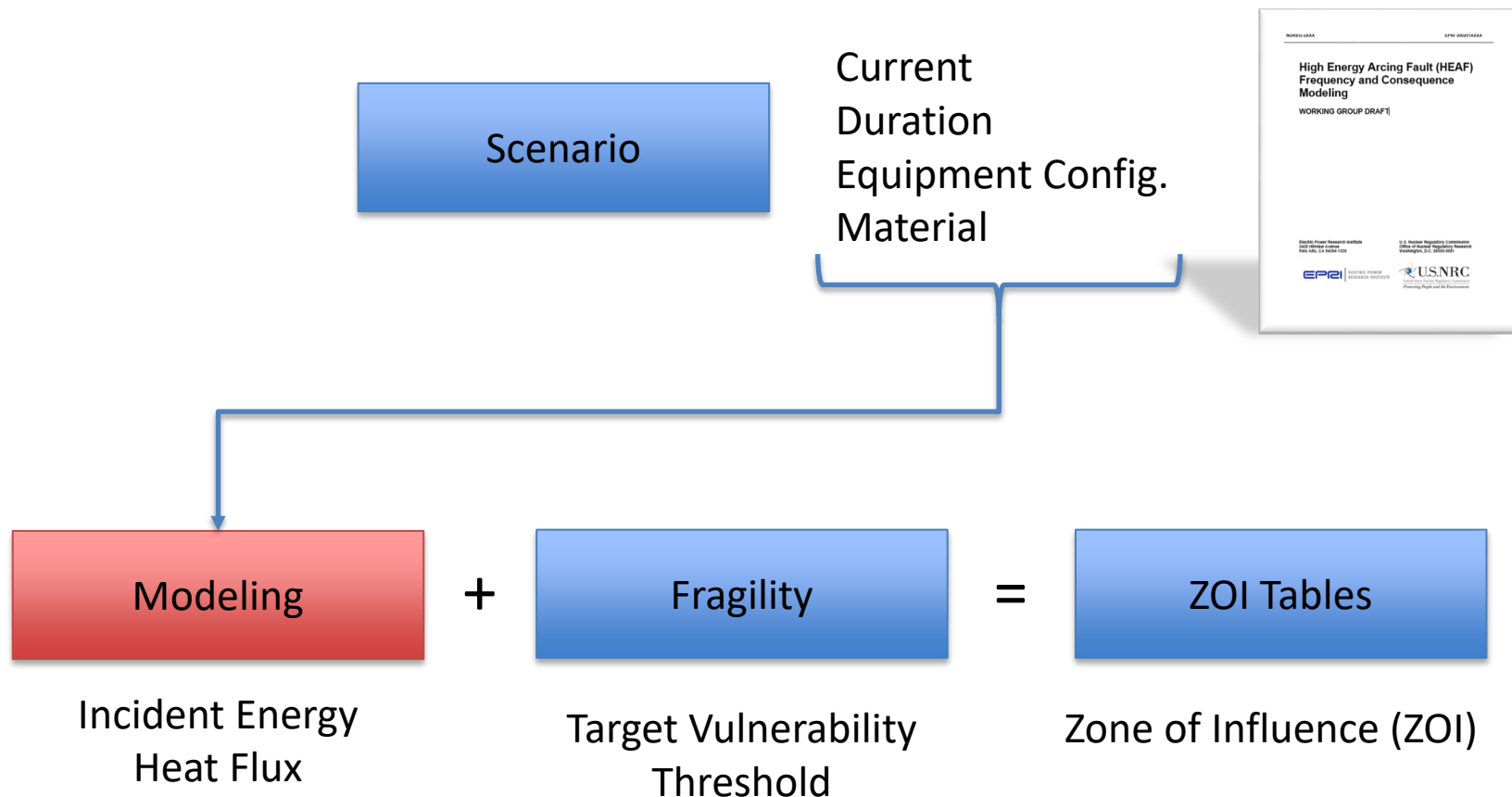


# Modeling Overview

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# Overview of ZOI development



