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EPRI ELECTRIC POWER RESEARCH INSTITUTE

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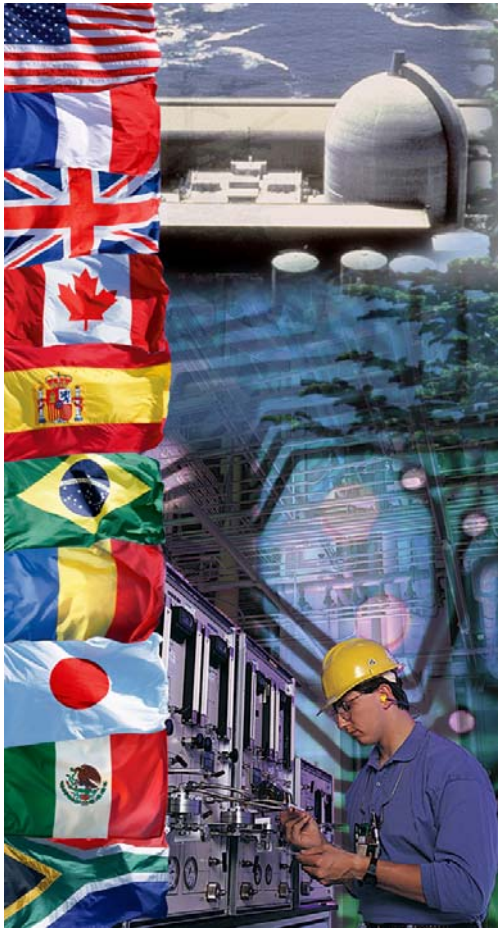


EPRI/NRC-RES FIRE PRA METHODOLOGY

Integration, Lessons Learned and Insights

Bijan Najafi, SAIC
Steve Nowlen, SNL

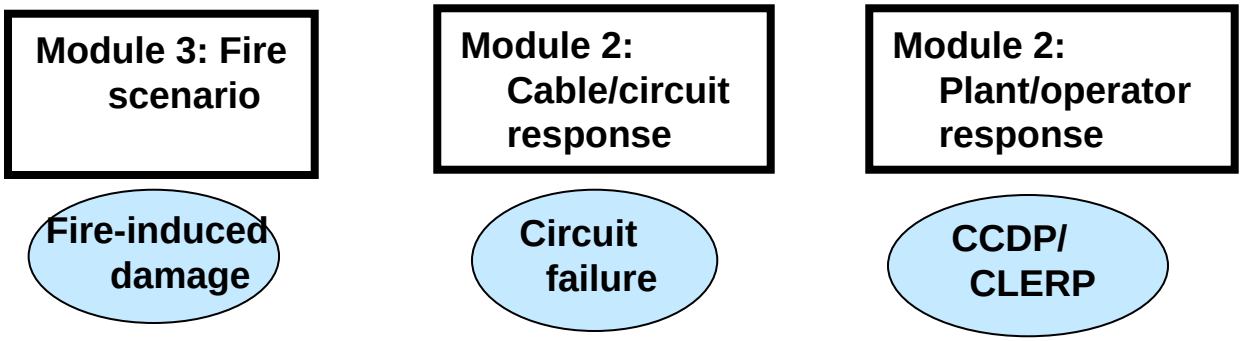
Joint EPRI/RES Fire PRA Course
July 23-27, 2007
Palo Alto, CA

