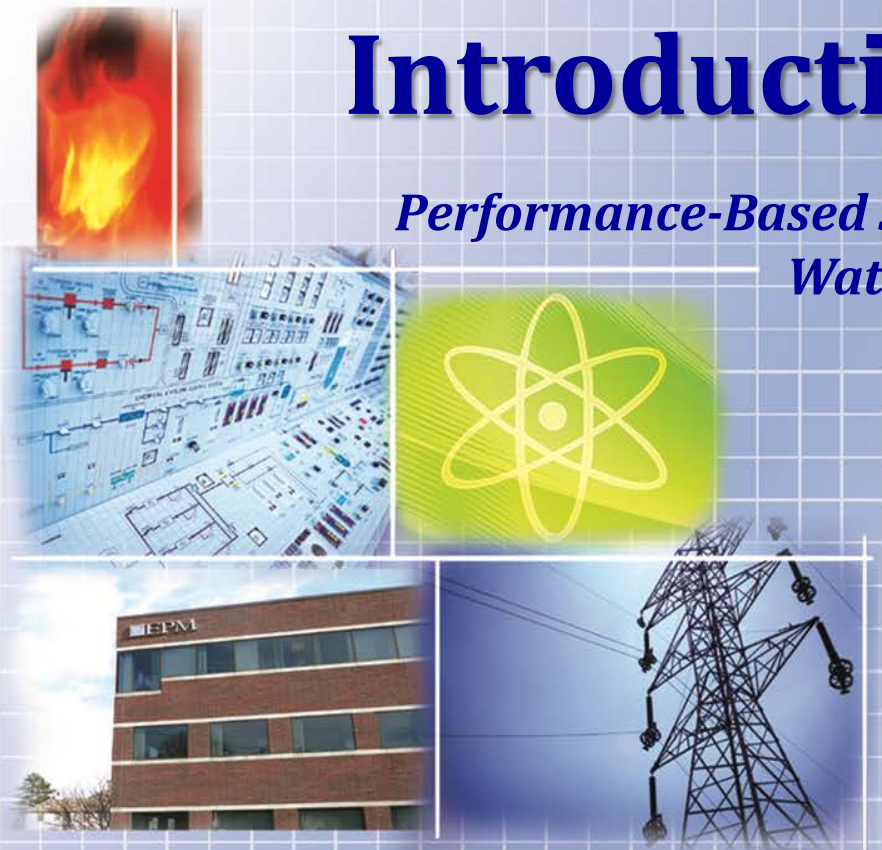
EPM
Engineering Planning and Management, Inc.
ONET GROUP



Introduction to NFPA 805

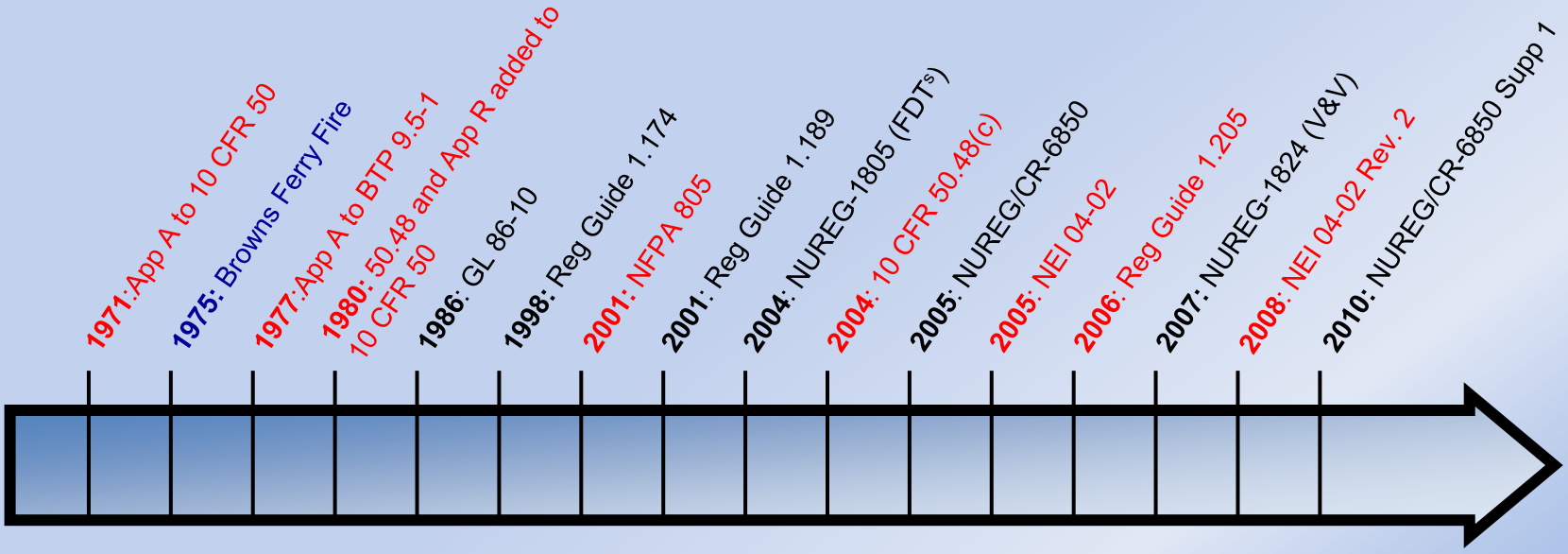
Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants

