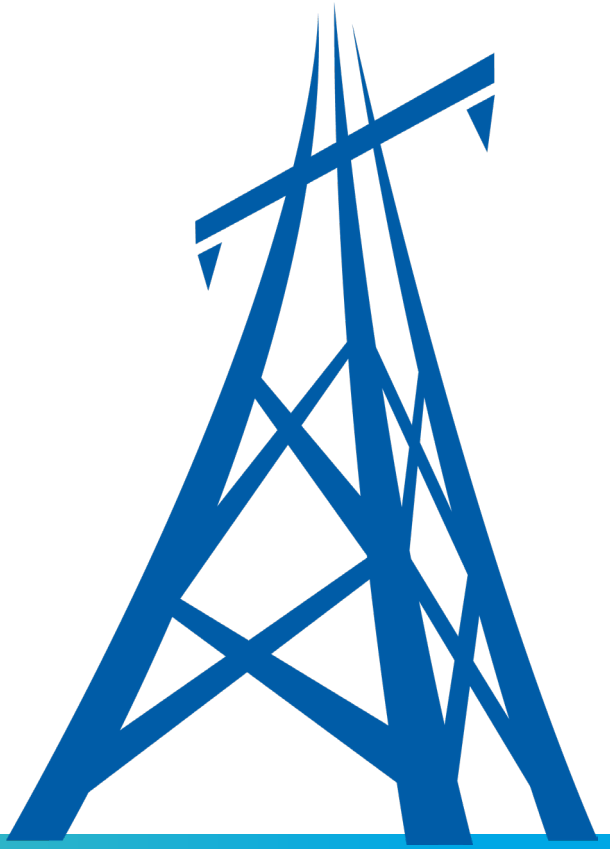
Procedure to prioritize Undergrounding Projects using 8388.5(c)(2) factors

wildfire risk reduction, public safety, cost efficiency and reliability benefits

Confirmed Project can begin "Construction"

# 3. DATA, MODELING, METRICS

- Key Decision-Making Metrics (KDMMs)
- Current Risk Values
- Model Risk Landscape
- **System-Level, Portfolio-Level** and **Project-Level**
- Designed to fulfill Energy Safety's SB 884 responsibilities
- Aligns with CPUC CBR and Energy Safety WMP




(d)(2)
"SUBSTANTIALLY INCREASE ELECTRICAL RELIABILITY … SUBSTANTIALLY REDUCE THE RISK OF WILDFIRE"

# KEY DECISION-MAKING METRICS (KDMMS)

The risk modeling, comparative analysis and (d)(2) standard evaluation revolve around explicit computations of Key Decision-Making Metrics

- Explainable scores measuring quantities related to wildfire risk reduction and wildfire-related intentional outages
- Measured at the Project-Level and aggregated up to Portfolio-Level and System-Level
- Modeled at a contemporary baseline and every 5 years up for the next 60 years
- 7 required KDMMs are pre-defined by ES
- Up to 5 additional may be defined by the large electric corporation and included in their EUP

# KEY DECISION-MAKING METRICS

i. **Overall Utility Risk:** A combined measure of Ignition Risk and Outage Program Risk that measures the total risk of wildfires and Outage Program Events related to wildfire risks. This is computed as the inner product of the likelihoods of adverse events and their consequences.

ii. **Ignition Risk:** The measure of impacts from wildfire at a given location. This metric is the product of two factors: (1) the likelihood a wildfire will occur, and (2) the potential consequences of a wildfire originating from this location.

iii. **Ignition Consequence:** The total anticipated adverse effects from a wildfire on each community it reaches. This metric considers the wildfire hazard intensity, the wildfire exposure potential, and the inherent wildfire vulnerabilities of communities at risk.

iv. **Ignition Likelihood:** The likelihood of an ignition at a given location given a probabilistic set of environmental conditions.

v. **Outage Program Risk:** The measure of reliability impacts from Outage Programs at a given location. This metric is the product of two factors: (1) the likelihood an Outage Program Event will be required due to environmental conditions exceeding design conditions, and (2) the potential consequences of the Outage Program for affected customers, considering exposure potential and vulnerability.

vi. **Outage Program Consequence:** The total anticipated adverse effects from an Outage Program for a community. This considers the Outage Program exposure potential and inherent Outage Program vulnerabilities of communities at risk.

vii. **Outage Program Likelihood:** The likelihood of a large electrical corporation utilizing an Outage Program given a probabilistic set of environmental conditions.

# TYPES OF PROJECTS

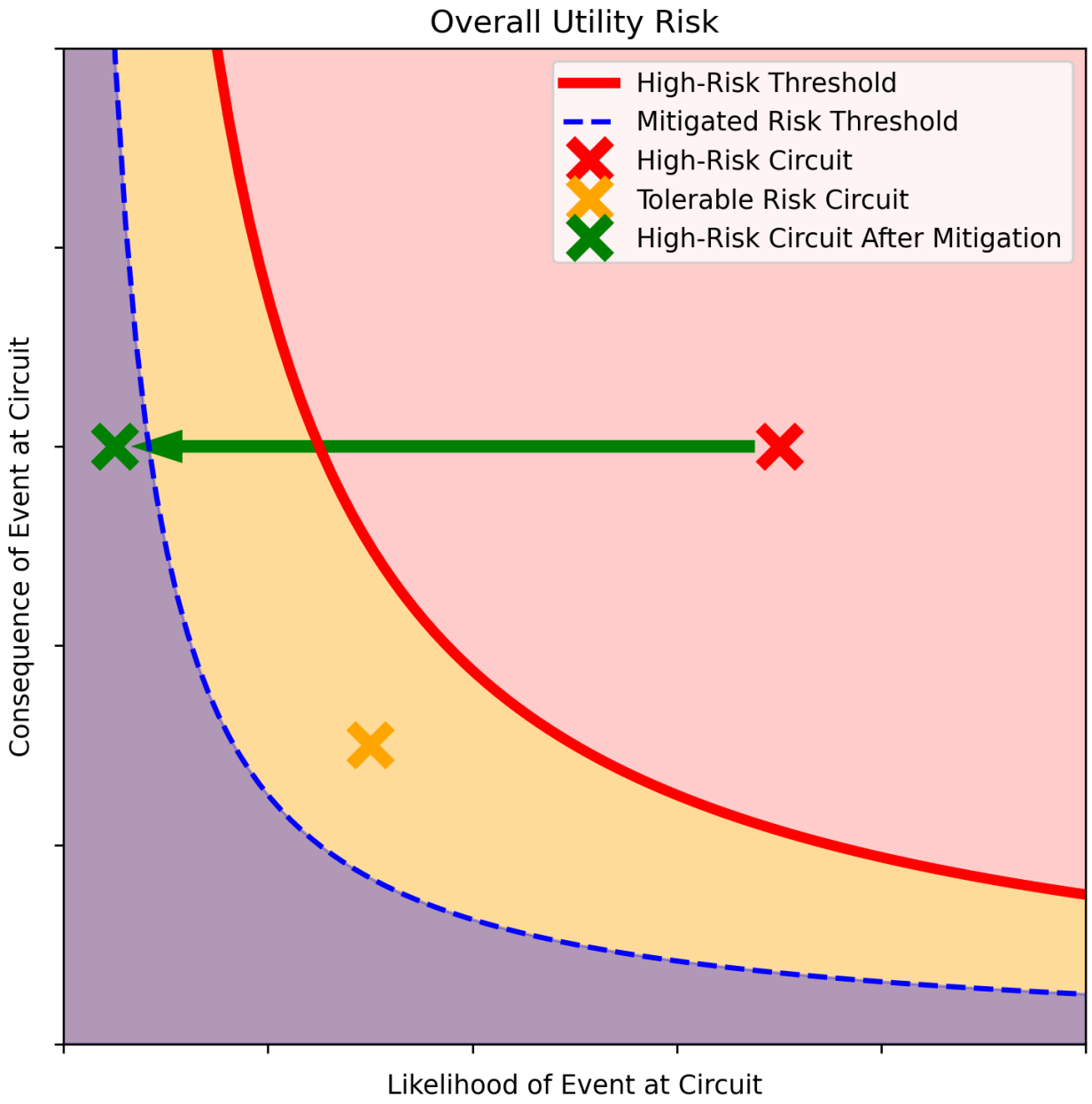
| | High-Risk Circuit Segments | Ignition Tail-Risk Circuit Segments | High Frequency Outage Program Circuit Segments |
|---|---|---|---|
| **Eligible if Circuit Segment Exceeds:** | High-Risk Threshold | Initial Tail Risk Thresholds | High Frequency Outage Program Threshold |
| **Threshold Measured In:** | Overall Utility Risk | Ignition Consequence | Outage Program Frequency |
| **Project-Level Mitigation Criteria measured as formal calculations of:** | Overall Utility Risk + *additional KDMMs* | Ignition Likelihood + *additional KDMMs* | Outage Program Likelihood + *additional KDMMs* |

# HIGH-RISK CIRCUITS SEGMENT

Circuits qualify for mitigation by being above an IOU determined **High-Risk Threshold** measured by **Overall Utility Risk**

Circuits are considered successfully mitigated if they fall below an IOU determined **Mitigation Threshold**

Energy Safety reviews these thresholds as a part of EUP approval after stakeholder input

