COMMISSION BRIEFING SLIDES/EXHIBITS

BRIEFING ON FIRE PROTECTION LESSONS LEARNED FROM SHEARON HARRIS

NOVEMBER 3, 2009

NFPA 805
Lessons Learned
Shearon Harris Nuclear Plant

November 3, 2009

Joe Donahue

Vice President Nuclear Oversight

NGG Nuclear Generation Group

Progress Energy

NFPA 805 Lessons Learned Topics

- Plant Fire Protection Status
- Transition Results
- Insights Going Forward

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Shearon Harris NFPA 805 Status

- RAI Responses/ Supplement 3, 10/9/09
- Program Implementation Mid 2010
- Modifications Complete by End of 2010

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Progress Energy Fleet Status

- Incorporating Lessons Learned
  - Pilot Plant RAI Responses
  - RG 1.205, Rev 1 when issued
  - Pilot Plant SERs when issued

- Reassessing LAR Schedules

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Shearon Harris Fire Protection Improvements

- 4000+ Fire Scenarios evaluated
- Reliance on Operator Manual Actions significantly reduced
- NFPA 805 Transition and modifications resulted in overall plant risk reduction
- Example Modifications Installed:
  - Hemyc/MT Fire Wrap barriers upgraded
  - Incipient detection / Alternate Seal Injection

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Decision Making During and Post Transition

- Ensure Fire Defense-In-Depth Maintained
- Input from Various Sources:
  - Classical / Safe Shutdown / PRA / Others
- Risk Informed Post Transition Fire Plant Change Process

NRC Guidance Improvements

- Technical Adequacy of Fire PRA
  - Peer Review Process of RG 1.200
- Engineering Equivalency Evaluations
  - FAQ 06-008 Closure
- Clarifications of Scope of Recovery Actions Requiring Treatment in LAR

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Stable Regulatory Environment

- Need to Pilot Inspection Process
- Consistent Application of NUREG 6850 and Related PRA Methods Needed
  - NFPA 805
  - Other Applications
  - Fire SDP Phase 3

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Fire PRA Conservatisms

- EPRI / NEI Ongoing Efforts to Address
  - Fire growth and Heat Release Rates in electrical cabinets is priority

- Inappropriate to treat Internal Events and Fire equally due to PRA realism differences

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NFPA 805 Lessons Learned

Questions?

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Post-Pilot Transition To NFPA 805 – Industry Perspective

November 3, 2009

Danny Pace, Senior Vice-President, FENOC

FENOC
FirstEnergy Nuclear Operating Company

FirstEnergy Nuclear Operating Company

- Beaver Valley 1 - Westinghouse 911 MWe, 3 Loop PWR, 1976
- Beaver Valley 2 - Westinghouse 904 MWe, 3 Loop PWR, 1987
- Davis-Besse - 908 MWe, Babcock and Wilcox PWR, 1977
- Perry - 1268 MWe, General Electric, BWR 6 - Mark III, 1986

FENOC NFPA 805 Transition - Decision

- Opportunity to improve nuclear safety through a risk-informed fire protection program
- Potential to resolve industry legacy fire protection issues
- Standardize fleet approach to fire protection
- Use as leverage to improve PRA models and PRA staff capability

FENOC NFPA 805 Transition - Strategy

- Initial feasibility study conducted for each site
- Letter of intent sent December, 2005 to transition to NFPA 805
- Staggered implementation plan for all four units

Beaver Valley Transition

- Initial cost of $7M with projected 2008 submittal
- Current cost of $15.4M and projected 2010 submittal
- Unit 1 fire screen model complete; fire area modeling 70% complete
  - Ongoing rework
- Unit 2 fire screening model 30% complete
  - Unit 1 is pilot for Unit 2

Davis-Besse Transition

- Initial transition cost of $3.2M is now projected at $8.8M
- Fire screening model complete
- Focus on fire area modeling

Perry transition is scheduled to follow Davis-Besse

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Key Industry Transition Issues

- Methods used to select modeling inputs
- Schedule overlap between pilot plants and post-pilot transition plants
- Our solution has introduced new challenges
- Cost benefit of NFPA 805 transition

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Methods Used to Select Modeling Inputs

- Deterministic approach
- Unrealistic modeling outputs
- Results not comparable
- Existing standards have not been consistently applied

Schedule Overlap Between Pilot Plants and Post-pilot Transition Plants

- Lose benefit of pilot approach
- Substantial rework
- No fleet benefit
- Challenges limited resources

Our Solution Has Introduced New Challenges

- Deterministic approach
  - Manual operator actions
  - Circuit issues
- Risk informed approach
  - Adds HRA, fire ignition frequency, fire propagation challenges, etc.

