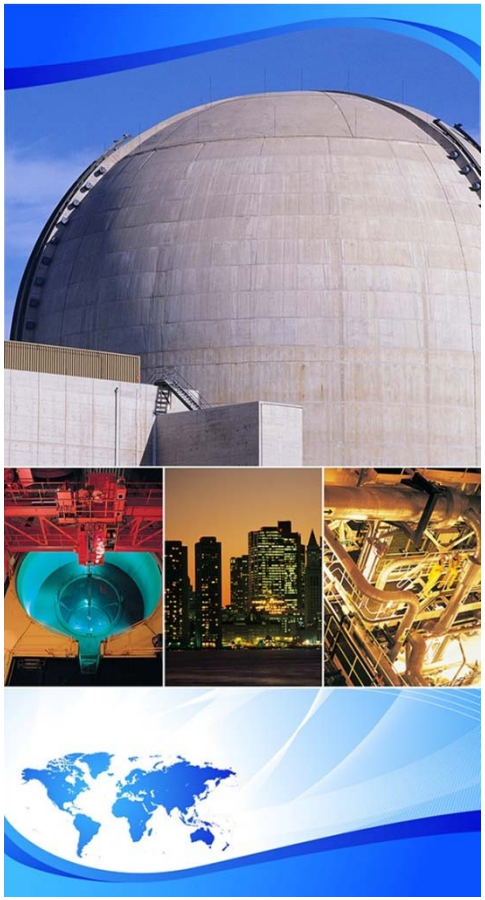

EPRI/NRC-RES FIRE PRA METHODOLOGY

Introduction and Overview: the Scope and Structure of PRA/Systems Analysis Module

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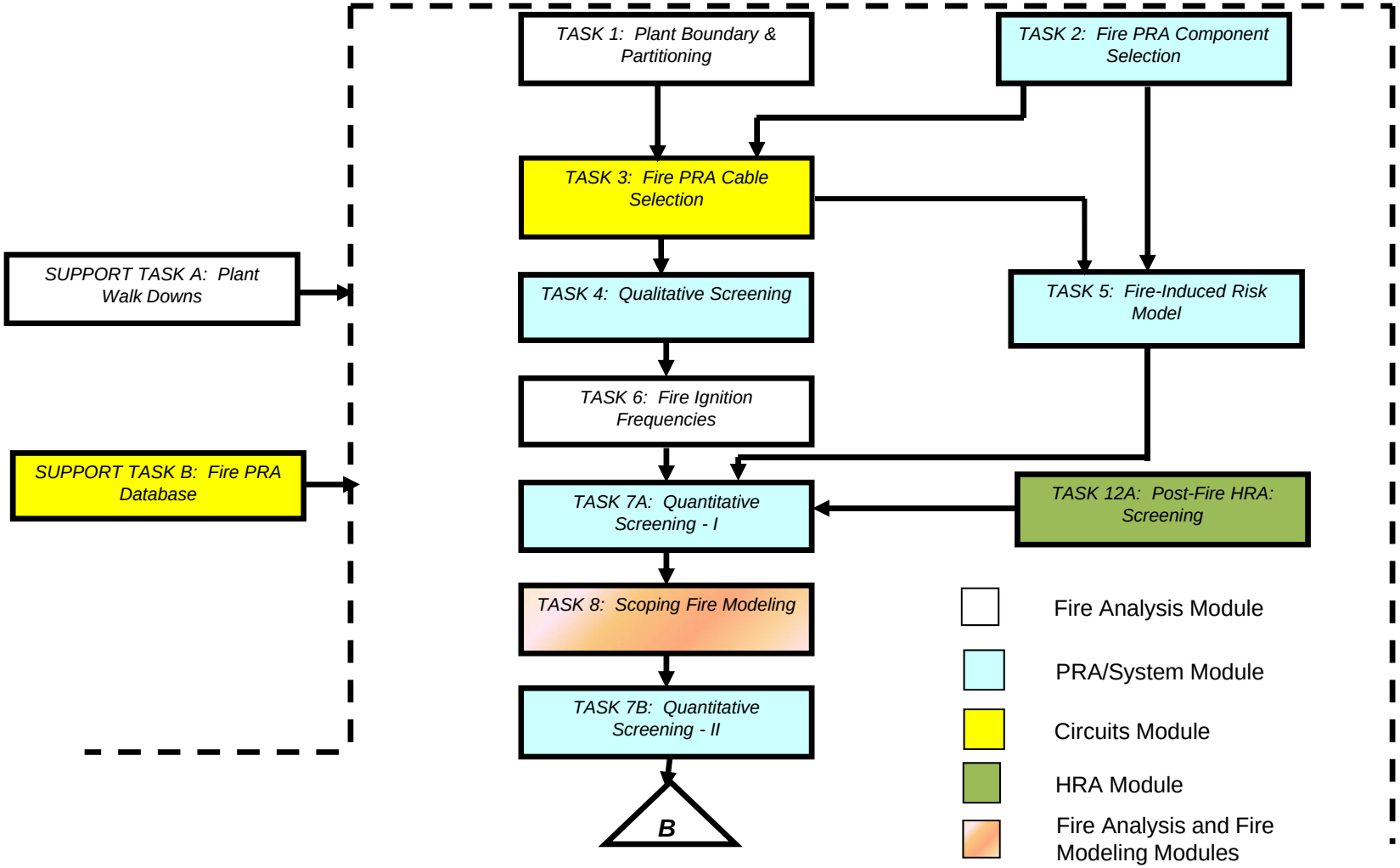
What we'll cover in the next four days
An overview…