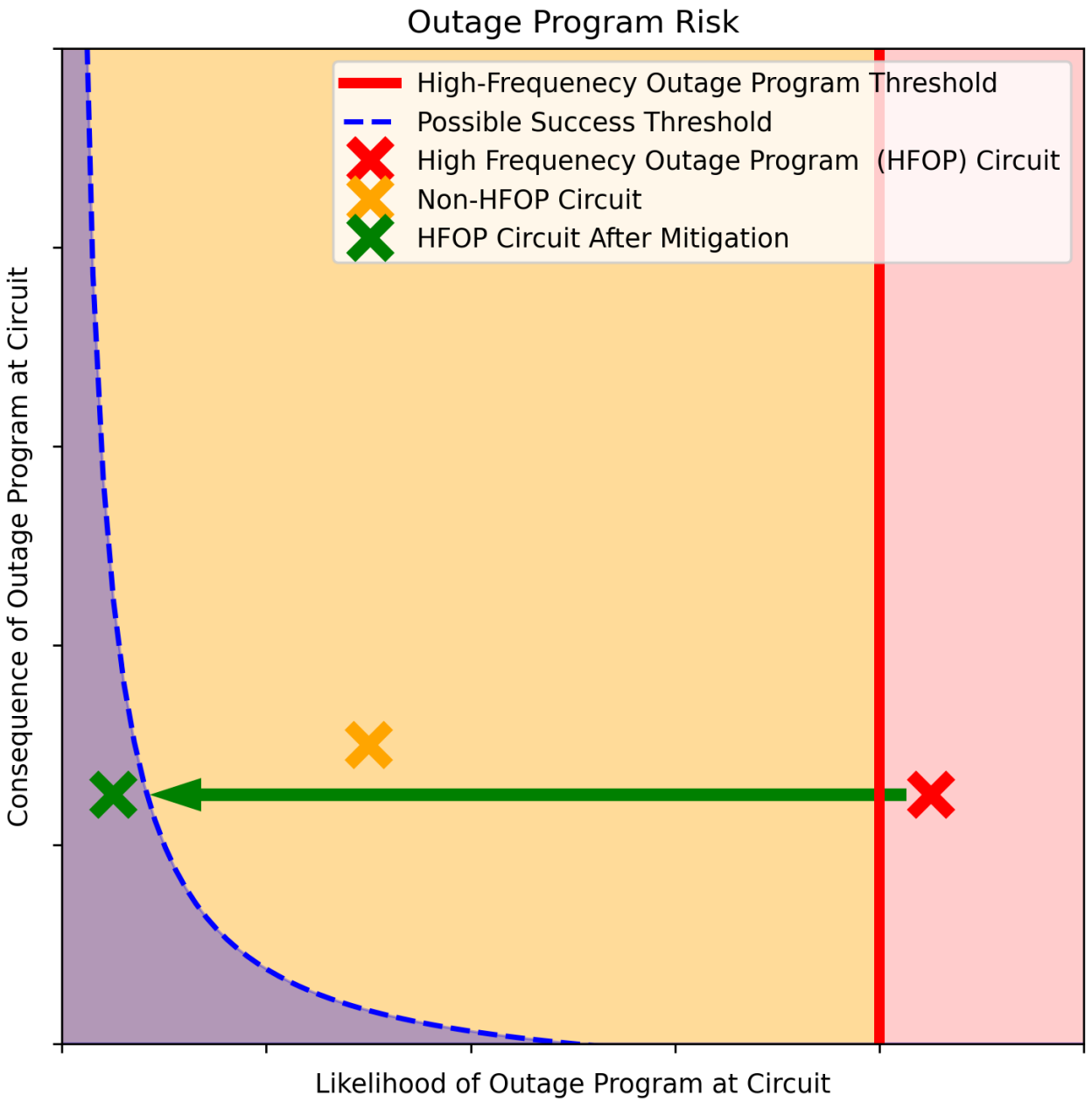


# HIGH FREQUENCY OUTAGE PROGRAM CIRCUIT SEGMENTS

Circuits segments qualify for mitigation by being above an IOU determined **High-Frequency Outage Program Threshold** measured by **Outage Program Likelihood**

Circuits are considered successfully mitigated if they fall below an IOU determined **Mitigation Threshold or other explicit calculation**

Energy Safety reviews these thresholds as a part of EUP approval after stakeholder input

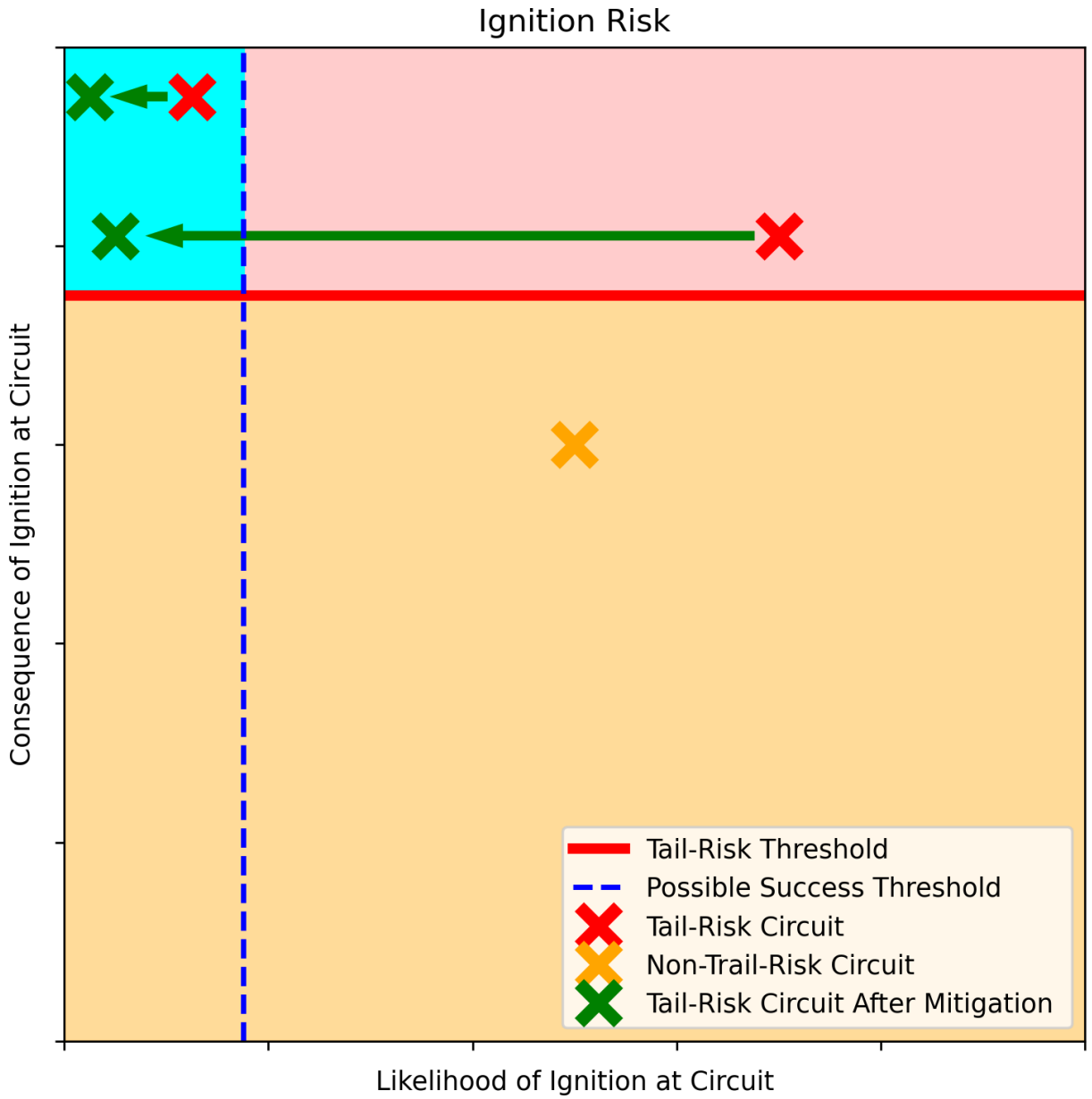


# IGNITION TAIL-RISK CIRCUIT SEGMENTS

Circuit Segments qualify for mitigation by being above an IOU determined **Ignition Tail Risk Threshold** measured by **Outage Program Likelihood**

Circuits are considered successfully mitigated if they fall below an IOU determined **Mitigation Threshold or other explicit calculation**

Energy Safety reviews these thresholds as a part of EUP approval after stakeholder input



# Questions?


PROJECT
ACCEPTANCE
FRAMEWORK

# FRAMEWORK APPROACH

- Because the plan covers a 10-year period, the large electrical corporations will not have fully scoped all projects at plan submission
- Project Acceptance Framework designed to guide decision-making throughout the duration of the plan
- The 4 Screens are applied sequentially, but project-specific details needed before completing Screens 3 and 4
- Strong framework supports finding that the plan will achieve substantial risk reduction and reliability improvement

# 2. PROJECT ACCEPTANCE FRAMEWORK

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wildfire risk reduction, public safety, cost efficiency and reliability benefits

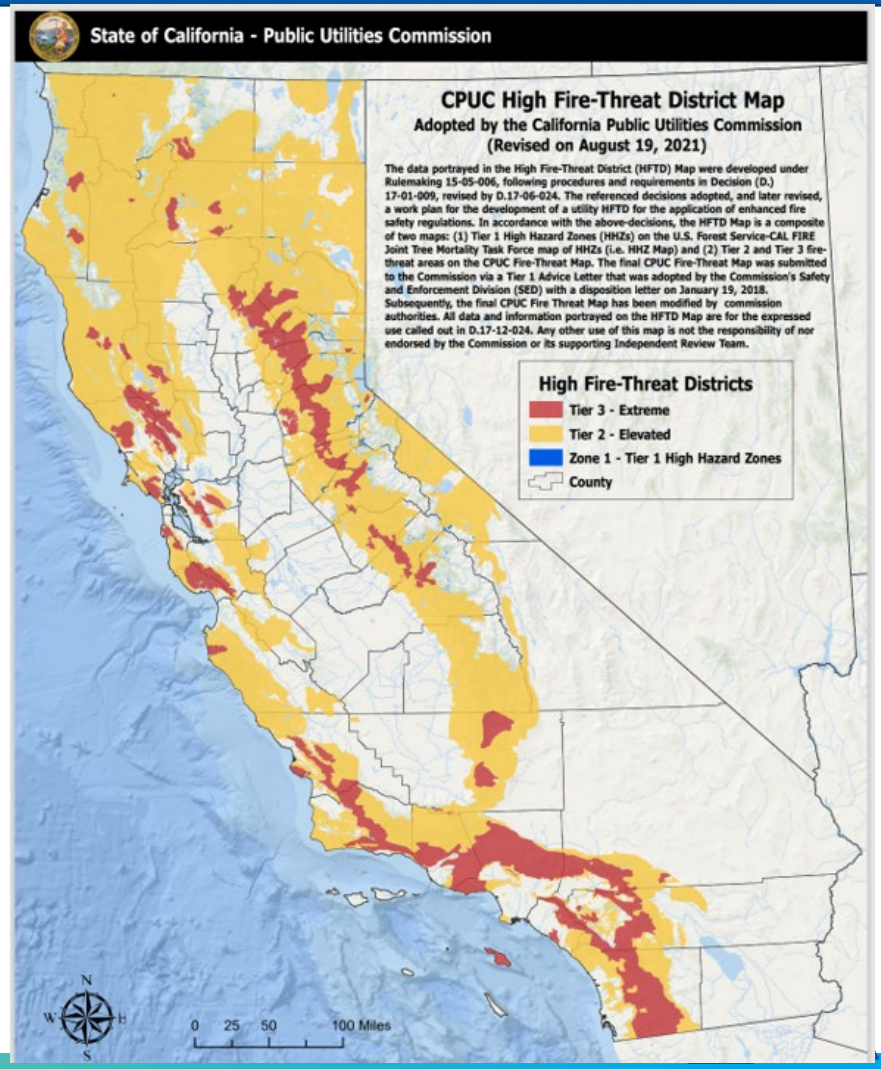
Confirmed Project can begin "Construction"

# FRAMEWORK SCREEN 1

## Screen 1: Circuit Segment Eligibility

- **Exclude Circuit Segments that are not in eligible area**
  - Is it in Tier 2 or 3 High Fire-Threat District?
  - Is it in a Wildfire Rebuild Area?