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

PART I

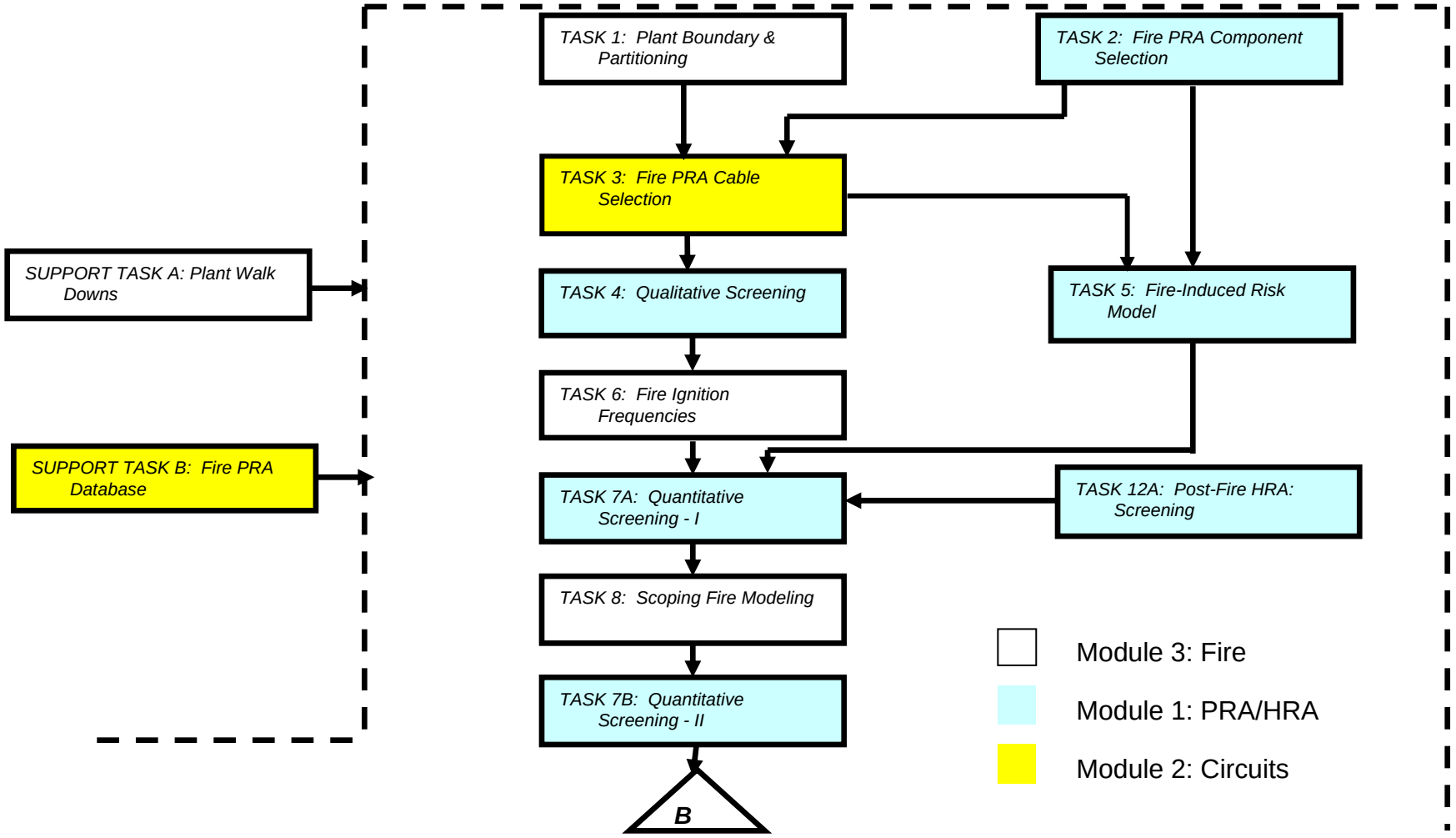
Integration

Integration
Modules

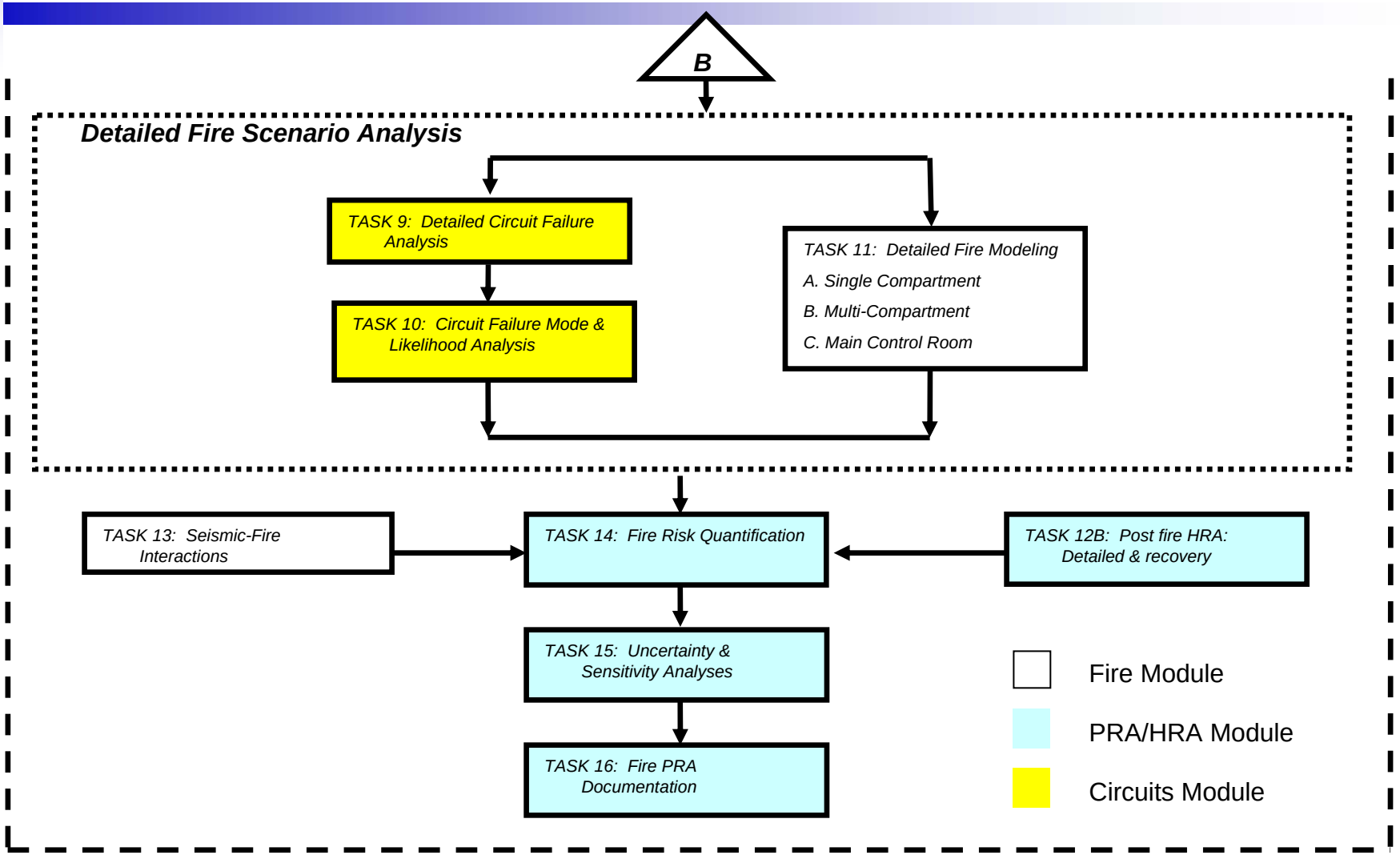


- Module 1: PRA/HRA
  - Post-fire plant response model, including systems, components and operator manual actions (CCDP, CLERP)
- Module 2: Cable selection, circuit failure mode analysis
  - Electrical response, embedded in the Post-fire plant response model (P_{cf})
- Module 3: Fire analysis
  - Fire hazard; ignition frequency, fire severity, fire growth, detection/suppression (IF * SF * P_{ns})

Overview Of Fire PRA Process and Module Structure



Overview Of Fire PRA Process and Module Structure (2)



PART II

Lessons Learned and Insights to-date

on Use of

EPRI 1011989, NUREG/CR-6850

Lessons Learned and Insights
Scope of this Module

- Demonstration studies / Pilots
  - *NRC/RES involvement in the demonstration studies ceased following September 2005 publication of the report*
- Others applications
- FAQ
- General insights; Programmatic & Technical
- Path forward with EPRI 1011989 , NUREG/CR-6850

Lessons Learned and Insights
Demonstration /Pilot Studies

- The procedures have been individually tested:
  - By our team at two PWR's
  - A third team demonstration has been completed at a BWR (2005-2007)
- All the procedures worked, and seemed to be of reasonable depth, scope, and clarity to make implementation practical
- The procedures *have not yet been tested* top-to-bottom as a full, consolidated, and complete set
