EPRI/NRC-RES FIRE PRA METHODOLOGY

Fire PRA Circuit Analysis Overview

Dan Funk – Kleinsorg Group
Gabriel Taylor – U.S. NRC
Office of Nuclear Regulatory Research

Joint RES/EPRI Fire PRA Training Workshop
Bethesda, MD, July and September 2012

A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

CIRCUIT ANALYSIS OVERVIEW
Introductions

- Instructors
  - Daniel Funk, P.E., Kleinsorg Group
  - Gabriel Taylor, NRC Office of Nuclear Regulatory Research
- Who's here and Why?
  - Name, Organization, Experience
  - What do you want from this course?
- Logistics

CIRCUIT ANALYSIS OVERVIEW
Course Prerequisites

- Who Should Attend?
  - Nuclear plant personnel with electrical and plant operating knowledge, but limited exposure to Appendix R and PRA
  - Nuclear plant personnel with substantial Appendix R and/or PRA experience, but limited circuit analysis experience
  - Anyone who went to the Circuit Analysis Basics course

CIRCUIT ANALYSIS OVERVIEW
Objectives

- This module covers technical tasks for analysis of fire-induced circuit failures in support of a Fire PRA
- This module is geared toward PRA practitioners and fire safe shutdown analysts with a practical understanding of the concepts and methods of fire-induced circuit failure analysis within the context of Fire PRA or Appendix R circuit failure assessments. Specifically, familiarity with the following topics is recommended:
  - General circuit design and operational control for typical plant equipment
  - Basic circuit analysis techniques for identifying and classifying fire-induced circuit failure modes
  - Working level knowledge of typical electrical drawings, including one-line diagrams, schematic diagrams, electrical block diagrams, wiring/connection diagrams, raceway layout drawings, instrument loop diagrams, etc.
  - Cable and raceway, Appendix R safe shutdown, and Fire PRA database structures and software
  - Appendix R safe shutdown circuit analysis
  - Emerging issues and challenges associated with the analysis of multiple spurious operations

CIRCUIT ANALYSIS OVERVIEW
Objectives, cont…

- It is expected that upon completion of the Circuit Analysis Module, attendees will have sufficient working knowledge of techniques and methods to perform at a practical level the electrical analysis tasks associated with supporting a Fire PRA

- **NEW!** Methodology presentations will show relationships to the PRA Standard and NEI 00-01, Rev. 2

Note: NEI 00-01, Rev 3 is issued but not yet approved by the NRC. Delta analysis for NFPA 805 is to Rev. 2

CIRCUIT ANALYSIS OVERVIEW
Presentation Road Map

- Course Introduction
- Circuit Analysis Process, Methods, and Criteria
- Walk Through Sample Problems
- Hands-on Sample Problem Exercises
- Database & Data Management
- Project Strategy, Key Considerations, and Lessons Learned