- **Exclude Circuit Segments that do not have sufficient risk reduction potential**



# FRAMEWORK SCREEN 1 (CONTINUED)

## Exclude Circuit Segments that do not have sufficient risk reduction potential

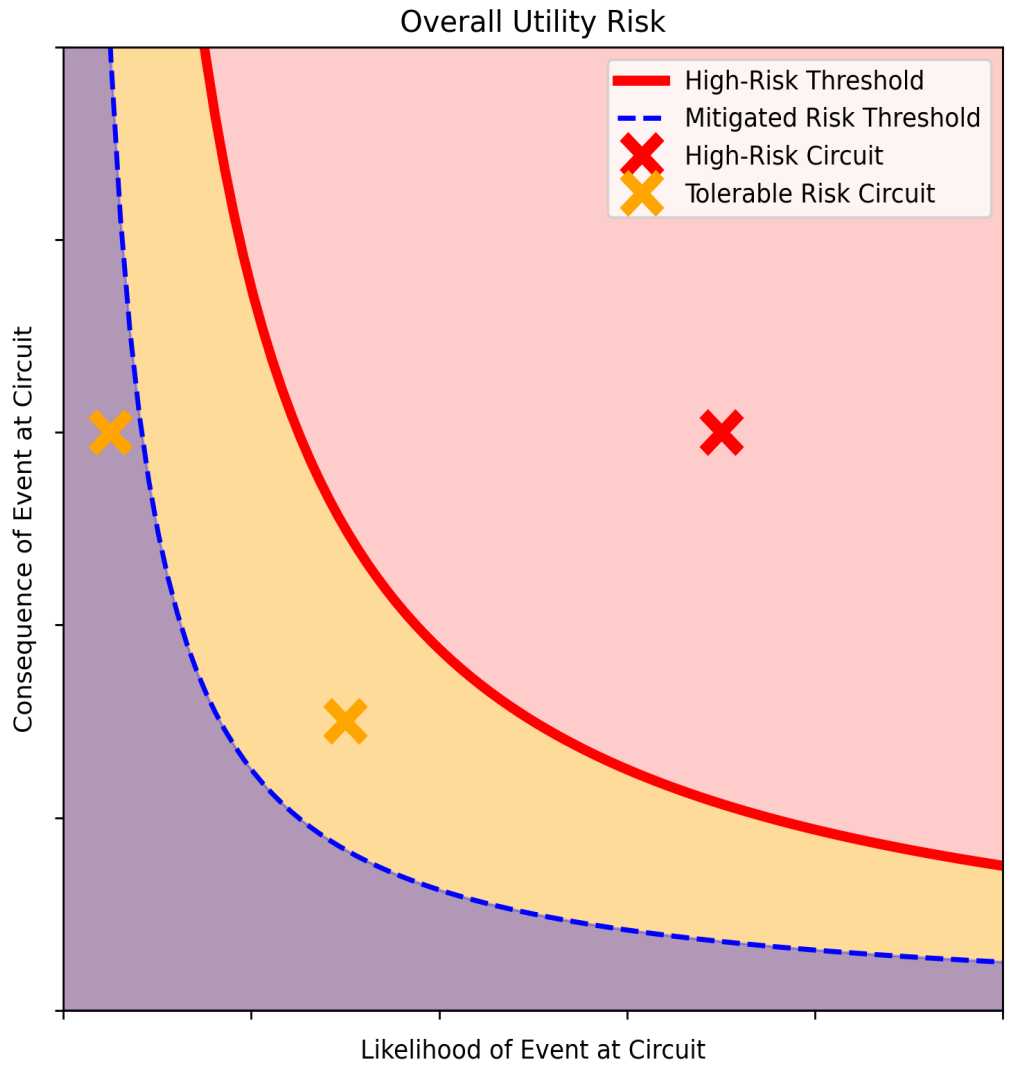
*Large Electrical Corporation develops the eligibility and mitigation values by following modeling section*

**Circuit Segment is Eligible if its score exceeds one of these thresholds:**

(i) Overall Utility Risk Threshold;
(ii) Ignition Consequence Threshold; or
(iii) Outage Program Reliability Threshold.

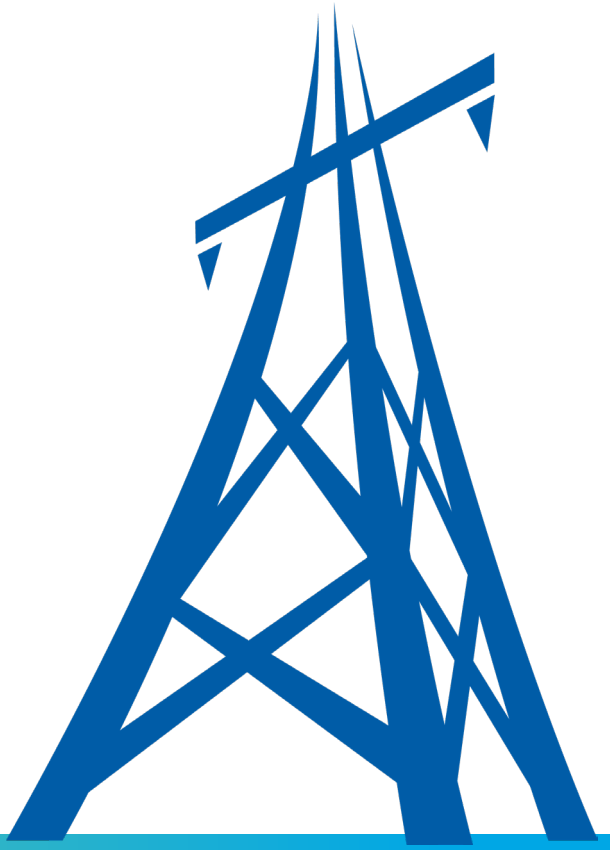
**Circuit Segment is not eligible if it doesn't exceed any of these thresholds.**

*This assures that group of circuit segments that are being considered have been screened to meet a minimum standard before further consideration*



## Screen 2: Project Information and Alternative Mitigation Comparison

- Per CPUC Resolution SPD-15, CPUC needs this information, including CBR, for CPUC Application
- Helps Energy Safety understand plan potential to reduce risk
- Allows for estimates, aggregates, assumptions, if project-specific information isn't available



# FRAMEWORK: DATA TABLES FOR SCREENS 1 AND 2

## Project ID Table

| | | | | |
|---|---|---|---|---|
| Circuit Segment ID | Project ID | Project Category | CPUC Risk Tranche[1] | Feasibility Score by Project[2] |
| CPUC Risk Rank | Overall Risk Score Rank | Ignition Consequence Rank | Outage Program Likelihood Rank | Customers Served |
| HFTD Tier | Wildfire Rebuild Area | Work Category Type | | |

## Project Index Table

### For each project:

- Risk Reduction of the Undergrounding Project per D.22-12-027.
- Project Unit Cost per Mile of Overhead Exposure.
- Project Unit Cost per Mile of Undergrounding.
- Total Undergrounding Project Cost.
- Cost-Benefit Ratio of the Undergrounding Project per D.22-12-027. Benefits must relate to the mitigation of overhead line miles not miles of undergrounding.

### For each alternative:

- Description of the type of mitigation.
- Risk Reduction of the Undergrounding Project per D.22-12-027.
- Project Unit Cost per Mile of Overhead Exposure.
- Project Unit Cost per Mile of Undergrounding.
- Total Undergrounding Project Cost.
- Cost-Benefit Ratio of the Undergrounding Project per D.22-12-027. Benefits must relate to the mitigation of overhead line miles not miles of undergrounding.

# Screen 3: Project Risk Analysis

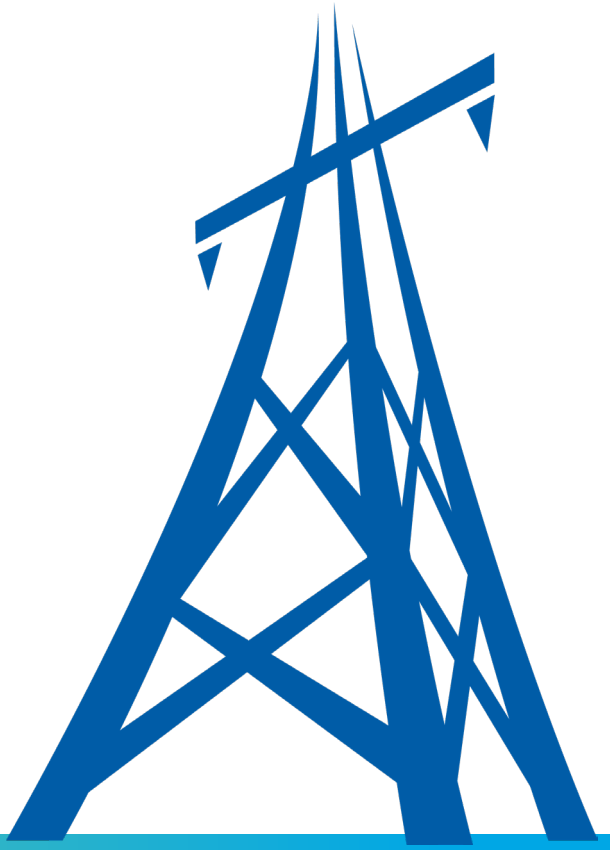
This screen fulfills need to have IOU consider **PROJECT-SPECIFIC** information in the context of the **PORTFOLIO.**

Necessary for risk analysis because it takes timeline and other project information into account **AND** how a particular project fits in portfolio context.

This screen is a big part of Energy Safety modeling and data effort (see KDMMs and Core Capabilities).

Helps Energy Safety understand how individual project will support the overall risk reduction for the plan.

All 7 mandatory KDMMs are analyzed in Screen 3.