Presented by:
Engineering Planning and Management, Inc.
www.epm-inc.com

Evolution of NPP FP

- 1975 Browns Ferry Fire was the nuclear industry's wake-up call
  - Cable shorts, multiple spurious operations, loss of core cooling
  - Loss of control of primary and secondary cooling systems
- Regulatory response to BFN fire: 10 CFR 50 Appendix R; NUREG 0800; and BTP 9.5-1 Appendix A (deterministic standards):
  - Deterministic - rules-oriented, assumes all possible impacts can be identified / predicted, and thus addressed (by compliance with a rule); one-size-fits-all application.
  - 900+ exemptions to 10 CFR 50 Appendix R!
- NFPA 805 is a new approach to nuclear fire protection that can be more uniformly applied.

Evolution of NPP FP



EPM
Engineering Planning and Management, Inc.
ONET GROUP

Allowance as Alternative Rule

- 10 CFR 50.48(c) – voluntary rule
  - Utilities using voluntary rule need to inform the NRC and utilize established transition process

- 10 CFR 50.48(b) – existing rule
  - Utilities have the option to maintain compliance with existing deterministic rule vs. transitioning to NFPA 805

Incorporation By Reference

- NFPA 805 is an independent NFPA standard that gets revised on a periodic basis per established NFPA timetables
- NRC regulation 10 CFR 50.48(c) specifically adopted the ***2001 edition*** of NFPA 805
  - Transitioning utilities must demonstrate compliance with 2001 edition; subsequent editions are not endorsed

Why NFPA 805?

- Under 10 CFR 50 Appendix R
  - Existing plants not designed with rule in mind
  - Required most plants to apply for several exemptions from compliance with rule
  - Many licensees took credit for manual operator actions to achieve compliance post-fire, which was not allowed under requirements (unless explicitly approved via the exemption process)