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FirstEnergy Nuclear Operating Company

Cost Benefit of NFPA 805 Transition

- Original assumptions are no longer valid
- Deterministic approach is gaining certainty
- Circuit analysis methods now developed
- Station modifications may cost less

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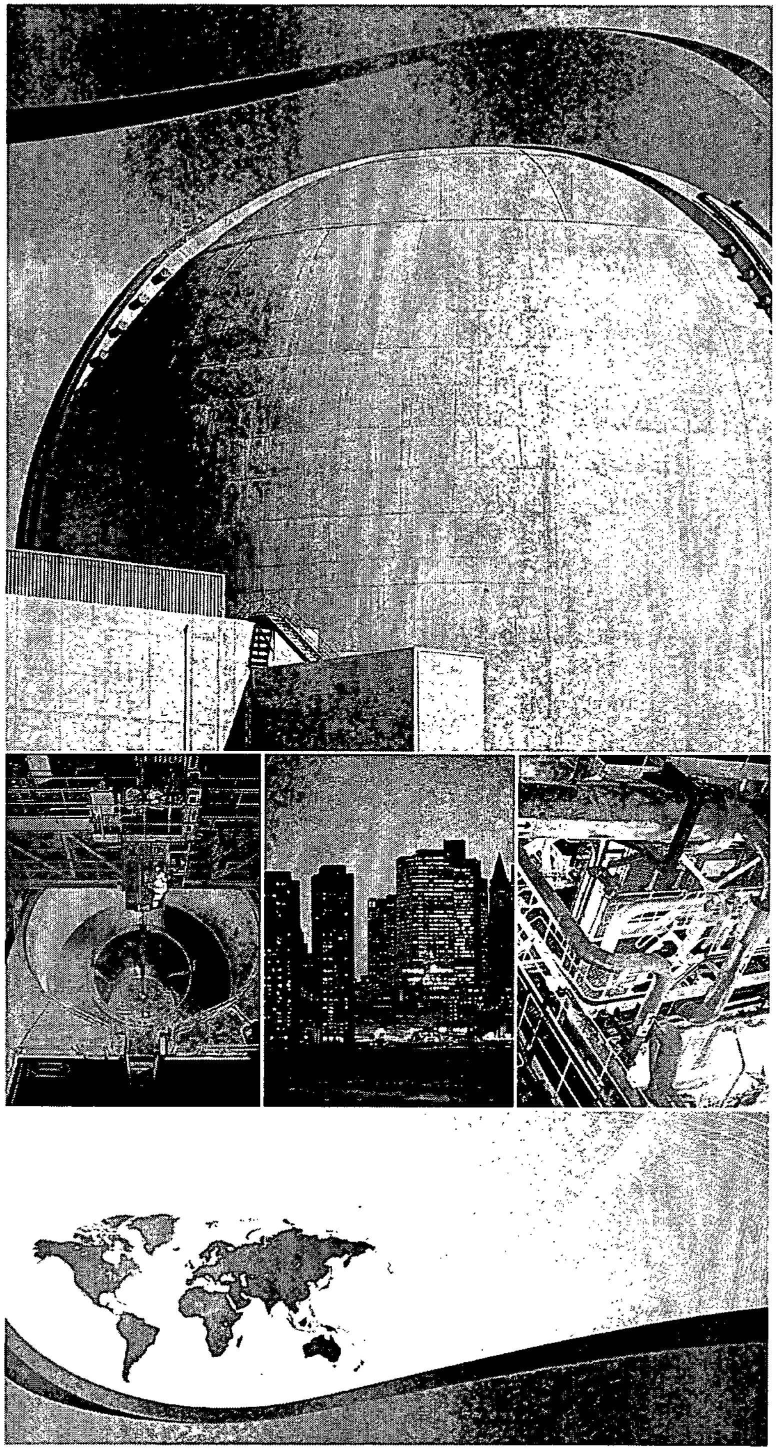
FirstEnergy Nuclear Operating Company