# SCREEN 2 AND SCREEN 3 TABLES

***Example Screen 2 Table***

| Basic Info | Project | Alt. 1 | Alt. 2 |
|---|---|---|---|
| Work Type | Underground-ing | Covered Conductor | Covered Conductor + Fast Trip |
| Safety Benefits | | | |
| Reliability Benefits | | | |
| Financial Benefits | | | |
| Risk Reduction | | | |
| Unit Cost Per Overhead Mile Deenergized | | | |
| Unit Cost Per Underground Mile Energized | | | |
| Total Costs | | | |
| Cost-Benefit Ratio | | | |

***Example Screen 3 Table***

| Basic Info | Baseline | Project | Alt. 1 | Alt. 2 |
|---|---|---|---|---|
| Work Type | Baseline 1 | Under-ground-ing | Covered Con-ductor + Fast Trip | Line Removal/ Remote Grid |
| Fulfills Project- Level Standard? | N/A | | | |
| Cumulative Overall Utility Risk in year 60 | | | | |
| Cumulative Wildfire Risk in Year 60 | | | | |
| Cumulative Outage Program Risk in Year 60 | | | | |
| Mean Ignition Consequence in first 10 Years of Program | | | | |
| Mean Outage Program Likelihood in first 10 years of Program | | | | |

*Note: These tables are human-eye-friendly summaries used on the project reference sheets are not the complete list of the required metrics. For an exhaustive accounting, see Section 2.8.1 of our Guidelines and Appendix C.*

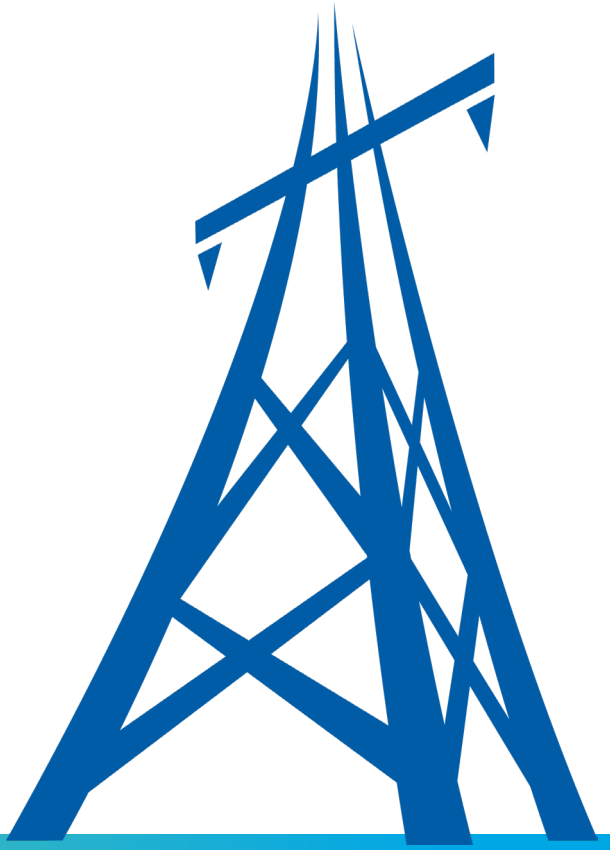
# FRAMEWORK SCREEN 4

## Screen 4: Prioritization of Projects

Means of prioritizing undergrounding projects based on:

- **wildfire risk reduction**
- **public safety**
- **cost efficiency**
- **reliability benefits**

The IOU must define each of these and explain how they are factored into the Prioritization scheme



# SUMMARY OF SCREENS

## Screen 1: Circuit Segment Eligibility

**Purpose: identify eligible circuits and create the "list of projects"**

**Statutory Reference: Section 8388.5(d)(2) and Section 8388.5(c)(2)**

**EUP Content: Narrative in EUP; *Progress Report* 0: list of circuits; data submission**

**When: Must apply in filed EUP. Can reapply during EUP period.**

## Screen 2: Project Information and Alternative Mitigation Comparison

**Purpose: statutorily required alternative mitigation comparison (using aggregate/estimates) + get CPUC CBR information**

**Statutory Reference: section 8388.5(c)(4)**

**EUP Content: Narrative in EUP; Progress Report 0: list of circuits, Portfolio Coversheet; data submission**

**When: Must apply in filed EUP. Can reapply during EUP period.**

## Screen 3: Project Risk Analysis

**Purpose: alternative mitigation comparison (using project-specific information); Risk analysis of project in portfolio context**

**Statutory Reference: Section 8388.5(d)(2), Section 8388.5(c)(4)**

**EUP Content: Narrative in EUP; Progress Report 0: list of circuits, Portfolio Coversheet, Project Coversheet; data submission**

**When: when ready, apply to batch of at least 25 projects. At least 1 batch expected at EUP filing. Can apply or reapply during EUP period.**

## Screen 4: Prioritization of Projects

**Purpose: required by statute; allows consideration of factors when "prioritizing"**

**Statutory Reference: Section 8388.5(c)(2)**

**EUP Content: Narrative in EUP; Progress Report 0: list of circuits, Portfolio Coversheet, Project Coversheet; data submission**

**When: when ready, apply to batch of at least 25 projects. At least 1 batch expected at EUP filing. Can apply or reapply during EUP period.**

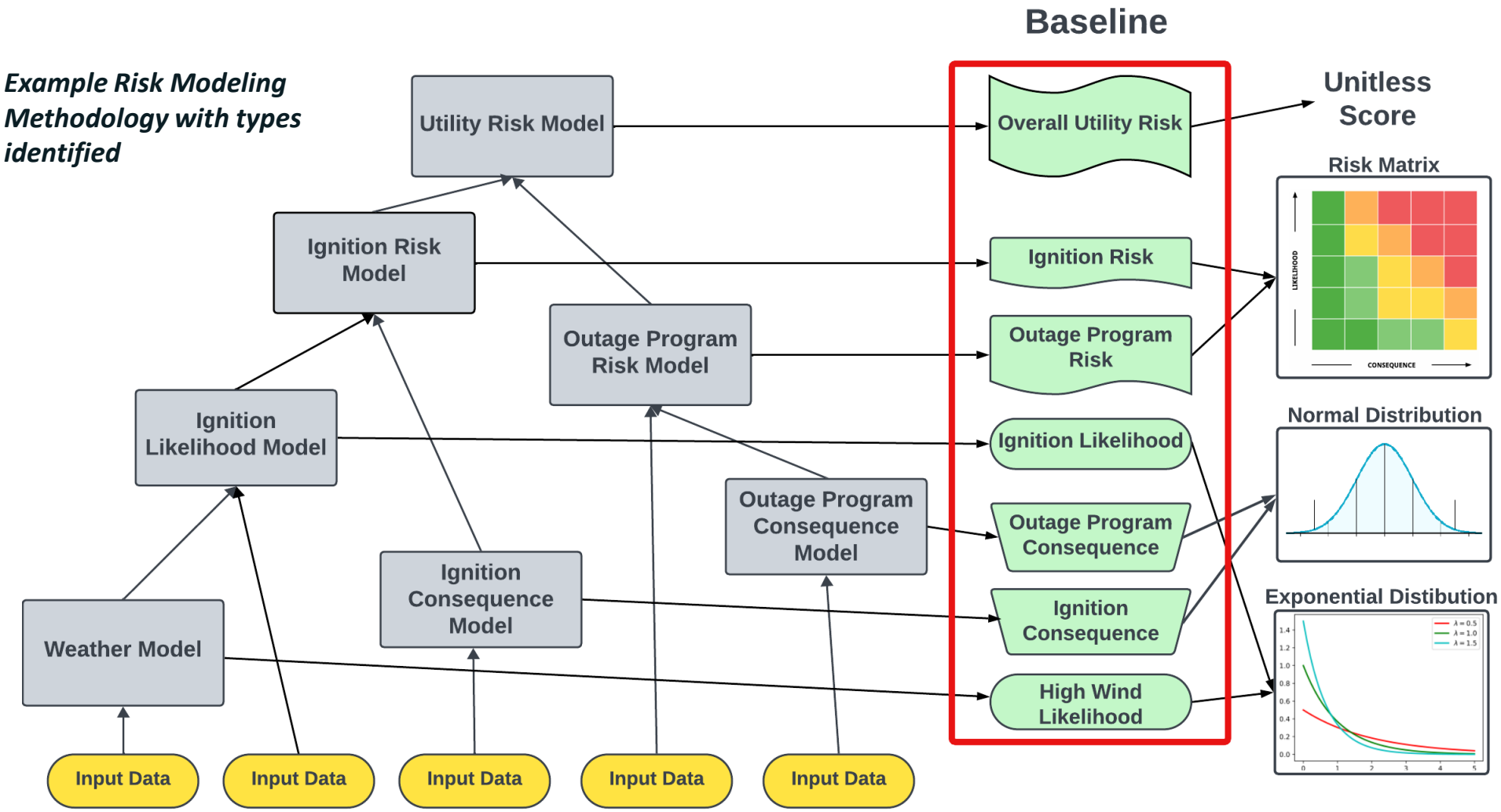
# Questions?

# Break


MODELING
DEEP-DIVE

# RISK MODELING METHODOLOGY: MODEL RISK LANDSCAPE

***Example Risk Modeling Methodology with types identified***



# VERIFICATION: REPORTS ON MODELS

| Section | Description |
|---|---|
| **Model Usage** | The model's scope, how often the model is invoked, what sections of the system are measured |
| **Model Type** | The taxonomy (e.g., physics simulation, mathematical model, machine learning classification) |
| **Model Inputs** | The data that is fed into a calibrated model, including a description of the original data collection |
| **Model Solution** | The method used to calibrate, train, simulate, optimize, or implement the model from a mathematical standpoint |
| **Model Outputs** | The data produced by the model is fed into other models or used by the large electrical corporation to make risk-related decisions. |
| **Uncertainty** | Amount by which a calculated value might differ from the true value when the input parameters are known |
| **Toy Problems** | This section must describe three examples, specifying input and output values, using synthetic data. One input must lead to a low-risk (or low-probability, low-consequence) output, one for a medium-risk case, and one for a high-risk case. |
| **Shelf-life** | The length or period the model is expected to be valid |

# MODEL RISK LANDSCAPE

The **Model Risk Landscape** is the collection of all inputs, outputs and intermediate calculations used in the Risk Modeling Methodology.

This includes all KDMMs, their precursor calculations, and any additional numerical evidence that the large electrical corporation uses to evaluate or report the risk reduction of an Undergrounding Project or alternative mitigation.