  - We cannot provide numerical results to back up some of our insights in particular
  - There could be some hidden surprises in store for us – and *you may be the one to find them*
  - Please pass your experience back to us – the procedures are intended to be "living documents" to at least some extent

Lessons Learned and Insights
Pilot Studies – Our Experience Shows…

- Easy to get distracted, e.g.:
  - If you want to re-baseline Appendix R, do that first, then do your fire PRA – the objectives are *NOT* the same although the Fire PRA would benefit
  - Work together with the Appendix R re-baseline to ensure the final product is useful for Fire PRA purposes

- Be sure you get a team of the right people with the right knowledge to do the job, e.g.:
  - The PRA gurus may think they know circuits, but you really need those with a true electrical expertise

Lessons Learned and Insights
Frequently Asked Questions (FAQ)

- One vehicle for feedback to 1011989, NUREG/CR-6850
- To date, three FAQ's addressed related to implementation of EPRI 1011989, NUREG/CR-6850
  - TASK 6, Fire Ignition Frequencies - FAQ related to the counting of electrical cabinets
    - Only clarifications to the guidance in NUREG/CR-6850
  - Task 6, Fire Ignition Frequencies – FAQ related to the frequency of high energy arcing fault events
    - A frequency was calculated for medium and high voltage cabinets
  - Task 6, Fire ignition Frequencies – FAQ related to the counting of the main control board
    - Clarifications to the guidance in NUREG/CR-6850