Appendix R vs. NFPA 805

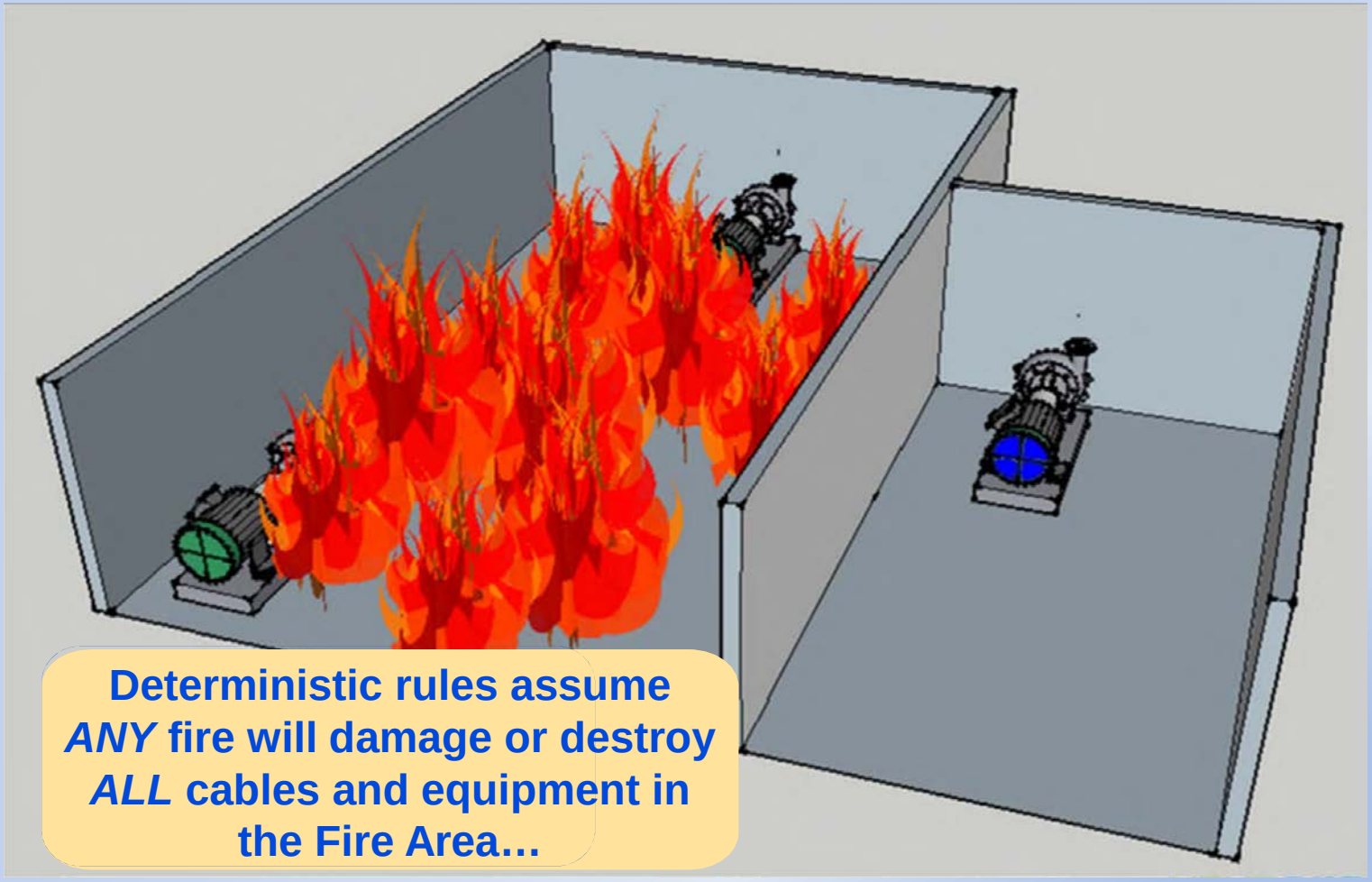
10 CFR 50.48(b) (10 CFR 50 Appendix R) "Deterministic" Rule	10 CFR 50.48(c) (NFPA 805) Risk-Informed, Performance-Based Rule

• Rule-oriented, "shotgun" approach that applies generic rules and requirements plant-wide
  • FP resources are generally applied uniformly and conservatively
  • Requirements do not consider realism of fire risk
  • Formal NRC approval required for exemption from deterministic requirements
	• Goals-oriented approach that identifies actual fire risks throughout the plant
	  • FP resources are applied as needed
	  • Actual fire risks addressed more effectively
	  • FP Resources not expended "just to comply"