**MRL (VERSION, CALIBRATION, PORTFOLIO, FORECAST TIME)**

1. **Version of the model (Architecture)**
2. **Scenario Calibration (Training data, historical tables, on-the-ground measurements)**
3. **Portfolio (Set of projects)**
4. **Forecast time (At what time, or over what time periods are we measuring)**

**Model Risk Landscape:=** ***MRL(v0, s0, P={a,b,c,...k}, Q2023)***

***MRL(v1, s3, P={a'",c,d...,s,t'...}, 2Q2027)***

**Note: (Non-standard notation warning)**

This can be expressed as a non-linear scheme.

$$\boldsymbol{MRL}(*,*,\boldsymbol{P}-\boldsymbol{a},:) \not\equiv \boldsymbol{MRL}(*,*,\boldsymbol{P},:) - \boldsymbol{MRL}(*,*,\boldsymbol{a},:)$$

- We use + and – inside the MRL arguments indicate set difference.
- The + and – signs outside the arguments indicate signed distance under the (potentially weighted) Fréchet norm.

$$\boldsymbol{MRL}(*,*,\boldsymbol{P}/\boldsymbol{a},:)\,! \equiv \delta(\boldsymbol{MRL}(*,*,\boldsymbol{P},:),\boldsymbol{MRL}(*,*,\boldsymbol{a},:))$$

# DIFFERENCES WITH CPUC CBA-MATH

The numbers that we ask for do not force the IOUs to create a separate system from the CPUC's CBA (R.20-07-013)

Energy Safety is primarily concerned with conducting a ***Probabilistic Risk Assessment.***

We ask the IOU to report their Risk Modeling Methodology in a slightly different way, including numbers which are ***upstream*** of the R.20-07-013 benefits.

Specifically, we require metrics to be reported in ***natural units*** (as opposed to dollarized units) and at a ***finer spatial and temporal granularity*** and ***without any risk-attitude scaling.***

# CORE CAPABILITIES OF RISK MODELING METHODOLOGY

1. Project Level Risk Analysis
2. Aggregate Risk Analysis
3. Ignition and Outage Risk as Separate and Collective Risks
4. Future Risks and Accumulation of Risk over Time
5. Establishment of Baselines and Historical Calibrations
6. Comparisons with Alternative Mitigations

**For each, we require a narrative section with additional Toy-Problem examples**

# 1. PROJECT-LEVEL RISK ANALYSIS

The IOU must demonstrate that its framework can analyze risk reduction of projects in its Portfolio both separately and collectively

For each project the large electrical corporation must conduct a Collective Analysis, a Separate Analysis, and an Ablation Analysis

Let ***a,b,c*** be projects, and ***P*** be a portfolio of projects.

***Separate Analysis:***

$$\boldsymbol{MRL}(*,*,\boldsymbol{a},:)$$

***Collective Analysis***

$$\boldsymbol{MRL}(*,*,\boldsymbol{P}=\{\boldsymbol{a},\boldsymbol{b},\boldsymbol{c}\ldots\},:)$$

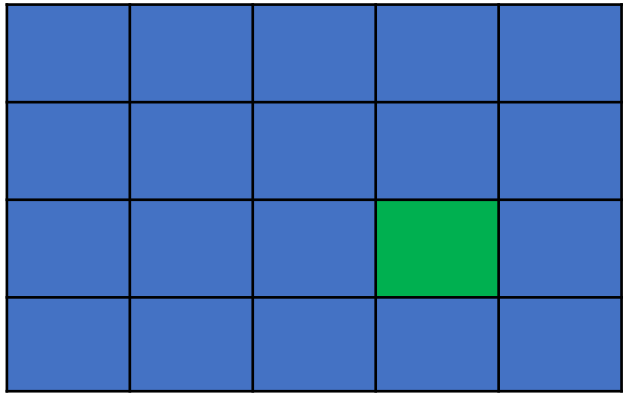
***Ablation Analysis***

$$\boldsymbol{MRL}(*,*,\boldsymbol{P}-\boldsymbol{a},:)$$

*Note: These formulas, and the ones on the next 10 slides are illustrative. In the plan, the IOU must explicitly define them and provide example calculations.*

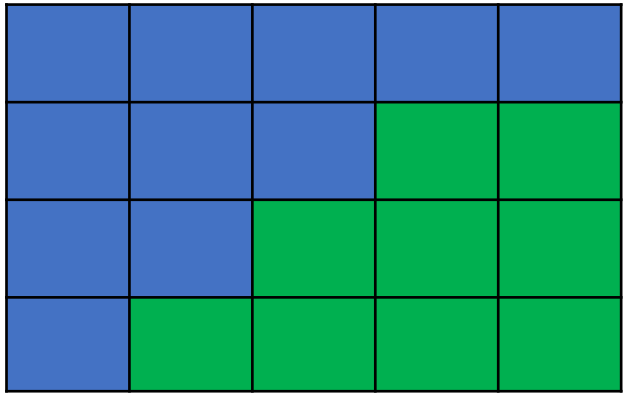
# The 3 Analyses:

***Separate*** = Single Project



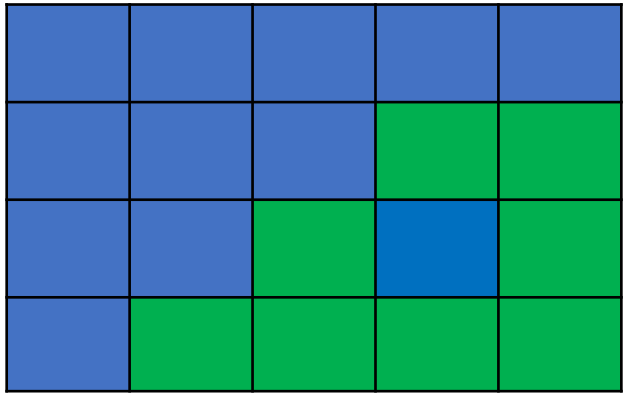
The **Separate Study** measures the effects of this Project alone, as if no other 884 Projects are begin completed

***Collective*** = Portfolio



The **Collective Study** measures the effects of this Project along with the rest of the Portfolio

***Ablation*** = Portfolio - Project



The **Ablation Study** measures the effect on removing this project from the portfolio

# 2. AGGREGATE RISK ANALYSIS

For each KDMM, the IOU must provide an explanation of how circuit level risks are combined to model its risk across the electrical distribution system

*Note: This aggregation may include a summation of circuit/circuit segment risks, or may include weighed linear, or nonlinear accumulations.*

***Project-Level:***

$$\boldsymbol{MRL}(*,*,\boldsymbol{a},:) .^{*} \boldsymbol{\chi_{\omega}}, \quad \boldsymbol{\chi_{\omega}} = \begin{cases} \mathbf{1} & \boldsymbol{at\ \omega} \\ \mathbf{0} & \boldsymbol{otherwise} \end{cases}$$

***Portfolio-Level:***

$$\bigcup_{\boldsymbol{\omega} \in \boldsymbol{\Omega} \coloneqq \boldsymbol{Portfolio}} \boldsymbol{MRL}(*,*,\boldsymbol{a},:) .^{*} \boldsymbol{\chi_{\omega}}$$

*--or--*

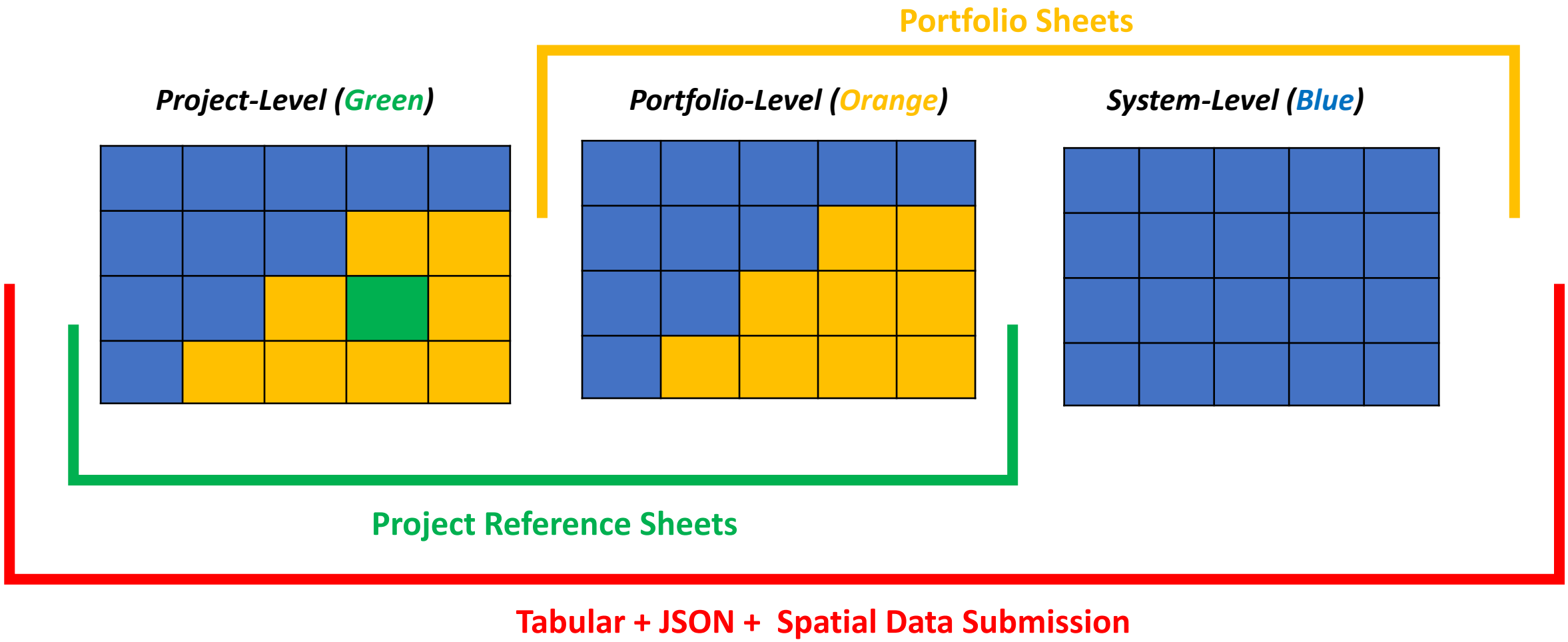
$$\boldsymbol{MRL}(*,*,\boldsymbol{a},:) .^{*} \boldsymbol{\chi_{\Omega}}$$

***System-Level:***

$$\boldsymbol{MRL}(*,*,\boldsymbol{a},:)$$

*Note: These unions may also be computed as sums, integrals or similar operations provided the operation is explicitly defined and reviewed by Energy Safety*