Summary

- Risk-informed approach – good intention
- Still need to resolve open technical issues
- Front end transition plants intend to complete
- Follow-on plants are reevaluating positions



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Fire PRA Methods Development: Lessons Learned

NRC Commission Briefing
November 2009

Ken Canavan
Senior Program Manager

Fire PRA Methods Development

- Initial Methods Developed 20 Years Ago
- Modified by EPRI and NRC RES
- NUREG/CR-6850 and EPRI 1011989
  - State-of-the-art when released
  - Not fully piloted
  - Issues expected as a result of initial application
- Worked with Stakeholders to Improve Methods

Presentation Focuses on Process Improvements

Fire PRA Methods Development – Pilot Lesson Learned # 1

How not to Address Fire PRA Methods Issues

- Prior to Pilot
  - Researchers
  - Small groups
  - Long lead time
- During Pilot
  - Implementers
  - Extremely large group
  - Short lead time
- Group Dynamics
  - Higher stress
  - Different goals
  - Difficult consensus
- Result
  - Inefficient resource usage
  - Compromise methods

Fire PRA Methods Development – Pilot Lesson Learned # 2

Methods Should not be Developed in Abstract

- Single plant identified issues
- Method refinements proposed without benefit of multiple examples
- Abstraction has led to "… but what if …"

Fire PRA Methods Development – Pilot Lesson Learned # 3

Compromise Methods do not Solve Issues

- "Compromise Methods"
  - Use conservative and / or use bounding inputs
  - Analysis is done to remove conservatism
  - Results do not comport with experience
  - Interim solutions not applicable to all plants

Fire PRA Methods Future Development

- NFPA 805 is a Risk Informed Performance Based approach
  - Blend of deterministic and probabilistic
  - Methods should:
    - Use best information and analysis
    - Comport with operating experience
    - Encourage innovation, mature and refine over time with monitoring
    - Encourage increased safety

Fire PRA Action Plan

- Fire PRA Action Matrix of Methods issues
  - Characterization of the Issue
  - Owners (EPRI, Owners Groups, Others)
  - Resources and Schedules
- Approach
  - Begin with small team of knowledgeable experts
  - Specific solutions – not in abstract
  - Methods not “approved” but available for review
  - Refinements from
    - Implementers
    - Peer Reviews
    - NRC Request for Additional Information
    - Approval of methods in NRC Safety Evaluation Report

Fire PRA Methods – Current and Planned Activities

- High Energy Arcing Faults*
- Large Oil Fires*
- Incipient Fire Growth in Electrical Cabinets*
- Credit for Incipient Detection*
- Hot Short Probabilities
- Fire Ignition Frequency*
- Fire Suppression Probabilities*
- Hot Short Duration*
- Enhancement of Fire Event Database
- Peak heat release data review and analysis, testing
- Control Room Modeling and Treatment in the Fire PRA
- Human Reliability methods and performance shaping factors
- Control vs suppression of fires
- Ignition frequency treatment of standby components
- Fire growth and propagation investigation
- Incipient detection testing
- Transient Fire HRR
- Empirical data and comparison with fire PRA
- Update of the Fire PRA Standard
- Additional Peer Review Guidance

* indicates a "Compromise Method" that will need addition analysis and method development

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Fire Protection Regulation and Transition to NFPA 805

By Paul Gunter, Director of Reactor Oversight Project, Beyond Nuclear

Before the United States Nuclear Regulatory Commission

November 3, 2009

Thank you.

The Browns Ferry fire in 1975 demonstrated as reality that a significant fire can occur at a nuclear power station and that a fire can significantly challenge the safe shutdown capability of the reactor. The Browns Ferry fire further demonstrated that even an incalculably improbable source of ignition can lead to a significant fire in reactors operating today.