RI-PB Philosophy

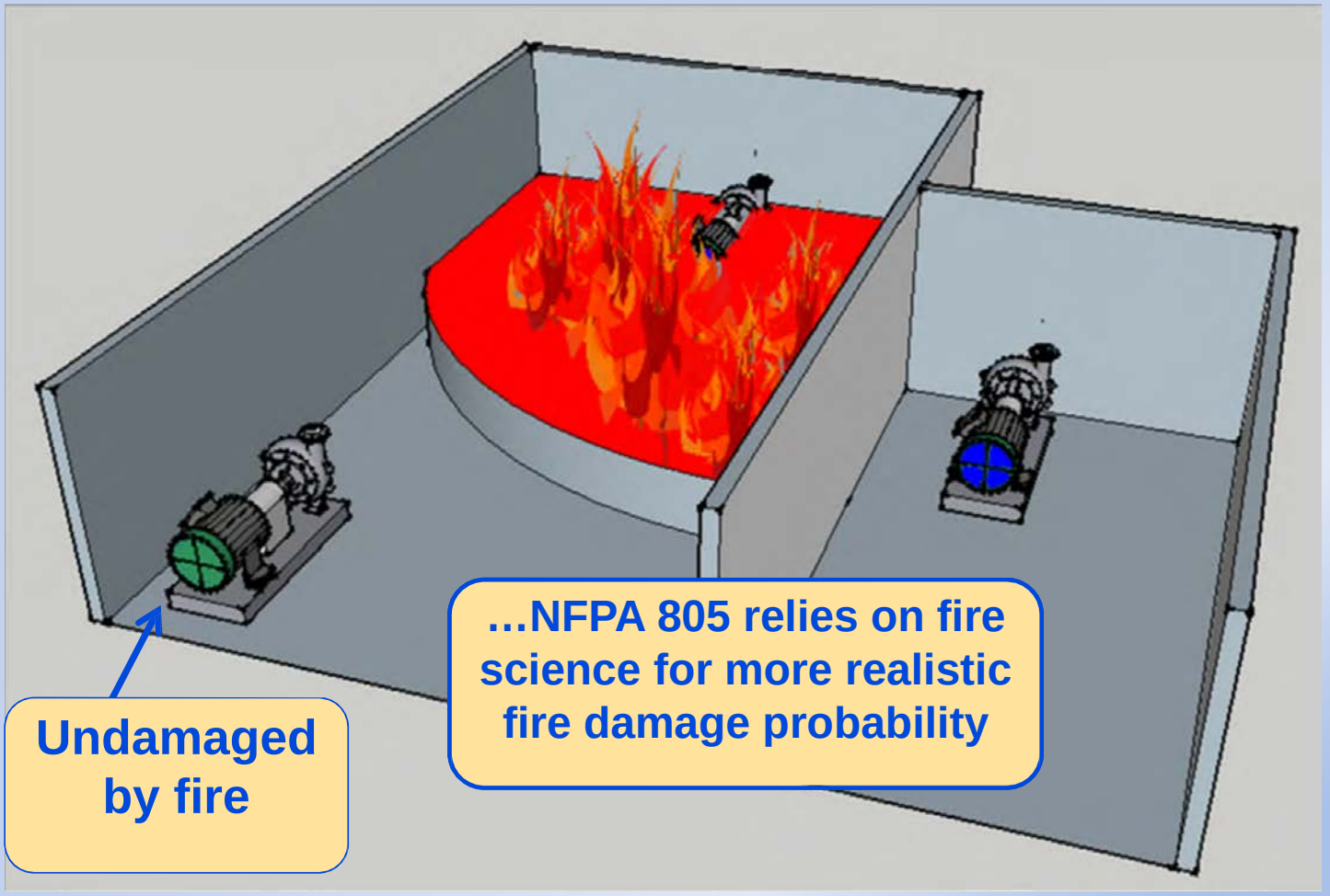
Risk-Informed Analysis	Performance-Based Approach
• What can go wrong? • How likely is it to happen? • What are the consequences if it does happen?	• Goal-oriented; asks "Given the identified fire risk and plant conditions, what is the best way to achieve desired goal?" • Fire protection is essentially customized for the licensee, based on specific, identified fire risks.

RI-PB Philosophy



EPM
Engineering Planning and Management, Inc.
ONET GROUP

RI-PB Philosophy



EPM
Engineering Planning and Management, Inc.
ONET GROUP

Basic NFPA 805 Requirements

- Classical Fire Protection Requirements
  - Applied deterministically
  - Process allows engineering evaluation of deviations in some cases; others require NRC approval

- Fire Protection Program
- Fire Prevention Program
- Fire Brigade Program
- Fire Pumps and Water Supply
- Standpipe System
- Fire Extinguishers

- Fire Detection Systems*
- Fire Suppression Systems*
- Fire Barriers*

*When required to support NSCA
*Self-eval of exceptions allowed

EPM
Engineering Planning and Management, Inc.
ONET GROUP

Basic NFPA 805 Requirements

- Nuclear Safety Requirements
  - Option to use deterministic requirements or risk-informed, performance-based requirements, or a combination of both, for each fire area
    - Deterministic requirements mimic Appendix R
    - An area can be deterministic at first, and risk-informed, performance-based methods can be incorporated later if dictated by plant changes

Performance-Based Approach

- Start with deterministic compliance model and determine any non-compliances
  - Variances from Deterministic Reqts. (VFDRs)
- Assess risk acceptability of each VFDR via NFPA 805 fire modeling or fire risk evaluation (FRE) (latter is more common)
  - NUREG-6850 fire modeling can be used to support FRE