# The 3 levels of spatial accumulation:



# 3.IGNITION AND OUTAGE RISK AS SEPARATE AND COLLECTIVE RISKS

The large electrical corporation must detail its method for evaluating Ignition Risk and Outage Program Risk through separated and combined metrics

The IOU must demonstrate that its analysis for each of these metrics can be performed independently and collectively and detail the trade-off between the two

***Ignition Risk:***

$$\boldsymbol{I} \coloneqq \{\boldsymbol{MRL}(*,*,\boldsymbol{a},:)\}|_{\boldsymbol{Ignition}}$$

***Outage Program Risk:***

$$\boldsymbol{O} \coloneqq \{\boldsymbol{MRL}(*,*,\boldsymbol{a},:)\}|_{\boldsymbol{Outage}}$$

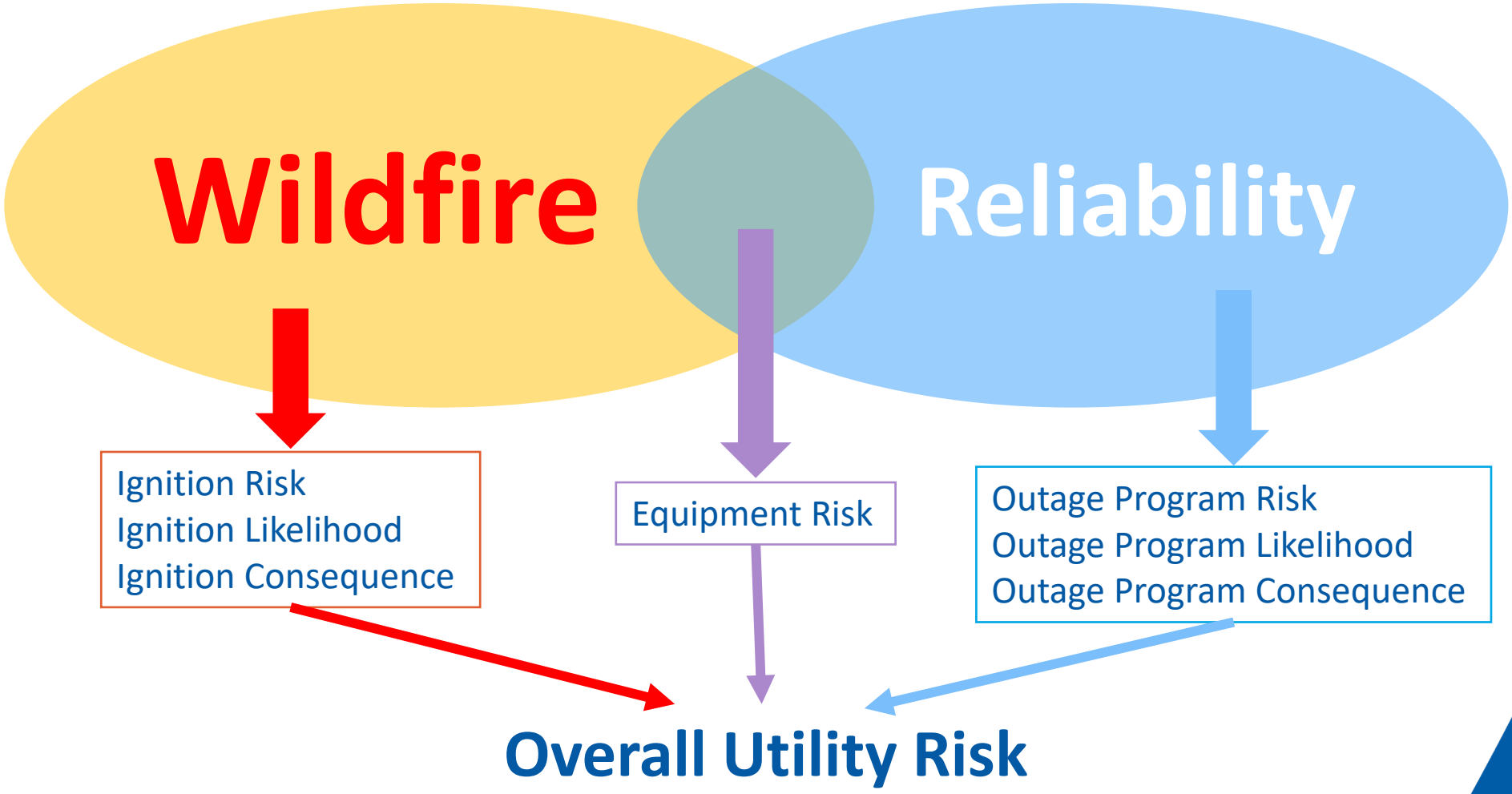
***Requirements:***

$$\boldsymbol{I} - \boldsymbol{O} \neq \emptyset, \qquad \boldsymbol{O} - \boldsymbol{I} \neq \emptyset$$

$$\boldsymbol{I} \cap \boldsymbol{O} \neq \emptyset$$

$$\textbf{\textit{Overall Risk}} \coloneqq \boldsymbol{f}(\boldsymbol{I}, \boldsymbol{O})$$

# EXAMPLE


Wildfire
Reliability
Ignition Risk
Ignition Likelihood
Ignition Consequence
Equipment Risk
Outage Program Risk
Outage Program Likelihood
Outage Program Consequence
Overall Utility Risk

# 4. FUTURE RISKS AND ACCUMULATION OF RISK OVER TIME

The IOU must detail its method for evaluating Ignition and Outage Program Risk at future dates and the accumulation of these risks over time

The large electrical corporation must report the KDMMs at 0, 5, 10, 20, 30, 40, 50, 60 years into the future for all Confirmed Projects

***Example Accumulations:***

$$\int_{t_0}^{t_F} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{t}), \emptyset, \boldsymbol{t})\ \boldsymbol{\delta\sigma}(\boldsymbol{t})$$

$$\sum_{t_0}^{t_F} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{ti}), \emptyset, \boldsymbol{ti})$$

$$\bigcup_{t_i}^{|t_F|} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{ti}), \emptyset, \boldsymbol{ti})$$

Evaluated at $\boldsymbol{t_F} = 0, 5, 10, 20, 30, 40, 50, 60$ years

# 5. ESTABLISHMENT OF BASELINES AND HISTORICAL CALIBRATIONS

The IOU must demonstrate how it ensures that the Risk Modeling Methodology is evaluated with up-to-date information, and that comparisons between projects and alternatives are made on a statistically consistent scale

To establish a Baseline, the large electrical corporation must model the risk landscape assuming that no projects from this program are constructed

Baselines must be measured and reported at the same cadence as other risk model landscape at **0, 5, 10, 20, 30, 40, 50 and 60** years

***Original Baseline:***

$$\int_{t_0}^{t_F} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{t}), \emptyset, \boldsymbol{t})\ \boldsymbol{\delta\sigma}(\boldsymbol{t})$$

$$\approx \sum_{t_0}^{t_F} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{ti}), \emptyset, \boldsymbol{ti})$$

***Year 7 Baseline:***

$$\int_{t_0}^{t_F} \boldsymbol{MRL}(\boldsymbol{v}, \boldsymbol{s}(\boldsymbol{t}), \boldsymbol{P_7}, \boldsymbol{t})\ \boldsymbol{\delta\sigma}(\boldsymbol{t})$$

*where $\boldsymbol{P_7}$ includes only Projects which have passed through screen 4 by year 7.*

# ESTABLISHING BASELINES OVER THE LIFECYCLE OF 884

- With each new modeling update / model calibration / project completion there will be new baseline(s) established
- Old baselines will be recorded and used to establish model reliability and establish a reduction in risk over time
- New baselines will be used for back-testing projects and evaluating new projects
    - New projects should always be evaluated on the newest baseline

# 6. COMPARISONS WITH ALTERNATIVE MITIGATIONS

The large electrical corporation must demonstrate its method for comparing Undergrounding Projects with Alternative Mitigations

This must include at least two alternative mitigations. For each project, the large electrical corporation must evaluate its Model Risk Landscape, using the same versioning and calibration, to produce a Separate Alternative Analysis and a Collective Alternative Analysis

Let $\boldsymbol{\alpha}$ be an alternative for $\boldsymbol{a}$:

