

NUREG/CR-6850 FIRE PRA METHODOLOGY

Module 1

**Internal Event, At-Power
Probabilistic
Risk Assessment Model for SNPP**

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

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Commission

Fire PRA Workshop

June 24, 2019 – June 28, 2019

Rockville, MD U.S. NRC HQ



What We'll Cover in the Next Four Days

An Overview...

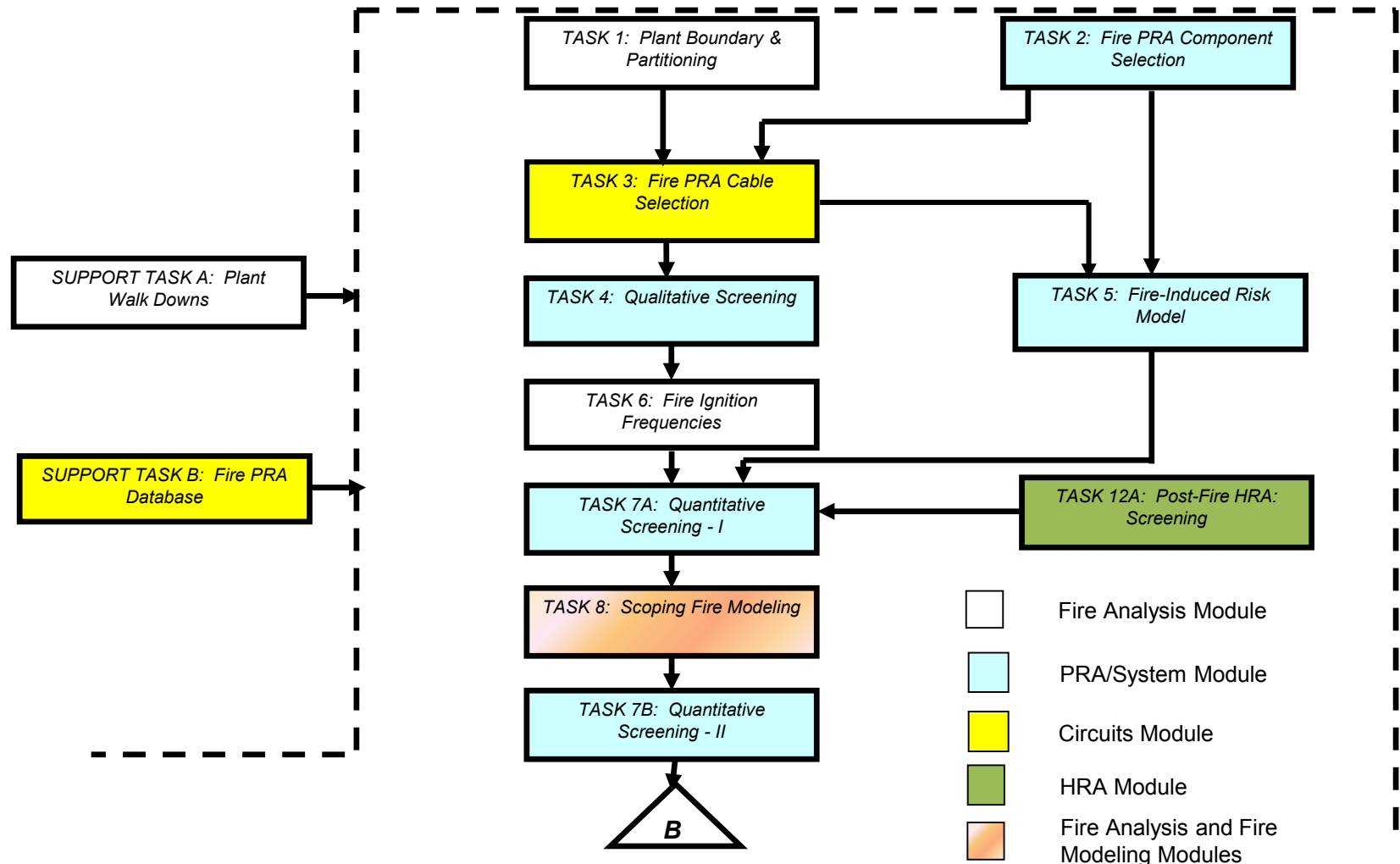
- The purpose of this presentation is to provide an Overview of the Module 1 – PRA/Systems Analysis
 - Scope of this module relative to the overall methodology
 - Which tasks fall under the scope of this module
 - General structure of the each technical task in the documentation
 - Quick introduction 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