CIRCUIT ANALYSIS
Schedule / Agenda

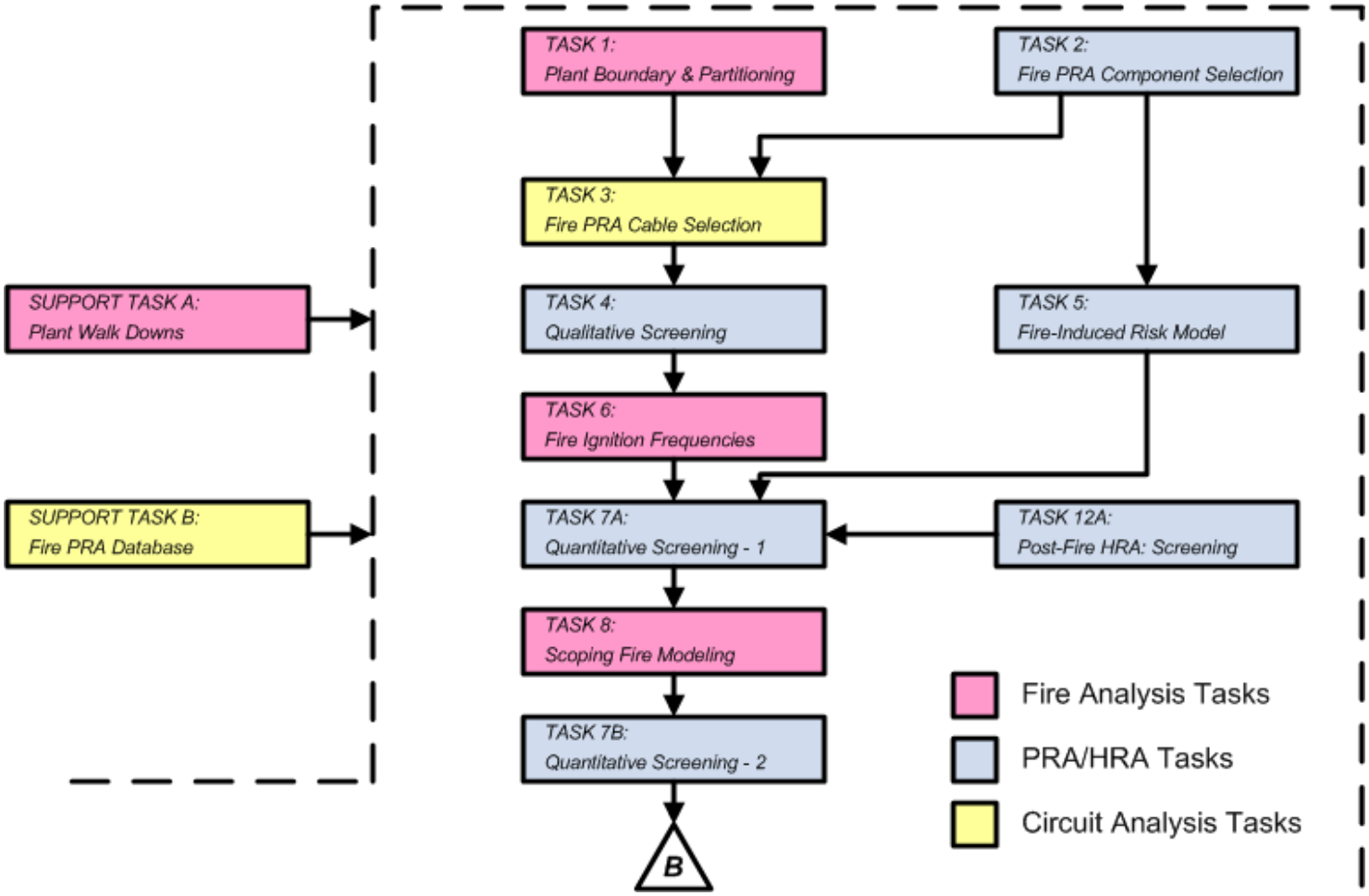
	Tuesday	Wednesday	Thursday	Friday
8:30	General Session Introduction to all Modules	Presentation Detailed Circuit Failure Analysis (Task 9)	Presentation Fire PRA Database	Exercises Task 9/10 Sample Problems
8:45				
9:00				
9:15				
9:30				
9:45			Break	Break
10:00			Presentation Fire PRA Database (Continued)	General Session Closing All Modules
10:15	Break	Break		
10:30	Presentation Fire PRA Circuit Analysis Overview	Presentation Task 3 & Task 9 Sample Problem Definition and Examples		
10:45				
11:00			Discussion Open, Q&A, etc.	
11:15				
11:30				
11:45				
12:00	Lunch Break	Lunch Break	Lunch Break	Adjourn
13:00	Presentation - Fire PRA Circuit Analysis Summary	Exercises Work Task 3 & Task 9 Sample Problems	Presentation Circuit Failure Mode Likeliood Analysis (Task 10)	
13:15				
13:30	Open Discussion			
13:45				
14:00				
14:15				
14:30	Break		Break	
14:45	Presentation Fire PRA Cable Selection (Task 3)		Exercises Circuit Failure Mode Likelihood Analysis (Task 10)	
15:00				
15:15				
15:30				
15:45	Break	Break	Break	
16:00	Presentation Fire PRA Cable Selection (continued)	Discussion Task 3 & 9 Sample Problems	Additional Exercises	
16:15				
16:30				
16:45				
17:00	Adjourn	Adjourn	Adjourn	

