U.S.NRC
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EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Module II – Circuit Analysis

Fire PRA Circuit Analysis Summary

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CIRCUIT ANALYSIS SUMMARY

Topics

- Circuit Analysis “Big Picture” Road Map
- Interface with Fire PRA Group
- Circuit Analysis Strategy & Implementation
- Key Considerations & Factors
- Relationship to Appendix R & NFPA 805
- Lessons Learned

CIRCUIT ANALYSIS SUMMARY

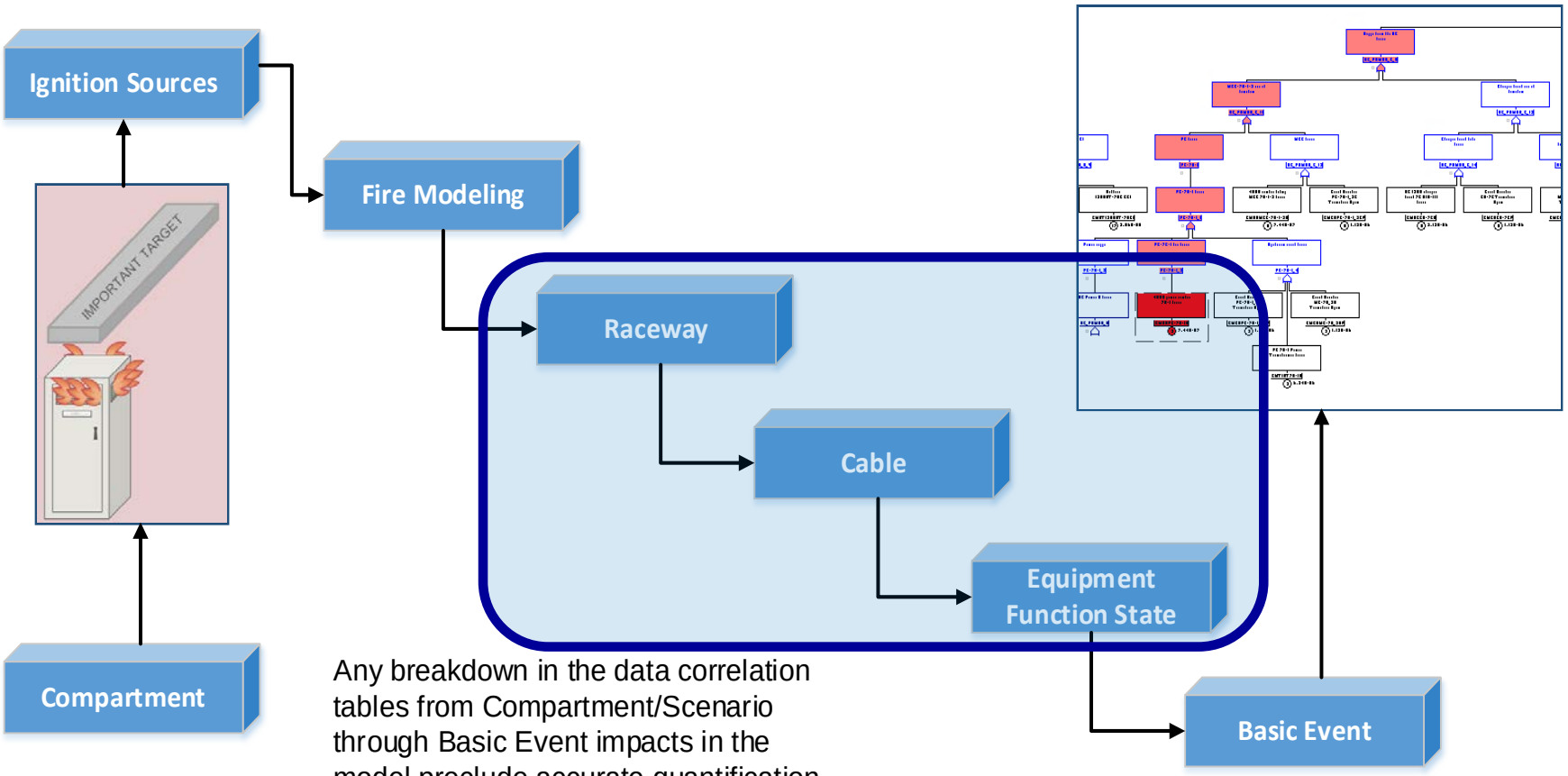
Circuit Analysis Road Map

- Task 3 / 9A
  - Fire PRA Cable Selection
  - Circuit Analysis (Part A): Design Attributes
- Task 9B / 10
  - Circuit Analysis (Part B): Configuration Attributes
  - Circuit Failure Mode Likelihood Analysis
- Support Task B – Fire PRA Database

Remember – You cannot work in a vacuum! You must interface continuously with all team members!

