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Fire PRA Method: FAQs, Updates, and Training

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

Background

- The RES/EPRI consensus fire PRA method was published Sept. 2005
- Full piloting of the method had not been completed at the time of publication
- NFPA-805 pilot plants and other early adopters have become the true pilot applications
- As expected, these early applications have identified methodology issues and questions
  - This expectation is stated in Volume 1 of the report
- Efforts to refine methods continue

The FAQ process

- FAQ process is active under the NRR and NEI NFPA-805 implementation process
- 17 methods-related FAQs total, NRC closure memos issued for all but 3
  - Some closures represent interim solutions pending further work
- Time does not allow us to cover each FAQ in detail:
  - Clarification of existing guidance
  - Supplemental guidance to extend/enhance existing approaches
  - Revised guidance for existing approaches, typically to reduce conservatism
  - Address topics not covered by the original guidance
- Pending FAQs:
  - Kerite FR damage criteria
  - Non-suppression curves for manual fire fighting
  - Hot short duration

Several pending topics cannot be quickly resolved via the FAQ process

- Fire event data quality and analysis
  - An effort to update and improve the fire event database is underway
    - See Canavan, Plenary 5
  - Fundamentally, better data would allow us to refine methods and reduce conservatism
  - We need a basis to refine methods, reduce conservatism, reduce uncertainty
  - Event data is potentially a powerful tool, but quality and completeness are critical

Pending topics continued…

- Incipient fire detection
  - Not covered by original method
  - Interim solution (pending) creates future challenges
    - Approach won't work as-is over the longer term
  - Basic premise: incipient detection can prevent actual fires
  - Interim solution: adjust fire frequency via an event tree
    - This is OK today because very few installed systems
    - Fire frequency reflects an absence of such systems so OK to adjust
  - Looking downstream: as more systems are installed the "credit" should be inherently reflected in the rate of fire events
    - i.e., some years from now "credit" will be embedded in event statistics
  - Future challenge: A method needed to focus the "credit" for reduced fire likelihood on that equipment protected by incipient detection
    - If we continue to apply interim solution, we will be double counting

Pending topics continued…

- Manual fire fighting
  - Method as documented is not giving enough credit to early fire suppression success compared to actual fire events
    - Manual fire fighting was identified in original document as an area that would benefit from further development
  - Interim FAQ solution will revise fire non-suppression curves and assume brigade response is embedded in that response time
    - No separate assessment of brigade response time except under certain specific conditions
  - This is effectively a step backwards to IPEEE-vintage approaches
  - Longer term, a more sophisticated approach would improve ability to refine and quantify scenarios, reduce uncertainty

Pending topics continued…

- Fire development from the incipient stage
  - Withdrawn FAQ – difficult problem
  - Fire modeling generally assumes that at “time=0” fire is entering fire growth stage
    - Exceptions: in-cabinet fire detection, FAQ on incipient detection (pending)
  - In reality fires may be detected at earlier incipient stages
  - A more realistic treatment would be to consider the broader fire time line including incipient stages, e.g.,
    - Overheating component -> smoldering -> flaming -> growth -> burnout
  - One approach would be to develop a mechanistic model of fire ignition/growth
  - Would likely need coupled statistical models to address aleatory uncertainties in timing, duration of incipient stage
  - Basis will be a real challenge on this one…

Pending topics continued:

- Cable fire modeling
  - Tools for cable fire modeling remain primitive
    - Cable fire growth/spread/burnout
    - Heat release rate
    - Onset of damage
  - Quality data to benchmark and validate fire models has historically been lacking
  - NIST tests are designed to rectify data needs
    - See McGrattan, same session
  - Our challenge will be to take the NIST results and work them into the methodology

Updating the method document

- As expected the methodology continues to evolve
  - Many insights coming from early applications
- A supplement is planned to consolidate closed FAQs and errata
- At some point an update to the methodology document will may be warranted
- Scope would need to be established, but could include:
  - Integrate closed FAQs into main document
  - Insights from fire event database work (ongoing)
  - Insights on circuit analysis and testing (ongoing)
  - Improved fire modeling tools
    - e.g., THIEF and the cable fire modeling work ongoing at NIST
  - The “pending topics”
  - Other needs yet to be identified…

Update Schedule – Questions to the audience

- We would like your feedback on the following questions:
  - When do we update the document?
  - At what point do revisions to existing methods warrant consolidation and an update?
  - When has state of the art advanced far enough to warrant update?
  - How important is it that guidance be consolidated in one document?

Fire PRA Training

- RES and EPRI continue to offer joint training on the fire PRA methods
  - Sessions offered twice each year
  - Alternate hosting by EPRI and RES
- This year's first session was held in June 2009 (Palo Alto)
- Second session for 2009 is coming up:
  - October 12-16, 2009, Richmond VA
- Intent is to continue joint training at least through 2010

Fire PRA Training continued

- This year's training includes two major changes
  - "Fundamentals" sessions for each technical area
    - Electrical, PRA/Systems, Fire
    - One day introduction to the technical area (Monday)
    - Intended for those not familiar with a technical area who want to attend the corresponding full session or simply want a bit of cross training
    - Fundamentals session are OPTIONAL
  - PRA/Systems module includes one-day presentation on new EPRI/RES consensus fire HRA quantification method
    - Based on pending draft for public comment
    - Covers recommended approach to screening through quantification
    - See Julius/Hyslop presentation…