The near-catastrophic experience proved so harrowing that the Nuclear Regulatory Commission responded by dramatically amending and expanding its fire protection philosophy to include the development of General Design Criteria 3, Branch Technical Position 9.5.1 and the promulgation of law under Code of Federal Regulation for minimum fire protection requirements to conservatively ensure that a level of compliance exists at all nuclear power plants.

Unfortunately, as witnessed through my personal experience since 1991 before the Commission, one critical analyzed area of these fire safety requirements in nuclear power plants was not properly implemented nor subsequently enforced; namely, for a large number of Appendix R III G.2 fire areas requiring qualified physical and passive fire protection features for control room power, control and instrumentation electrical circuits to reasonably assure that the redundancy for reactor safe shutdown equipment cannot be destroyed by a single fire.

Apparently after 29 years of effort, such regulatory assurance appears to be overly burdensome and no longer considered reasonable, attainable by industry nor enforceable by the federal agency without a large number of exemptions.

Given the widespread level and duration of non-compliance, the infrequency of serious fires at nuclear power plants is at the same time a blessing and a curse; a blessing in that, to date, more significant fires have not challenged nuclear power stations safe shutdown operations; a curse in that the lack of such experience leaves many broad areas of uncertainty in an aging industry. The expanse of this uncertainty includes not only a lack of an experiential knowledge base but introduces questions and disputes involving i variability, randomness, indeterminacy, judgment, approximation, linguistic imprecision, error, the unreliability of human behavior and the significance surrounding fire safety issues.

These broad uncertainties play a major role in our discussion and our concerns today regarding the public's confidence in the proposed transition from the ongoing failure to achieve compliance with a prescriptive fire code to the optional National Fire Protection Association 805 "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants."

Because of these uncertainties, we remain skeptical of the outcome of the NFPA 805 transition and implementation process.

I would like to focus my presentation on the issue of fire modeling.

Verified and validated fire models used to predict the extent of fire damage from a range of fire sources are held up as an integral, indeed essential, part of the transition to NFPA 805 in determining the survivability of reactor safe shutdown equipment in lieu of protecting that same equipment through compliance with Appendix R III.G.2 through qualified physical passive fire protection features.

Given the potential high safety consequence arising from a fire that knocks out the control room operation and maintenance of reactor safe shutdown, accurately capturing all of the proper fire scenarios becomes crucial to public safety.

We argue that fire modeling remains a significant limitation in NFPA 805 and fire safety analysis and design for power reactors. Published literature continues to warn that fire modeling is still in its developmental stages with its associated uncertainties.[i] In our view, this remains a significant stumbling block to a "reasonable assurance" standard and a continued impasse to effective enforcement policy for future fire safety issues arising in NFPA 805 nuclear power plants.

It remains very difficult to employ a computer-generated fire model with a high level of confidence so that it makes a valuable contribution to real-world decision-making as opposed to leading to inaccurate and inappropriate interpretations that can leave power reactors vulnerable to fire.

The European experience in fire modeling further suggests that different fire model users can produce very different results, even when using the same probabilistic model and applying it in the same case, where risk estimates can differ by "several orders of magnitude" and are crucially based on the users' knowledge and experience, or lack thereof.

A number of identified error sources and grey areas in fire modeling include;

a) lack of reality of the theoretical and numerical assumptions used in fire models. The assumptions used in "field models" are approximations to the real world experience from a particular fire;

b) lack of fidelity of various numerical solution procedures;

c) direct errors in computer software, where the software will not be an accurate representation of the model and numerical solutions procedures;

d) faults in computer hardware, where a fault can exist as the result of mistakes in microprocessors;

e) significant and undetected mistakes in fire model applications while inputing into the model

These potential error sources can remain significant challenges to both industry and regulator that cloud, complicate and further prolong the development of a fire safety resolution path and improved enforcement policy.

Given the troubled history of NRC's official policy of non-enforcement which spans decades old fire protection violations, it begs the question if a transition to NFPA 805 helps or further hinders the institution of NRC enforcement policy on fire protection?

The failure of the NRC to effectively take enforcement action on the violation of inspectable prescriptive requirements, widespread industry abandonment of subsequent corrective action programs and failure to follow through with fire safety Confirmatory Action Orders does not lend to building public confidence that the agency can effectively address violations of an arguably more nebulous and difficult to inspect performance-based standard---potentially involving disputes between staff, industry and public over any number of areas of uncertainty identified.

