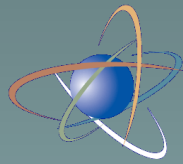


# **Lessons Learned from Risk-Informed, Performance-Based Fire Protection (NFPA 805) Regulatory Reviews**

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## Problem Statement:

Fire protection regulation (10 CFR 50.48) was promulgated after most nuclear power plants already built

As a result,

- plant-specific fire protection licensing basis can include numerous exemptions or deviations from the deterministic requirements AND
- plant-specific fire protection licensing basis can be complex and ambiguous – open to interpretation

## 2001

- Issued National Fire Protection Association (NFPA) Standard 805 “Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants,” 2001 Edition

## June 2004

- NRC promulgated a rule change to 10 CFR 50.48, “Fire Protection,” adding a new section - 10 CFR 50.48(c) - that allows licensees to adopt NFPA 805 (2001 Edition), with some clarifications, as an alternative to the solely deterministic requirements of 10 CFR 50.48(b)
- Rule relies upon combination of fire PRA and deterministic requirements
- About 50% of licensees indicated they would be voluntarily transitioning fire protection licensing basis to 10 CFR 50.48(c)

## Spring 2005

- 2 licensees (Oconee and Harris) volunteered to pilot transition to 10 CFR 50.48(c)

## September 2005

- NRC, in collaboration with the Electric Power Research Institute (EPRI), published NUREG/CR-6850, “EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Plants”

## 2005 – 2008

- Pilots developed fire PRAs and evaluated plants for transition
- NRC conducted a series of observation visits with pilots and evaluated industry guidance on making transition

# **Background** (continued)

## May 2006

- NRC issued Regulatory Guide 1.205, “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants,” that endorsed industry guidance (NEI 04-02, “Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c),” Revision 1)

## May 2007

- NRC published NUREG-1824, “Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications”

## May 2008

- Both pilots submitted license amendment requests to implement 10 CFR 50.48(c)

## May/December 2010

- Harris/Oconee license amendments approved with conditions

# Pilots Lessons Learned

Pilot applications and regulatory approval demonstrated that it is possible to transition to a risk-informed, performance-based fire protection licensing basis

- Demonstrated risk-informed approach for broad-scope applications
- Demonstrated use of fire PRA to identify and disposition licensing issues
- Eliminated many exemptions and deviations
- Established clear licensing basis and change process



# **Pilots Lessons Learned**

## **(continued)**

Transition license applications and regulatory reviews are more complex than originally estimated

- Significantly greater effort to collect information
  - Cable tracing and walk-downs
- Significantly more complex and detailed analyses
  - First-time integrated use of NUREG/CR-6850
  - Internal events PRA issues/simplifications can create fire PRA issues
- Significantly greater regulatory review effort and time
  - Much of the technical detail is in supporting analysis documentation and not directly in the license application
  - Requires significant knowledge of fire PRA methods

# **Pilots Lessons Learned**

## **(continued)**

Transition resulted in safety improvements

- Both licensees expended significant resources to evaluate and install modifications (and improve procedures) using risk insights
  - Moved at-risk safe shutdown cables
  - Installed 3-hour rated cables
  - Installed very early warning (incipient) fire detection in risk-critical electrical cabinets (alarms before flame occurs)
- Some fire-related modifications reduce overall plant risk
  - Installed alternate reactor coolant pump seal injection system significantly reduces plant risk, including from station blackout
  - Installing protected service water system significantly reduces plant risk, including from tornado and high energy line breaks

# **Pilots Lessons Learned**

## **(continued)**

Frequently asked question (FAQ) process is effective in resolving regulatory and technical issues and brings regulatory stability to transition

- Recognized need to address regulatory and technical issues during pilot application development and review
  - August 2007 Issued Regulatory Issue Summary 2007-19, “Process for Communicating Clarifications of staff Positions Provided in Regulatory Guide 1.205 Concerning Issues Identified During the Pilot Application of National Fire Protection Association Standard 805”
  - Monthly public meetings with industry task force to discuss emerging issues and develop solutions
  - Regulator documents interim regulatory position on each issue
  - About 50 issues resolved using FAQ process
    - e.g., PRA modeling of the installed incipient detection system