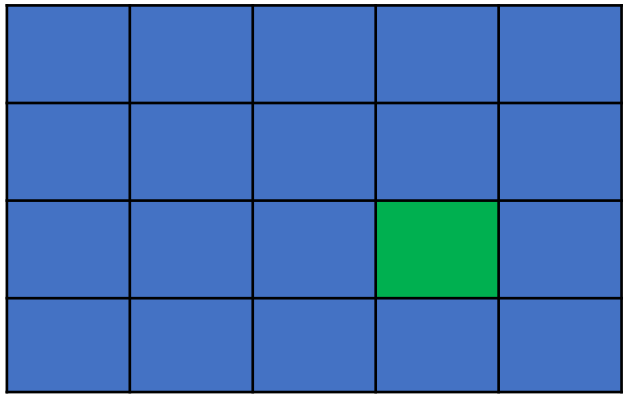
***Separate Analysis:***

$$\boldsymbol{MRL}(*,*,\boldsymbol{\alpha},:)$$

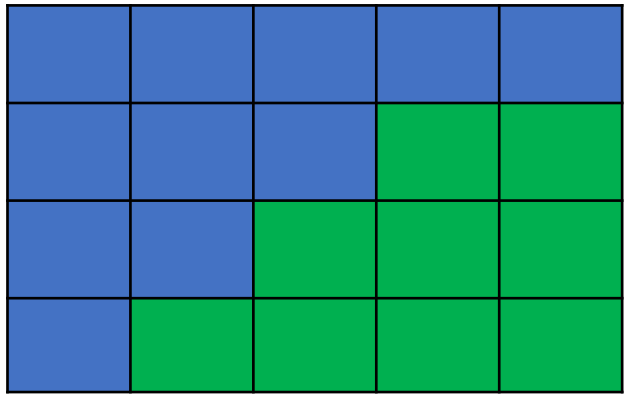
***Collective Analysis***

$$\boldsymbol{MRL}(*,*,\boldsymbol{P}-\boldsymbol{a}+\boldsymbol{\alpha},:)$$

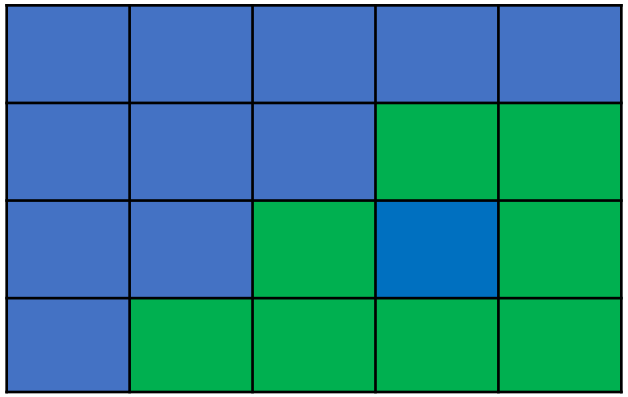
***Separate*** = Single Project



***Collective*** = Portfolio

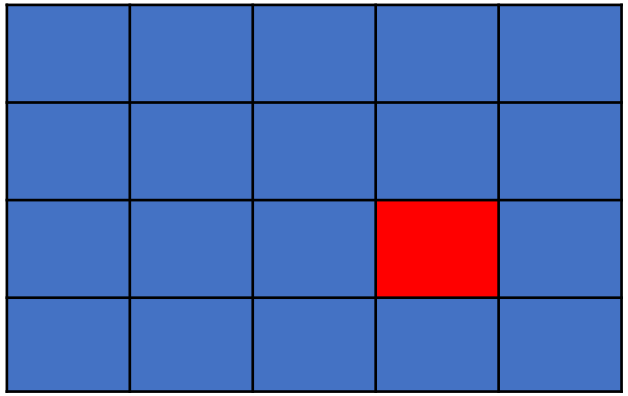


***Ablation*** = Portfolio - Project

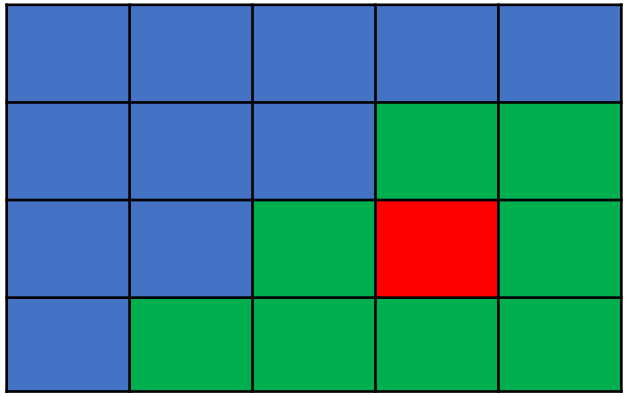


***Alternative Mitigation Studies***

***Separate Alternative*** = Single Alternative



***Collective Alternative*** = Portfolio – Project + Alternative



# Questions?

# Break


HUMAN
READABLE DATA

# APPENDIX D: PORTFOLIO COVERSHEET

| Section | Description: | Figures and Tables: |
|---|---|---|
| **Narrative Justification** | A narrative description outlining the portfolio and pointing out any key metrics | None |
| **Key Decision-Making Metrics** | A series of tables and figures which showing the KDMMs before and after the modeling of the projects include in the portfolio. | For both baseline and modeled mitigations:<br>-System-Level and Portfolio-Level KDMM Profiles<br>-System-Level and Portfolio-Level KDMM Tables |
| **Portfolio Development** | A series of tables and figures which show how the portfolio has changed over time. | -Portfolio Size Figures<br>-KDMM Development Tables |
| **Lists of Circuits** | A table listing circuits included in the portfolio and the stage of screens they have passes. | -Circuit Table |

# PROJECT INDEX TABLE

| Column Name | Field Description |
|---|---|
| project_id | A unique value identifying the project. |
| portfolio_id | A unique value identifying the portfolio. |
| circuit_id | A unique value identifying the circuit. |
| circuit_segment_id | A unique value identifying the circuit segment ID. |
| fips_county_codes | A Federal Information Processing Standards code used to uniquely identify U.S. counties and their equivalents. |

| Column Name | Field Description |
|---|---|
| project_category: | The category of the project. Acceptable values are:<br>• High Risk Project<br>• Ignition Tail Risk Project<br>• High Frequency Outage Program Project<br>• None |
| hftd | An integer value representing the CPUC High Fire-Threat District (HFTD) area. Below are the integer values with the associated meaning. Acceptable values are the following:<br>• HFTD Tier 2<br>• HFTD Tier 3<br>• Non-HFTD |

# PROJECT INDEX TABLE

| | |
|---|---|
| project_risk_reduction | Risk Reduction of the Undergrounding Project per D.22-12-027. |
| project_unit_cost_per_ overhead_mile_deenergized | Project Unit Cost per Mile of Overhead Exposure. |
| project_unit_cost_per_ underground_mile_energized | Project Unit Cost per Mile of Undergrounding. |
| project_total_costs | Total Undergrounding Project Cost. |
| project_cost_benefit_ratio | Cost-Benefit Ratio of the Undergrounding Project per D.22-12-027. Benefits must relate to the mitigation of overhead line miles not miles of undergrounding. |

| Then, for each of the alternative mitigations considered, the following columns: | |
|---|---|
| alt_#_work_type | Description of the type of mitigation. |
| alt_#_risk_reduction | Risk Reduction of the Undergrounding Project per D.22-12-027. |
| alt_#_project_unit_cost_per_ overhead_mile_deenergized | Project Unit Cost per Mile of Overhead Exposure. |
| alt_#_project_unit_cost_per_ underground_mile_energized | Project Unit Cost per Mile of Undergrounding. |
| alt_#_project_total_costs | Total Undergrounding Project Cost. |
| alt_#_project_cost_benefit_ratio | Cost-Benefit Ratio of the Undergrounding Project per D.22-12-027. Benefits must relate to the mitigation of overhead line miles not miles of undergrounding. |

# APPENDIX E: PROJECT REFERENCE SHEETS

**IDENITICATION AND CONTEXT**

| | | | | |
|---|---|---|---|---|
| **Circuit Segment ID** | **Project ID** | **Project Category** | **CPUC Risk Tranche[1]** | |
| | | | | |
| **Feasibility Score by Project[2]** | **CPUC Risk Rank** | **Overall Risk Score Rank** | **Ignition Consequence Rank** | **Outage Program Likelihood Rank** |
| | | | | |
| **Customers Served** | **HFTD Tier** | **Wildfire Rebuild Area** | **Work Category Type** | |
| | | | *Targeted UG* | |

[1] See PUC 884 Guidelines
[2] Optional: See PUC 884 Guidelines

**OTHER REQUIREMENTS IN PART 1:**

- **NARRATIVE EXPLANATION**
- **LIST OTHER UTILITIES ON POLES**
- **PROJECT TIMELINES (ESTIMATED AND COMPLETED)**

# APPENDIX E: PROJECT REFERENCE SHEETS

**SCREEN 2 REQUIREMENT**

| Basic Info | Project | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Work Type** | Undergrounding | Covered Conductor | Covered Conductor + Fast Trip |
| **Safety Benefits** | | | |
| **Reliability Benefits** | | | |
| **Financial Benefits** | | | |
| **Risk Reduction** | | | |
| **Unit Cost Per Overhead Mile Deenergized** | | | |
| **Unit Cost Per Underground Mile Energized** | | | |
| **Total Costs** | | | |
| **Cost-Benefit Ratio** | | | |

# APPENDIX E: PROJECT REFERENCE SHEETS

**SCREEN 3 REQUIREMENT**

| Basic Info | Baseline | Project | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
| **Work Type** | Baseline 1 | Undergrounding | Covered Conductor | Covered Conductor + Fast Curve System |
| **Fulfills Project- Level Standard?** | N/A | | | |
| **Cumulative Overall Utility Risk in year 60** | | | | |
| **Cumulative Wildfire Risk in Year 60** | | | | |
| **Cumulative Outage Program Risk in Year 60** | | | | |
| **Mean Ignition Consequence in first 10 Years of Program** | | | | |
| **Mean Outage Program Likelihood in first 10 years of Program** | | | | |


DETAILED DATA
REPORTING

## Tabular Data

- Queryable versions of Plan-level info
- Tracking info on Circuit Segments, Projects, Screen progress
- Readable & Searchable versions of detailed modeling info

## JSON Data

- Details on risk model, what inputs change from mitigations, what effect on KDMMs
- Detailed project-level modeling:
  - cumulative and instantaneous effects,
  - separate, collective, ablation, etc.

## GIS Data

- Show precise locations of overhead lines and assets to be removed, underground lines to be built
- Only required after passing all 4 screens and ready for construction

# Tabular Data Submission

13 tables, submitted as .CSV files

Templates will be provided

**Plan-level static values (thresholds, etc.)**

**Portfolio And Modeling Evolution**

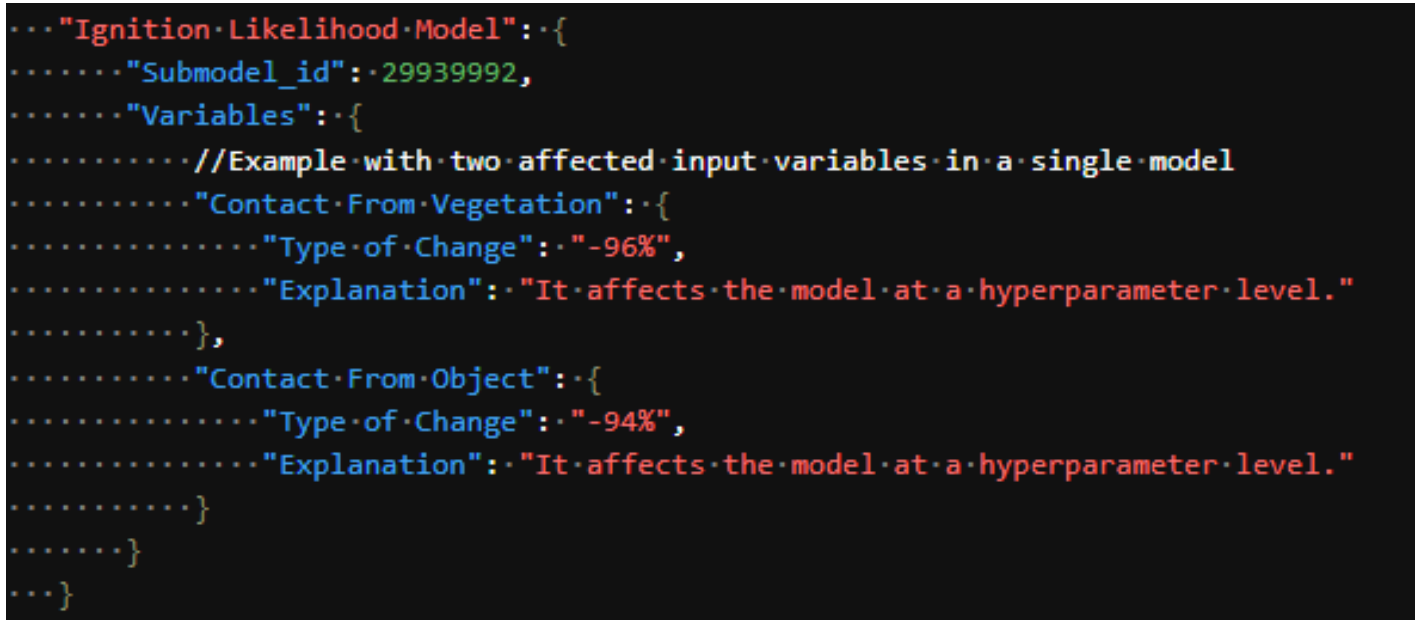
**Project Specific Tracking/Status and progress through screens**