Lessons Learned and Insights
Component Selection

- Resource intensive and critical, for the most part due to consideration of multiple spurious operation (MSO)
  - ANS Fire PRA Standard is identifying requirements on MSOs
- Defines the scope of the Fire PRA as it relates to post-fire plant (system and operator) response
  - Ongoing discussions re: instrumentation in NFPA 805 pilot program
- Fire PRA component list will be larger than your Appendix R and PRA component list
  - New components whose omission will be non-conservative
    - For MSO considerations
    - For fire-specific operator manual actions (OMAs)
  - Expect that you *will* want/need to consider others to get a realistic risk result
- NMP-1 pilot follows the EPRI/NRC-RES method on MSO consideration

Lessons Learned and Insights
Cable Selection

- Cable selection is probably the single biggest factor that will drive your resource requirements
  - The burden comes largely with the need to trace selected cables
  - You also need an *accessible* cable database, and constructing such a database from your existing system may not be so easy
  - This is going to depend a lot on the depth of your cable tracing and the nature of your current tracking system
- Exercise judgment
  - You may initially want to chase *all* your cables, but that may not be the best choice – you are taking on quite a job at most plants
  - Take advantage of the iterative approaches to cable tracing

Lessons Learned and Insights
Circuit Analysis

- Circuit analysis need not be a huge burden
- Compared to cable tracing, circuit analysis should be far less resource intensive – although it does require participation of key personnel (the electrical guru)
- The procedure provides various approaches that have been drawn from past practice and experience
  - Make use of those options!
  - Go after the “bang for the buck” circuits and “take the hit” when it is not risk important

Lessons Learned and Insights
Fire Ignition Frequency and Fire Modeling

- Understand the scope of work of Tasks 1, 6, 8 and 11
  - One walkdown effort for collecting information for all the tasks
  - Use of a relational database for organizing and analyzing data is recommended
  - It is recommended that Task 8, Scoping Fire Modeling be conducted with Task 6, Fire Ignition Frequencies or Task 11, Detailed Fire Modeling
- Fire modeling in single compartments
  - Most of the analytical fire modeling can be completed with hand calculations
  - Create fire modeling drawing packages. These are room layout drawings with ignition sources and Fire PRA targets highlighted.
- Fire modeling in the main control room
  - Fire zone or field models are necessary
  - Will require detailed system analysis and HRA
  - Smoke removal system can have significant impact on abandonment and risk

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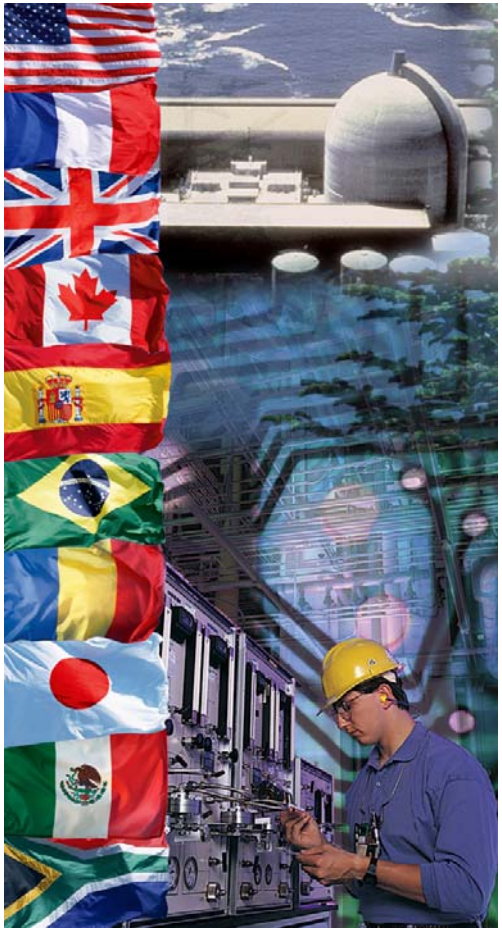

EPRI/NRC-RES FIRE PRA METHODOLOGY

Module III-2: Perspective

Robert P. Kassawara - EPRI
J.S. Hyslop - RES

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On The Requantification Project

- A consensus methodology for Fire PRA that is facilitating implementation of risk-informed fire protection
- Remains the best available method to estimate fire risk & obtain insights
- Guidance is producing greater agreement among technical experts
- The field of Fire PRA will continue to be refined, as further applications produce insights

Continued Cooperation

- We established a framework for future research cooperation
  - Quality of work and positive technical reviews pave the way for continued cooperation

- The cooperation under the MOU is continuing
  - Verification & Validation of Fire Models –
    - NUREG-1824/EPRI 101999
  - Fire Human Reliability Analysis (HRA)
  - Fire Low Power and Shutdown
  - Others….