# **Pilots Lessons Learned**

## **(continued)**

Lessons learned during pilots captured by supplements and revisions to industry and regulatory guidance

- Fire PRA and methods/model clarifications and enhancements
  - Supplement to NUREG/CR-6850 issued in December 2010
- Licensee application and review clarifications and enhancements
  - NEI 04-02, “Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c),” Revision 2, issued April 2008
  - NEI 00-01, “Guidance for Post Fire Safe Shutdown Circuit Analysis,” Revision 2, issued May 2009
  - Regulatory Guide 1.205, Revision 1, issued December 2009
  - Standard Review Plan Section 9.5.1.2 issued December 2009
- Developed templates for license application & safety evaluation
  - Identifies needed information and level of detail
  - Standardizes format and location of information

# Early Applications Lessons Learned

9 license applications have been submitted since the completion of the pilots  
Insights are based on the first 6 license application reviews

Recognized need for enhanced training for NFPA 805 reviewers so as to ensure common understanding of regulations, applications, and scope/approach to reviews

- Developed NFPA 805 training for all staff and support contractors
- Established quality/consistency oversight role to ensure consistency among multiple, simultaneous application reviews
  - 1 senior staff for deterministic fire protection and 1 senior staff for fire PRA
- Established shadow reviewer role for early application reviews to enhance knowledge of new and less experienced staff
  - Prepares new staff for lead discipline reviewer role on future applications
  - Regulatory overhead expense

# **Early Applications Lessons Learned** (continued)

License application and safety review templates provide consistent approach and presentation of information at a consistent level of detail

- Identifying additional clarifications for templates regarding specific information needed in license application

Use of an electronic document portal and performing site audit early in review allows regulator to review detailed supporting materials early in license application review

- Improves regulator understanding of licensee analyses/approach
- Focuses requests for additional information
- Should eliminate multiple rounds of questions
- Should reduce overall schedule of review

# **Early Applications Lessons Learned** (continued)

Enhancements to fire PRA methods continue to be developed and used in NFPA 805 license applications

- Identified as an issue during industry fire PRA peer reviews in determining appropriateness of new methods
  - Industry established a Fire PRA methods task force (expert panels) to review “unreviewed analysis methods (UAMs)”
    - Regulatory staff member is involved with review panels to ensure regulatory awareness and early identification of acceptability or issues related to new methods
    - Panel determination is sent to industry task force who sends it to rest of industry (including peer review teams) and submits it to the regulator
    - Regulator sends a letter back to industry to establish the regulatory position on the acceptability of new methods for risk-informed applications
    - Expect acceptable methods to be eventually incorporated into guidance documents (e.g., NUREG/CR-6850)

# Early Applications Lessons Learned (continued)

4 new methods have been through this process

- All have been changed to be found appropriate for use
- 1 method accepted by regulator with no clarification
- 1 method accepted by regulator with minor clarification
- 1 method accepted by regulator, but with modification to ensure correct input data are used
- 1 method rejected by the regulator (identified dissent during panel)

Use of UAMs in NFPA 805 license applications while under review by industry fire PRA task force panel creates uncertainty in regulatory acceptability of application

- Applications using UAMs need to perform sensitivity studies to accepted methods to understand the significance of the method to the application and allow application review to progress with an acceptable method



# Conclusions

- Two pilot license application approvals represent a significant milestone for industry and regulator
  - Both pilots proposed significant safety enhancements, demonstrating how risk insights can be used to improve fire safety (and overall plant safety) at nuclear power plants
  - Numerous lessons learned were incorporated into supplemented/revised guidance documents and development of license application and safety evaluation templates
- Lessons continue to be learned
- Achievements
  - Improved license applications
  - More efficient and effective regulatory reviews
  - Improved regulatory clarity and regulatory stability
  - Enhanced understanding of fire risk and improved plant safety

**Thank You!**

**Questions?**

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