**Human-readable project information**

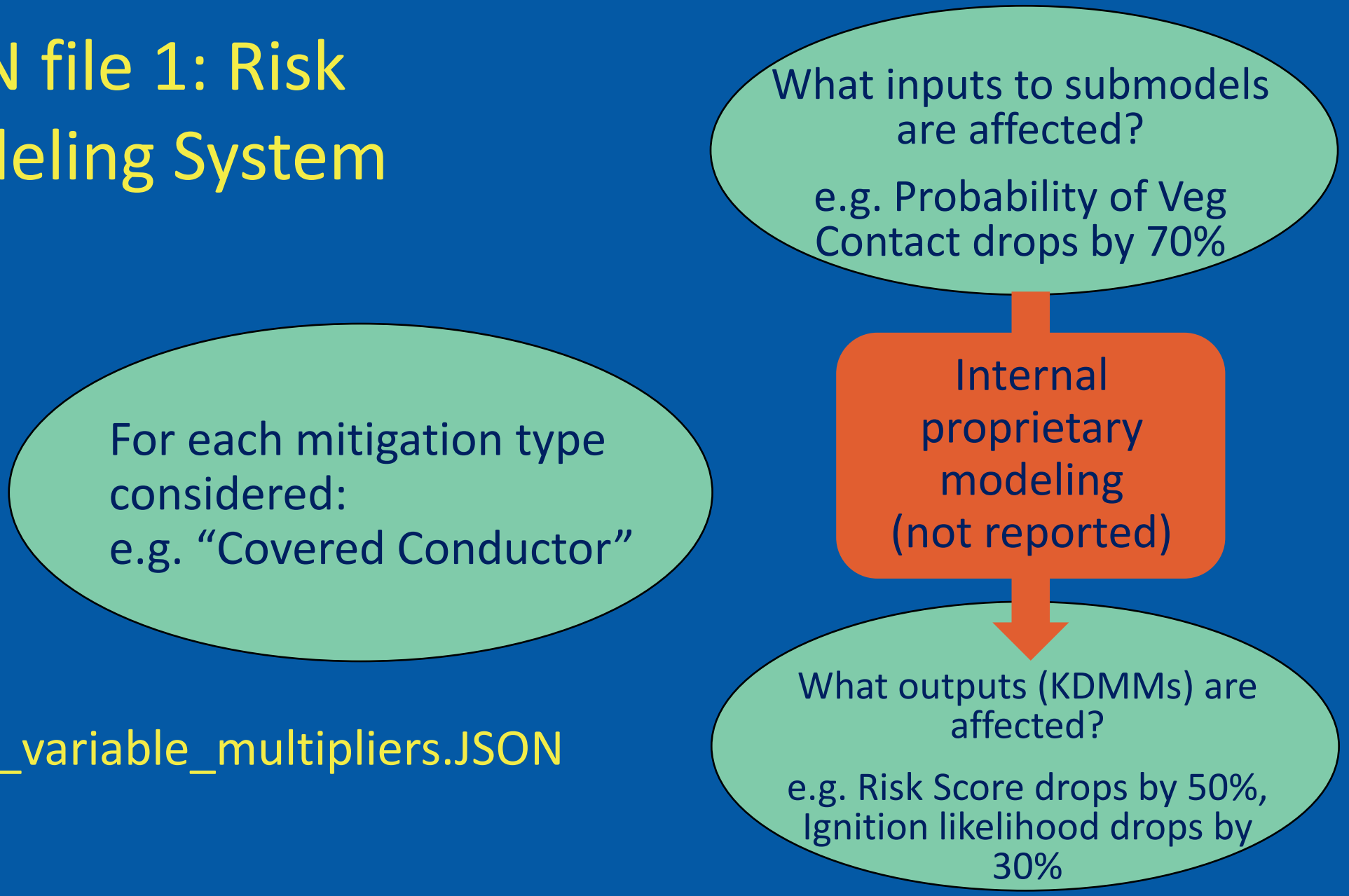
| Table Number | Table Name | Table Explanation |
|---|---|---|
| 1 | Plan Table | One submission with EUP |
| 2 | KDMM Table | One submission with EUP |
| 3 | Risk Model Version History | Rows added as versions update |
| 4 | Portfolio Table | One submission with each PR |
| 5 | Circuit Segment Identification Table | full table of Circuit Segments |
| 6 | Circuit Segment Risk Score Table | full table of Circuit Segments |
| 7 | Screen History Table | Track Circuit Segment Progress through screens |
| 8 | Project Table | Track Projects (after screen 2) |
| 9 | Screen 2 Table | Track Projects (after screen 2). Separated to put all screen 2 info in one place |
| 10 | Screen 3 Table | Track Projects (after screen 3). |
| 11 | Project Status Table | Track Projects (after all screens) |
| 12 | Project Construction Table | Track Projects ready for construction |
| 13 | Project Index Table | Stakeholder-readable project list, comparisons, scores |

# JSON DATA SUBMISSION

- Energy Safety is requiring data in JSON format for the first time.
- This is a lightweight, text-based data format that can be easily modified and analyzed without any proprietary software.
- It looks like code, but functionally acts like a pivot table that's easier to ingest/process
- Utilities will be required to publicly share a spreadsheet version of these files on their web site

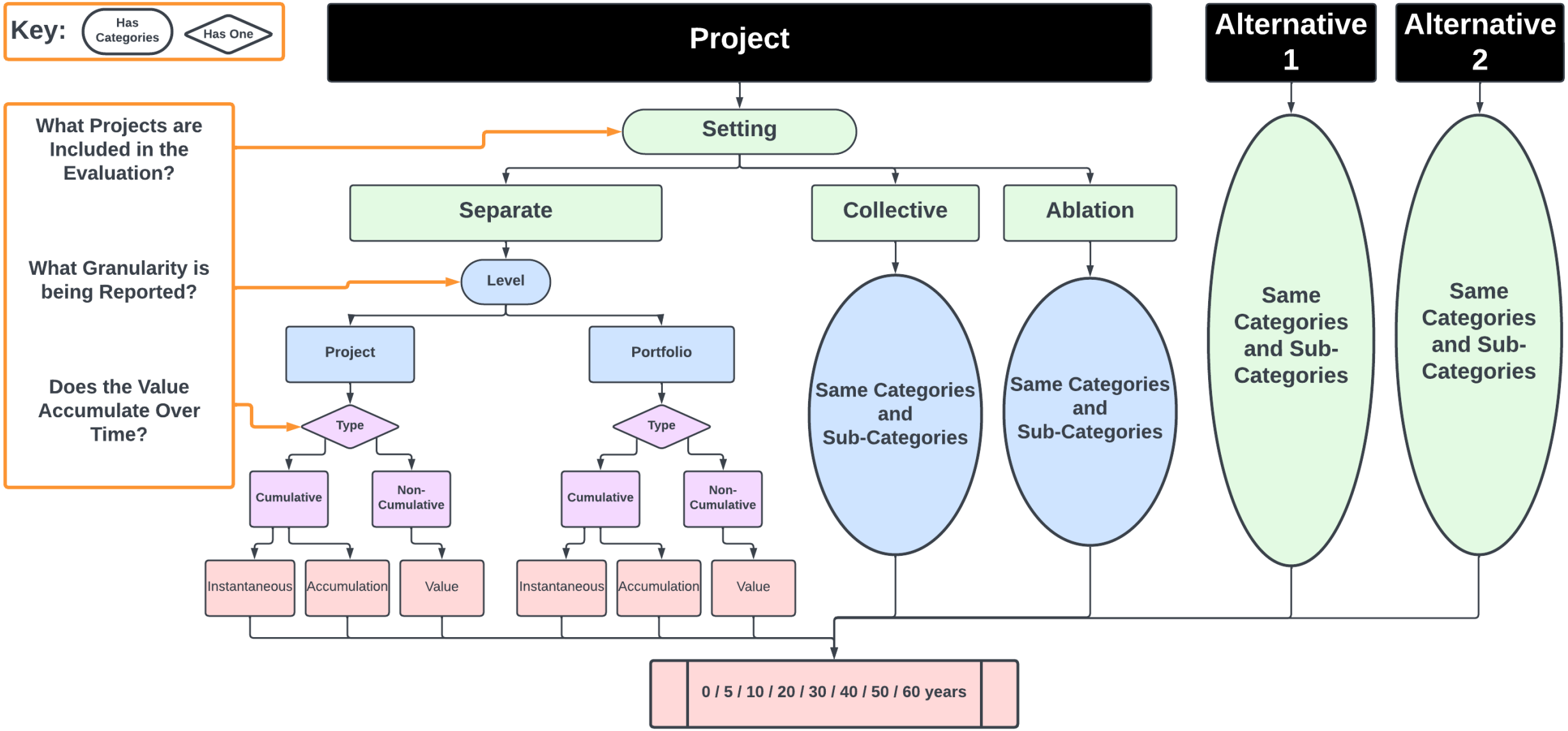


# JSON file 1: Risk Modeling System




Project_variable_multipliers.JSON

# JSON File 2: Project-Level Risk Modeling:



# GIS Spatial data


Spatial Data is required for projects after they reach "ready for construction" status

**Underground Assets Created**

- New underground lines (to be) installed
- Assets and equipment which will be attached to undergrounded lines

**Aboveground Assets Removed**

- Existing aboveground lines (to be) de-energized and removed
- Assets and equipment to be retired/ removed/ undergrounded

# Questions?

# NEXT STEPS

## Q&A Session: 5/22 1:00-3:00

Send questions by 5/20 COB to electricalundergroundingplans@energysafety.ca.gov

## Comments due 5/29

## Reply Comments due 6/10