# Flashback : April 2018

Merging with  
incorporation of  
CFD modeling  
insights

## Modeling Approach



- Bounding (Current models)
  - Enclosure, bus ducts
- Bounding by Categories
  - By power, energy, voltage, fault current, protection scheme, material, safety class
- Dynamic ZOI
  - Scenario dependent source
  - Target fragility

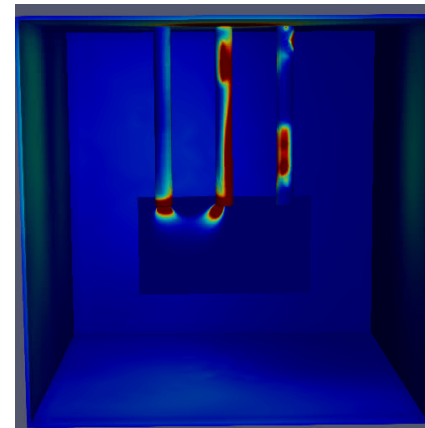
$$E = kVI\left(\frac{t}{D^p}\right)$$

$$E = k_1 \cdot t \cdot \left(\frac{k_2}{D}\right)^x \cdot 10^{[k_3 + k_4 \cdot \log(I) + k_5 \cdot G]}$$

NRC HEAF Phase II Information Sharing Public Workshop, April 18-19, 2018

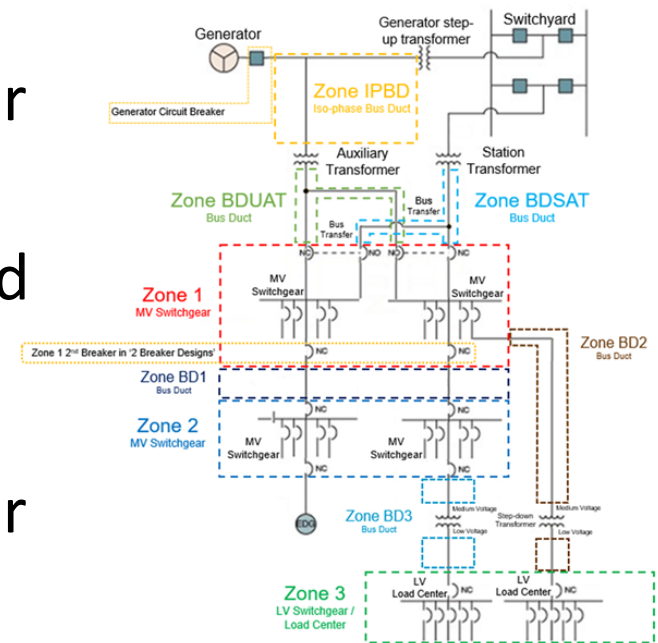
# Modeling Approaches

- SNL SIERRA Suite
  - Multi-physics coupled model
  - Focus on modeling arc (source term)
- NIST FDS
  - CFD modeling
  - Focus on modeling thermal transport to target
- Empirical
  - Data fit
  - Focus on specific phenomena; enclosure breach, arc voltage



# Modeling Scenarios

- Medium Voltage, Non-segregated phase bus duct
  - Enclosure: Steel or Aluminum
  - Conductors: Aluminum or Copper
- Medium Voltage Switchgear
  - Configuration: Supply, Main, Load
  - Energy Profile: Stiff, Decay, or Stiff + Decay
  - Conductors: Aluminum or Copper
- Low Voltage Switchgear
  - Conductors: Aluminum or Copper



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# Scenario Consolidation

- PRA document covers over 300 scenarios for just aluminum
- Low energy scenarios are being removed from initial list using empirical correlations and slightly conservative fragility thresholds
- Reduces scenario list by 88%
- Some scenarios have similar or identical hazard and can be consolidated even further

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# Summary

- Overall approach to decouple modeling and fragility efforts remains intact
- Modeling approach has evolved into a hybrid between category and dynamic
- PRA guidance document supports defining model scenarios
- Modeling appears to provide reasonable estimates to inform the working group's ZOI determination. However, areas for uncertainty reduction exist.