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Fire Protection Regulation and Transition to NFPA 805

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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 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 inputting 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.

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