- The purpose of this presentation is to provide an Overview of the Module 2 – PRA/Systems Analysis
  - Scope of this module relative to the overall methodology
    - Which tasks fall under the scope of this module
  - General structure of the each technical task in the documentation
  - Quick introduction to each task covered by this module:
    - Objectives of each task
    - Task input/output
    - Task interfaces

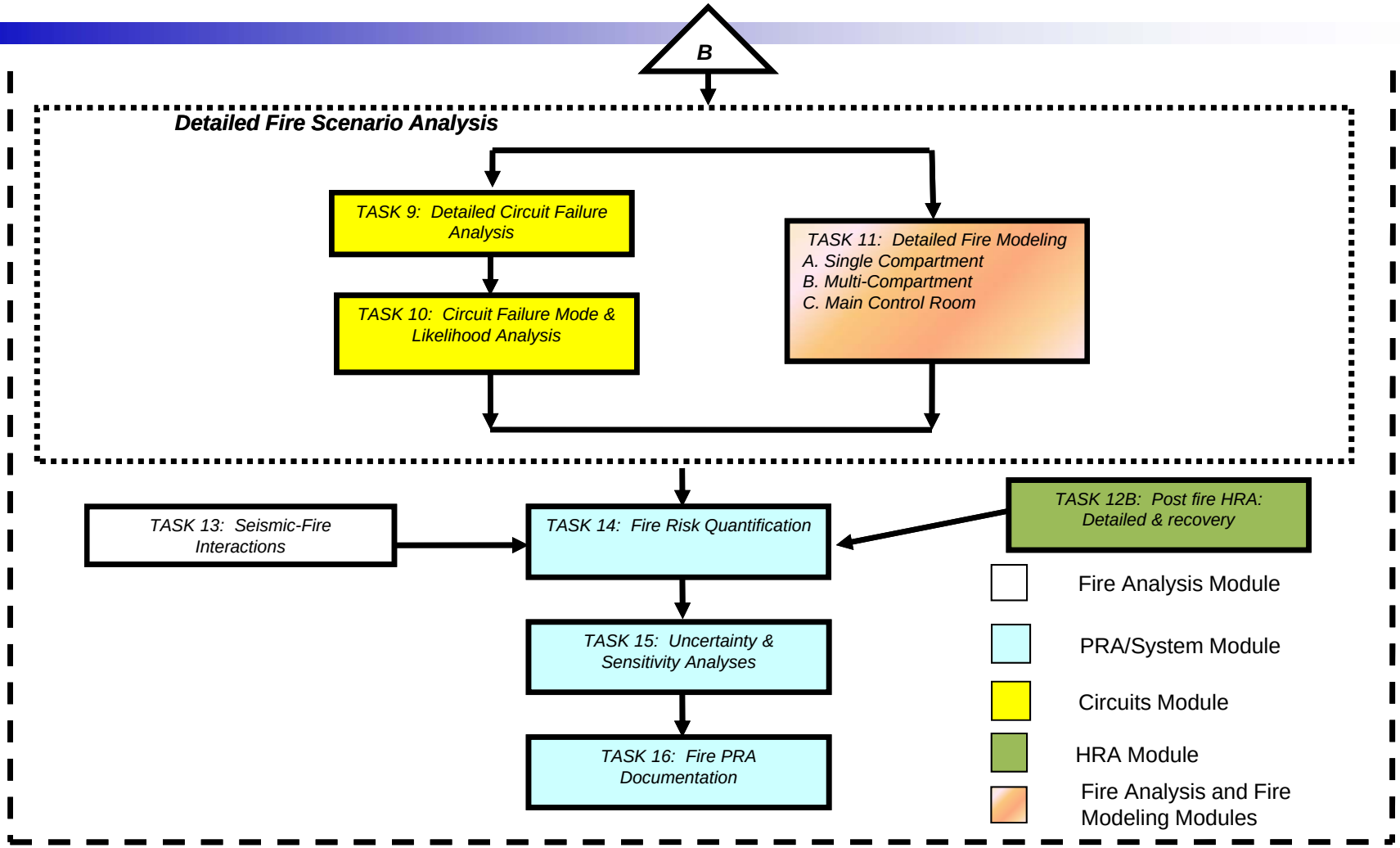
Training Objectives

- Our intent:
  - To deliver practical implementation training
  - To illustrate and demonstrate key aspects of the procedures
- We expect and want significant participant interaction
  - Class size should allow for *questions and discussion*
  - We will take questions about the *methodology*
  - We *cannot* answer questions about a *specific application*
  - *We* will moderate discussions, and *we* will judge when the course must move on