Finally, there is the concern that malevolent acts are beyond the scope of NFPA 805. The risks and consequences associated with sabotage cannot be accurately analyzed by probabilities nor can they be modeled. As we have raised to staff, we see a significant fire safety disconnect in a shift to performance-based risk-informed fire protection regulation that does not address security concerns when coupled with ongoing industry-wide non-compliance with the prescriptive requirements for Appendix III.G.2 fire areas (where redundant reactor safe shutdown circuitry appear in the same fire zones). These same nuclear power stations have long been identified by national laboratory study to have been inadequately evaluated in their design and construction for the effects of explosion and fire resulting from the impact of aircraft. These same nuclear power stations have been further exempted from any further mandatory aircraft impact hazards analysis. The security veil then falls to obscure from public view how the risks of deliberate destruction of reactor safety systems by fire are or are not being addressed.

As a result the question remains in the public interest community, is the federal regulator pursuing a compliance strategy to douse the flames of the fire protection controversy or is it at long last prioritizing the establishment and enforcement of fire safety regulation to maximize public safety margins during post fire reactor safe shutdown.

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[i] "Computer models and the limitations in safety design," Alan N. Beard, Civil Engineering Section, School of Built Environment, Heriot-Watt University (Edinburgh), Industrial Fire Journal, January 1, 2009.
http://hemmingfire.com/news/printpage.php/aid/460/Computer_models_and_the_limitations_in_safety_design.html

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

FIRE PROTECTION LESSONS LEARNED FROM SHEARON HARRIS

November 3, 2009

Agenda

- Closure Plan Progress
  - Jack Grobe, NRR
- NFPA 805 Activities
  - Alex Klein, NRR
- Update on Fire PRA
  - Donnie Harrison, NRR
- Fire Research – Mark Salley, RES
- Summary – Jack Grobe, NRR

Fire Protection Closure Plan Progress

- **Accomplishments and status**
  - **Completed Tasks**
  - **On-going Tasks**
    - **Operator manual actions**
    - **Multiple spurious actuations**

NFPA 805 Activities

- Regulatory Infrastructure
  - RG 1.205, Rev. 1 (Jan. 2010)
  - Standard Review Plan 9.5.1.2 (Jan. 2010)
    - Safety Evaluation template (2Q CY 2010)
  - Preparations for inspections

NFPA 805 Activities

- NFPA 805 pilot plant license amendment request reviews
  - Status
    - Challenges
    - Schedule

NFPA 805 Activities

- **NFPA 805 pilot plant lessons learned**
  - **Safety benefits**
  - **Communication**
  - **Planning**

NFPA 805 Activities

- **NFPA 805 non-pilot plant license amendment requests**
  - **Early to mid-2010 requests**
  - **Fall 2010 requests**

Fire PRA Infrastructure

- **10 CFR 50.48(c) (2004)**
  - **NFPA 805 (2001)**
- **RG 1.205, Rev. 1 (Jan. 2010)**
  - **RG 1.174, Rev. 1 (Nov. 2002)**
  - **RG 1.200, Rev. 2 (Mar. 2009)**
  - **NUREG/CR-6850 (Sept. 2005)**

Fire PRA
Lessons Learned

- Frequently Asked Question process
- Testing needed to address some uncertainties

Key Focus of Fire Research Activities

- **Support User Office**
  - **User Need Requests**
- **Collaboration with Technical Partners**
  - **Electric Power Research Institute**
  - **National Institute of Standards and Technology**
  - **National Laboratories**

Key Focus of Fire Research Activities

- Fire Modeling
- Fire PRA
- Experimental Activities
  - Cable Functionality Testing
  - Cable Combustibility Testing
- Knowledge Management

Acronyms

- **CFR – Code of Federal Regulations**
- **NFPA – National Fire Protection Association**
- **NRC – Nuclear Regulatory Commission**
- **NRR – Office of Nuclear Reactor Regulation**

Acronyms

- **PRA – Probabilistic Risk Assessment**
- **RES – Office of Nuclear Regulatory Research**
- **RG – Regulatory Guide**