CIRCUIT ANALYSIS OVERVIEW
Circuit Analysis Tasks

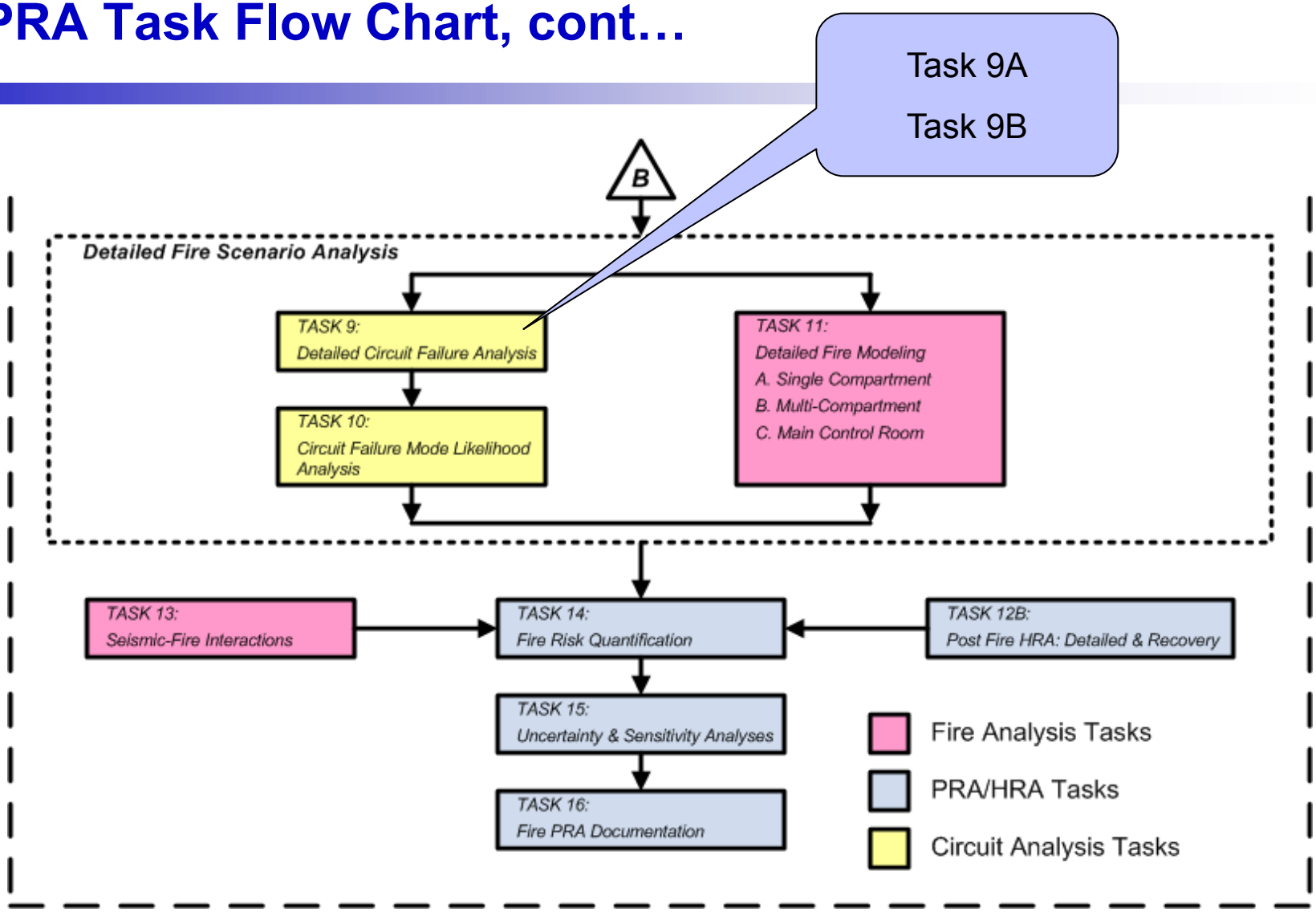
- Task 3: Fire PRA Cable Selection
  - What cables are associated with the FPRA components?
- Task 9: Detailed Circuit Analysis
  - Which cables can affect the credited functionality?
  - Task 9A / 9B Split
  - What failure modes are possible given fire damage to the cable?
- Task 10: Circuit Failure Mode Likelihood Analysis
  - How likely to occur are the failure modes of concern?
- Support Task B: Fire PRA Database
  - Warehousing data and determining impacts

CIRCUIT ANALYSIS OVERVIEW

PRA Task Flow Chart



CIRCUIT ANALYSIS OVERVIEW
PRA Task Flow Chart, cont…



CIRCUIT ANALYSIS OVERVIEW
Key Considerations

- Each Circuit Analysis task represents a refined level of detail (i.e., graded approach)
- Existing Appendix R Circuit Analysis is **NOT** as useful as originally envisioned
- Circuit Analysis for Fire PRA is more complex and difficult compared to Appendix R
- Circuit Analysis (including cable tracing) can consume 40%-70% of overall budget
- Circuit Analysis scope **MUST** be a primary consideration during project planning

CIRCUIT ANALYSIS OVERVIEW
Questions

Any questions before we start ???