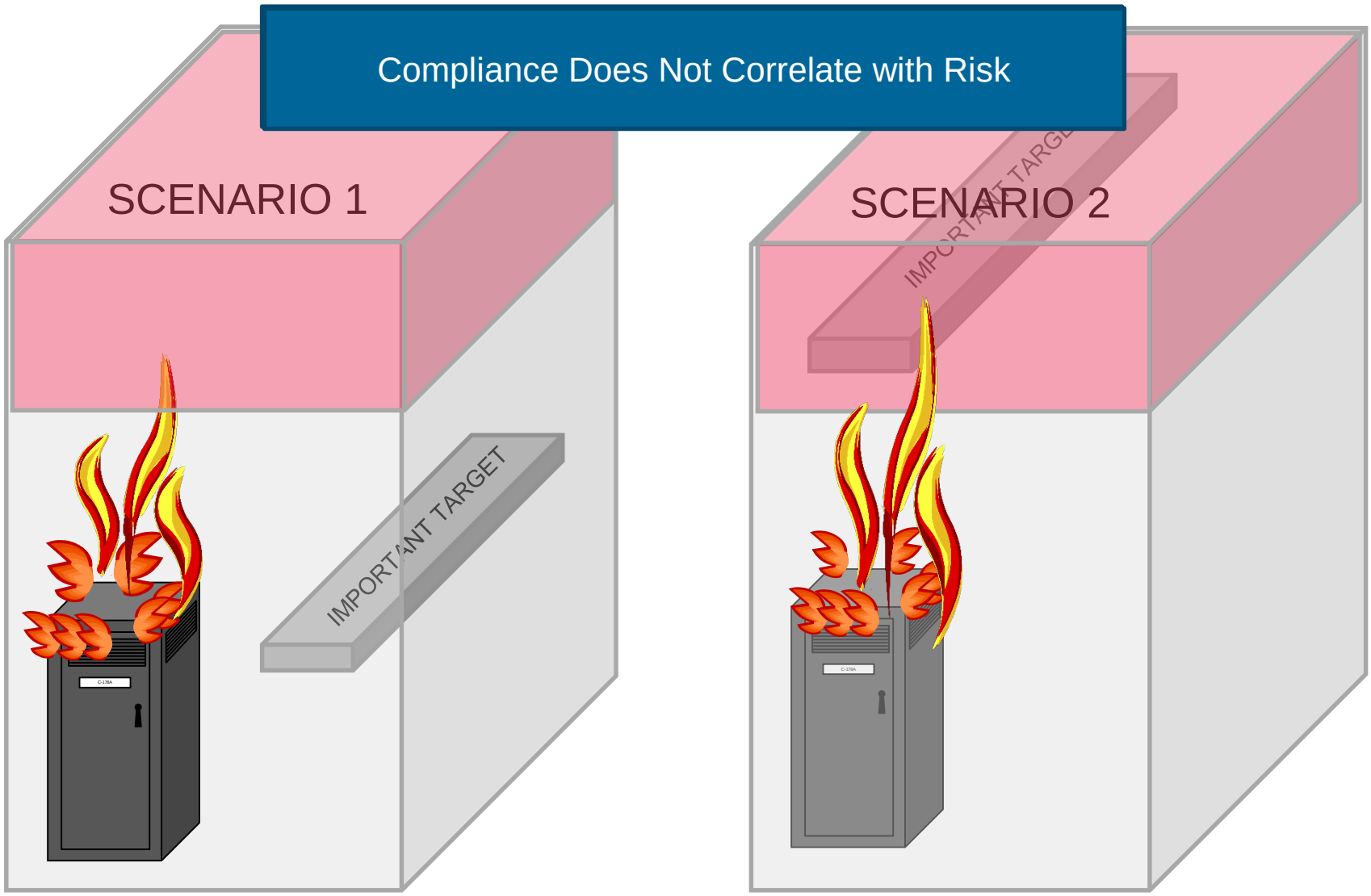
CIRCUIT ANALYSIS SUMMARY

Where Does Circuit Analysis Fit



Any breakdown in the data correlation tables from Compartment/Scenario through Basic Event impacts in the model preclude accurate quantification