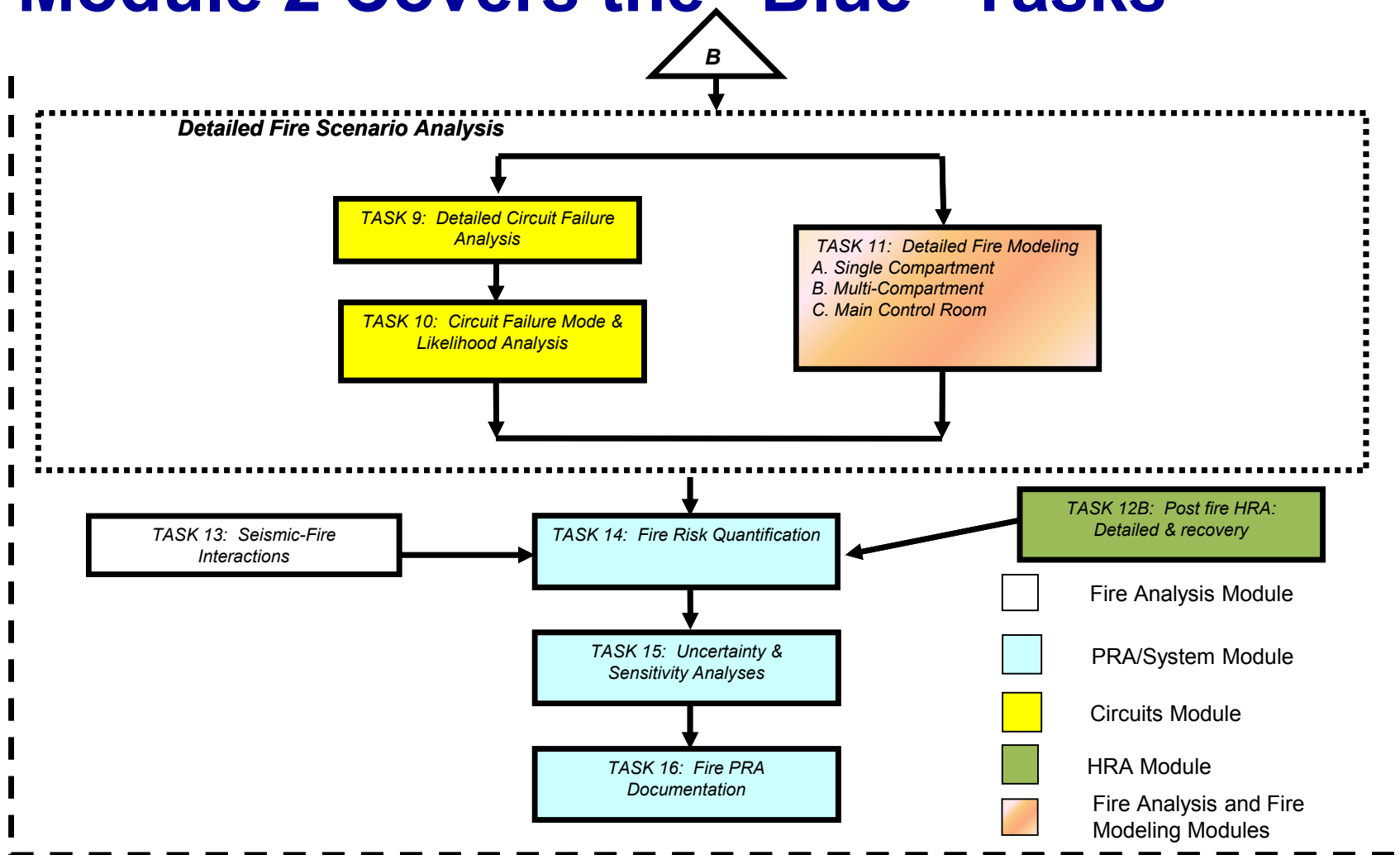
Recall the Overall Fire PRA Structure

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 14: Fire Risk Quantification
 - Task 15: Uncertainty and Sensitivity Analyses
 - Task 16: Documentation

Task 2: Equipment Selection (1 of 2)

Module 1

- 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)

Module 1

- 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)

Module 1

- 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)

Module 1

- 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

Module 1

- 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)

Module 1

- 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

Module 1

- 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

Module 1

- 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?