Recall the overall fire PRA structure
Module 2 covers the "blue" tasks



Recall the overall fire PRA structure (2)
Module 2 covers the "blue" tasks



Each technical task has a common structure as presented in the guidance document

1. Purpose
2. Scope
3. Background information: General approach and assumptions
4. Interfaces: Input/output to other tasks, plant and other information needed, walk-downs
5. Procedure: Step-by-step instructions for conduct of the technical task
6. References

Appendices: Technical bases, data, examples, special models or instructions, tools or databases

Scope of Module 1: PRA/Systems Analysis

- This module will cover all aspects of the plant systems accident response modeling, integration of human actions into the plant model, and quantification tasks
- Specific tasks covered are:
  - Task 2: Equipment Selection
  - Task 4: Qualitative Screening
  - Task 5: Fire-Induced Risk Model
  - Task 7: Quantitative Screening
  - Task 15: Risk Quantification
  - Task 16: Uncertainty Analysis

Task 2: Equipment Selection (1 of 2)

- Objective: To decide what subset of the plant equipment will be modeled in the FPRA

- FPRA equipment will be drawn from:
  - Equipment from the internal events PRA
    - We do assume that an internal events PRA is available!
  - Equipment from the Post-Fire Safe Shutdown analysis
    - e.g., the Appendix R analysis or the Nuclear Safety Analysis under NFPA-805
  - Other “new” equipment not in either of these analyses

Task 2: Equipment Selection (2 of 2)

- Many choices to be made in this task, many factors will influence these decisions
  - Fire-induced failures that might cause an initiating event
  - Mitigating equipment and operator actions
  - Fire-induced failures that adversely impact credited equipment
  - Fire-induced failures that could lead to inappropriate or unsafe operator actions
- Choices are important in part because “selecting” equipment implies a burden to *Identify and Trace* cables
  - Cable selection is Task 3 (Module 2)…

Task 4: Qualitative Screening (1 of 2)

- Objective: To identify fire compartments that can be screened out as insignificant risk contributors without quantitative analysis

- This is an *Optional* task
  - You may choose to bypass this task which means that all fire compartments will be treated quantitatively to some level of analysis (level may vary)

Task 4: Qualitative Screening (2 of 2)

- Qualitative screening criteria consider:
  - Trip initiators
  - Presence of selected equipment
  - Presence of selected cables

- Note that any compartment that is “screened out” in this step is reconsidered in the multi-compartment fire analysis as a potential source of multi-compartment fires
  - See Module 3, Task 11c

Task 5: Fire-Induced Risk Model

- Objective: Construct the FPRA plant response model reflecting:
  - Functional relationships among selected equipment and operator actions
- Covers both CDF and LERF
- Begins with internal events model but more than just a "tweak"
  - Adds fire unique equipment – various reasons/sources
  - May delete equipment not to be credited for fire
  - Adds fire-specific equipment failure modes
    - e.g., spurious actuations (Task 9)
  - Adds fire-specific human failure events (Task 12)

Task 7: Quantitative Screening (1 of 2)

Module 1

- Objective: To identify compartments that can be shown to be insignificant contributors to fire risk based on limited quantitative considerations

- This task is *Optional*
  - Analyst may choose to retain all compartments for more detailed analysis

Task 7: Quantitative Screening (2 of 2)

- Screening may be performed in stages of increasing complexity
- Consideration is given to:
  - Fire ignition frequency
  - Screening of specific fire sources as non-threatening (no spread, no damage)
  - Impact of fire-induced equipment and cable failures
    - conditional core damage probability (CCDP)
- A word of caution: quantitative screening criteria should consider the PRA standard and Reg. Guide 1.200
  - 6850/1011989 criteria are obsolete, but approach is unchanged

Task 14: Fire Risk Quantification

- Objective: To quantify fire-induced CDF and LERF
- Covered in limited detail
- Relatively straight-forward roll-up for fire scenarios considering
  - Ignition frequency
  - Scenario-specific equipment and cable damage
  - Equipment failure modes and likelihoods
  - Credit for fire mitigation (detection and suppression)
  - Fire-specific HEPs
  - Quantification of the FPRA plant response model

Task 15: Uncertainty and Sensitivity

- Objective: Provide a process for identifying and quantifying uncertainties in the FPRA and for identifying sensitivity analysis cases
- Covered in limited detail
- Guidance is based on potential strategies that might be taken, but choices are largely left to the analyst
  - e.g., what uncertainties will be characterized as distributions and propagated through the model?

Any questions before we move on?