EQUIVALENT DETERMINISTIC COMPLIANCE



CIRCUIT ANALYSIS SUMMARY

Interface with Fire PRA Group

- Coordination with Task 2 (Component Section) is essential – MUST understand the EXACT functionality credited for each component
- Essential for maintainability that Fire PRA and NFPA-805 data be fully integrated

  Note: The subtleties of aligning Fire PRA and traditional Appendix R / NFPA-805 data is more complex than originally anticipated. This primarily shows up in Component Selection (Task 2), but has major ramifications to the circuit analysis
- Existing Appendix R SSA Circuit Analysis is **NOT** as useful as originally envisioned
  - Auto functions not considered
  - Refined analysis not performed
  - Cable routing lacks precision required for Fire PRA scenarios

CIRCUIT ANALYSIS SUMMARY

Interface with Fire PRA Group (cont.)

- Be forewarned…the PRA process is iterative and the components / function states will change (i.e., you will redo some analyses)

- Do not expect the PRA analysts to fully understand the various nuances with the circuit analysis for any given functional state – you will need to question them on inherent assumptions with the Basic Events

Example: What automatic functions are inherently credited for a given Basic Event? Is the automatic function really required for the Fire Scenario?

CIRCUIT ANALYSIS SUMMARY

Strategy and Implementation

- Each Circuit Analysis task represents a refined level of detail (i.e., graded approach)
- Level-of-effort for the electrical work is a key driver for project scope, schedule, and resources
  - High programmatic risk if not carefully controlled
  - Analysis and routing of all cables can be a large resource sink with minimal overall benefit
  - Concerns validated by most projects
- Important to screen out obvious "Not Required" cables during the initial cable selection process (Task 9A), with refinement driven by quantitative screening (Task 9B)

CIRCUIT ANALYSIS SUMMARY

Strategy and Implementation (cont.)

- Circuit Analysis (including cable tracing) can consume 40%-60% of overall budget
- Circuit Analysis scope **MUST** be a primary consideration during project planning (budget, schedule, skill sets)
- Qualified and experienced circuit analysts must be integral members of the PRA team
- Evaluation, coordination, and integration with Appendix R must occur early and must be rigorous
- Long-term strategy for data configuration control – especially if sharing data with Appendix R / NFPA 805

CIRCUIT ANALYSIS SUMMARY

Key Considerations & Factors

- Circuit Analysis remains a technically and logistically challenging area
  - Practical aspects of dealing with an integrated data set
  - Practical approach for dealing with MSOs
  - Circuit Analysis is more complex and difficult than analyses performed under Appendix R
- Availability, quality, and format of cable data
- Availability of electrical engineering support
  - Circuit Analysis is a developed skill set
  - Do not expect to be a proficient analyst based on a simple introductory course

CIRCUIT ANALYSIS SUMMARY

Key Considerations & Factors (cont.)

- Usability of Appendix R SSA circuit analysis data
  - Not as useful as originally envisioned
  - Automated tools are essential
  - Functional state analysis is critical – overly conservative cable selection will not work for Fire PRA
- User-friendliness of electrical drawings
- It is possible to meet the PRA Standard with a completely unmaintainable analysis
  - This is not the desired end state
  - Schedules often drive poor decision-making

CIRCUIT ANALYSIS SUMMARY

Relationship to Appendix R & NFPA 805

- Practical aspects of dealing with an integrated data set
- Practical approach for dealing with MSOs
- Implication of these Advances:
  - Circuit Analysis is more complex and difficult than analyses performed under Appendix R
  - Higher skill set and more robust infrastructure required for long-term maintenance

CIRCUIT ANALYSIS SUMMARY

Lessons Learned

- Do not underestimate scope
- Ensure proper resources are committed to project
- Doable but **MUST** work smart
- Do not “broad brush” interface with Appendix R – have a detailed plan before starting
- Interface between PRA and Electrical groups is typically poor
- Develop project procedures – but don’t get carried away
- Compilation and management of large volume of data
  - Automated tools imperative for efficient process
  - Long-term configuration management often overlooked until very end of the project
- Cannot “broad brush” associated circuit analysis review

CIRCUIT ANALYSIS SUMMARY

THANK YOU VERY MUCH FOR PARTICIPATING IN THIS TRAINING

PLEASE TURN IN YOUR EVALUATION FORMS