Incorporation of Fire Research into Industry Guidance

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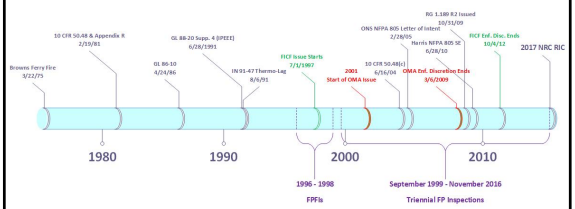
Agenda

- Fire Protection Time Line
- Where we started
- What needs to be considered
- Two fundamental approaches to fire safety
- Moving Forward
- Industry Guidelines
- Proposed changes
- Path forward
- Conclusions

Fire Protection Time Line



Where we started

- Fire induced circuit failures are considered within existing analyses.
- The prevailing philosophy was:
  "Any and all, one at a time" or "Single Spurious".
- As we have heard, testing has confirmed that fire-induced hot shorts, resulting in multiple spurious operation (MSO) can and do occur.
- The Licensing Basis for a number of plants is still single spurious, with MSOs considered a "**Beyond CLB, Voluntary Effort**".
- The Industry and the NRC have conducted extensive dialogue in an effort to incorporate the prevailing test results into useable guidance and establish regulatory stability in this area.

What needs to be considered?

When performing the analysis, we need to:

- **Aim for a "Risk Positive" result.**
  - ✓ Turning off systems has the potential to increase fire risk.
- **Don't assume the fire response will go as currently analyzed.**
  - ✓ If plant response doesn't follow the "worst case" path, we still want an acceptable outcome.
- **Transition into fire response mode/procedures is ambiguous.**
  - ✓ Operators don't scram the plant for a smoking light bulb
- **Avoid increasing operator burden post-fire.**

Two Different Paths to Success

- In 2004, **10CFR50.48(c) was issued** and provided a risk informed, performance based method, using NFPA 805.
- Currently 26 Sites, 42 Units are voluntarally transitioning to this new approach.
- The remaining Sites have decided to stay aligned to the existing deterministic method under "**10CFR50.48(b) or plant specific license conditions**".
  - ✓ General feeling was that Fire PRAs needed more time to mature.
  - ✓ A few Sites withdrew from NFPA 805 after reassessing their cost benefit analysis after the NFPA 805 pilot process was complete.

TWO FUNDAMENTAL APPROACHES TO FIRE SAFETY (TODAY)

- **Deterministic fire protection** – Based upon 10 CFR 50.48(a) (includes GDC 3 and 10 CFR 50.48(b)).
- **Risk-informed, performance-based (RI-PB)** – Voluntary - Based upon 10 CFR 50.48 (a) (includes GDC 3) and 10 CFR 50.48(c) (NFPA 805)

And while your performing this new analysis, let's do something about "Operator Manual Actions"

Incorporation of Test Data into Industry Guidance

- NEI 00-01 Rev. 2 and RG 1.189 Rev. 2
  - ✓ Issued in 2009, Major Step towards Regulatory Stability
  - ✓ Owner's Groups developed Generic Lists of impactful MSOs
  - ✓ Expert Panel Reviews used to make MSO List site specific
  - ✓ Since issued, additional circuit testing and review of results have provided additional insights into fire-induced circuit failure modes
  - ✓ Since issued, NRC Triennial Fire Inspections have identified several lingering issues

Need to Update Industry Guidance

Recent Successes have resulted in NRC/Industry consensus

- An EPRI/NRC-RES Team was used to develop and review NUREG/CR-7150;
  (Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE))
  - ✓ Volume 1 review conducted in 2012 – by the "Phenomena Identification and Ranking Table (PIRT) Panel"
  - ✓ Volume 2 review conducted in 2014 by an Expert PRA Panel
  - ✓ **Volume 3 is being finalized in 2017 by a Working Group (essentially a re-vitalized PIRT Panel)**

NEI 00-01, Rev. 4 Proposed Changes

- NEI 00-01 Revision 2 used as a starting point.
- Technical Papers from the EPRI Working Group incorporated.
- New Appendices added:
  - ✓ Appendix I – Design Considerations for Shorting Switches
  - ✓ Appendix J – Use of PIRT Panel Information to address:
    - Ground fault equivalent hot shorts;
    - Inter-cable hot shorts on thermoset insulated conductors]
- Major Sections revised:
  - ✓ Hot Short Duration – DC Circuits [40 minutes for DC]
  - ✓ MSO Rule of Four [Numerous rules based on circuit failure modes]
  - ✓ Proper Polarity [All conditions, (e.g., AC to DC & DC to AC) need to be evaluated]

Fire PRA Methods - Current

- Substantial improvements have been made since NUREG/CR-6850/EPRI 1011989 was first released in 2005
  - ✓ 2010: Supplement 1
  - ✓ 2013: Fire PRA FAQ process (continuing to provide improved methods)
  - ✓ 2015: Ignition frequencies (NUREG 2169)
  - ✓ 2015: Electrical cabinet heat release rates (NUREG 2178)
- Taken together, these improvements to realism have improved methods
  - ✓ Revised methods have shown improvements in results
  - ✓ Significant uncertainty and conservatism remain due to inherent issues with fire analysis and gaps in data
  - ✓ Not all updated methods have caused reduction in results – but are designed to make the results more realistic

Fire PRA Methods – Path to Continuing Improvement (1)

- NUREG/CR-2178, Vol. 3 - Improvements in realism for:
  - ✓ Obstructed radiation ZOI (Zone of Influence)
  - ✓ Fire growth profile timing
  - ✓ Cabinet to cabinet fire propagation
  - ✓ Pump and motor HRR (Heat release rate)
- Methods Panel Review
  - ✓ Liquid and Oil Spills
  - ✓ Wall and Corner Effects
  - ✓ Transient Fire Propagation

Fire PRA Methods – Path to Continuing Improvement (2)

- Incipient Detection (NUREG-2180)
  - ✓ EPRI Testing on cabinet fires
  - ✓ OE review to update (FAQ)
- Fire PRA FAQs
  - ✓ Cable Tray Combustion Temperatures
  - ✓ HEAF Suppression Factors
  - ✓ Transient Fire area frequency factors

Fire PRA Methods – Testing Priorities

- Computational studies
  - ✓ Many previous improvement efforts relied on fire testing
  - ✓ Software codes such as Fire Dynamics Simulator can be used to expand scope of progress made by testing (e.g. obstructed plume work)
- NRC Testing
  - ✓ EPRI and the Fire PRA Realism working group look forward to working with Fire Research to determine best path forward

Path Forward for PIRT Issues

- The NEI Fire Induced Circuit Failure Task Force – "FICFTF"
  - ✓ Has issued a draft of NEI 00-01 Rev. 4 for Industry and NRC review
  - ✓ Will be finalize in 2017
- The FICFTF has been combined with the NFPA 805 Task Force to form the NEI Fire Protection Task Force.

Conclusions:

- EPRI, NRR, NRC Research and the Industry are moving forward on a path to further increase regulatory stability in the area of post-fire safe shutdown circuit analysis.
- EPRI & NRC Research have provided a sound technical basis for a number of the open issues.
- NEI's FICFTF has worked to provide a revision to NEI 00-01 for NRC review and potential full or partial endorsement through Reg. Guide 1.189.
- Fire PRA Methods – Continued improvement will make Fire PRA results more realistic for both License Submittals and Significance Determination Process issues