Performance-Based Approach

- FRE Approach – FRE performed for each performance-based fire area
  - Change in risk for each VFDR determined utilizing Fire PRA
  - Includes evaluation of FP defense-in-depth (DID) and safety margins
  - Can credit recovery actions, enhanced admin controls, and/or engineering changes as needed to achieve acceptable delta risk numbers

Basic NFPA 805 Requirements

- Non-Power Operation (NPO) Requirements
  - Define High Risk Evolutions (HRE) and required safety functions based on outage management procedures
  - Identify areas in which a fire could result in loss of ability to achieve a safety function
  - Manage the risk associated with postulated fires
    - Verify operable detection/suppression
    - Fire Watches
    - Limit work/combustibles in pinch point areas

Basic NFPA 805 Requirements

- Radioactive Release Requirements
  - Fire suppression operations will not cause a radioactive release
  - Typically addressed through evaluations of adequate diking, drainage, and fire brigade training and procedural controls
  - Not considered for Appendix R compliance
  - Damage to reactor or plant systems not considered (addressed in NSCA or BDB)

Process for Transitioning

1. Existing licensed utility submits letter of intent to NRC to adopt voluntary rule
2. NRC acknowledges letter of intent and approves enforcement discretion period
3. Utility prepares transition report and submits to NRC as attachment to LAR
4. NRC preliminary review, RAI phase, audit by NRC licensing branch

Process for Transitioning

5. NRC issues conditional license amendment allowing time for implementation of mods and other plant program/process changes
6. Utility gets limited discretion for plant changes during implementation phase
   - Change in risk cannot be greater than minimal
7. Once plant is "fully implemented" plant changes can be made per license condition

EPM
Engineering Planning and Management, Inc.
ONET GROUP

Benefits

- Risk-informed rule allows licensees to "self-approve" certain changes to FP program
  - Plant changes that decrease plant risk
  - Plant changes that increase plant risk within threshold defined in Operating License
  - Changes to fundamental FP elements that are demonstrated to be functionally equivalent or adequate for hazard (when allowed)

Benefits

- Performance-based approach focuses resources on drivers of plant risk
  - FREs may determine that VFDRs do not present significant fire risk (e.g. the risk of a particular component failing based on a fire is low)
  - Reduction in number of manual actions required by operators to mitigate fire impacts

Pros vs. Cons

Benefits	Challenges
• Flexibility to update FP program without NRC approval process • Focus FP resources on areas of actual plant risk • A safer nuclear plant	• Timeline for transition (from intent to self-approval) longer than initially estimated • Costs to fully implement have far exceeded the initial estimates by an order of magnitude

Current Status in Industry

- 28 Sites / 45 Units have "opted in"
  - 25 plants have received conditional license amendments
    - 2 "pilot plants" and 21 other plants have met conditions of LAR and are fully implemented
    - 2 other plants are in implementing status
  - 2 plants are awaiting conditional license amendments
  - 1 plant is preparing its LAR

Transition Insights

- Many plant programs need to be engaged during transition to ensure success
  - FP, PRA, Engineering, Operations, Training, Licensing and others need to buy in
- As more plants transition, more industry issues emerge
  - Demonstrating compliance to an evolving rule

Transition Insights

- PRA may demonstrate that compliant plant is not acceptable from a risk perspective
  - Risk numbers unfavorable to support deterministic compliance
  - Need to used a performance based approach to satisfy PRA analysis
- Successful transition requires integrated SME team (FPE, NSCA, PRA, Ops) with early engagement and constant collaboration

Implementation Insights

- Breadth of impact underestimated
  - Plant modifications for compliance require coordination and planning
  - Training required for many plant organizations
- Program maintenance is crucial to success
  - FP group is important, but others are responsible as well
    - Operations (e.g. outage planning, fire procedures)
    - PRA (e.g. monitor risk, evaluate plant changes)

Inspection Insights

- Heavy focus on performance-based areas, especially high-risk areas
- Learning curve for inspectors
- Lack of evident collaboration between inspection and licensing branches
  - Differences of interpretation for requirements
  - Different levels of knowledge among branches and among regions

Questions?

- Vicken Khatchadourian, PE

  Technical Manager, Safety and Systems Analysis

  vak@epm-inc.com | (508)-532-7125

- Jason LeMaire

  Consulting Engineer, Fire Protection and Risk Services

  jhl@epm-inc.com | (508)-532-7152

EPM
Engineering Planning and Management, Inc.
ONET GROUP