U.S.NRC
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Protecting People and the Environment

Electric Power Research Institute (EPRI)

Sandia National Laboratory (SNL)

<u>Information Sheet</u>: Fire PRA Methodology for Nuclear Power Facilities, J.S. Hyslop *(NRC/RES/DRA)*

The Risk

The results of the Individual Plant Examinations of External Events (IPEEE) program and actual fire events indicate that fire can be a significant contributor to nuclear power plant risk, depending on design and operational conditions. In particular, failures of fire protection defense-in-depth, (i.e. failure to prevent fires, failure to rapidly suppress fires, or failure to protect plant systems to provide stable, safe shutdown) can lead to risk significant conditions. Fire PRA (probabilistic risk assessment) provides a structured, integrated approach to evaluate the impact of failures in the fire protection defense-in-depth strategy on safety. Those technical issues directly addressed in fire PRA are fire ignition frequency, detection and suppression, fire damage to diverse and redundant trains of core cooling equipment, circuits (i.e. spurious actuations), and plant response including manual operator actions.

The Needs

In 1995, the NRC adopted a policy statement on PRA with the intent to increase the use of PRA technology in all regulatory matters to the extent supported by the state of the art in PRA methods and data. Through the use of PRA, safety is enhanced by gaining insights which supplement NRC's traditional approach of maintaining defense in depth and safety margin, as well as our overall engineering judgment. In 2004, NRC amended its fire protection regulations to allow existing reactor licensees to voluntarily adopt the risk-informed, performance-based rule, 10CFR50.48c, which endorsed NFPA 805, as an alternative to the existing prescriptive fire protection requirements. In recognition of the need for a fire PRA methodology to support finer, more realistic decisions under risk-informed regulation, the NRC and EPRI (Electric Power Research Institute) embarked upon a cooperative program to improve the fire PRA state of the art. This joint program culminated in 2005 in the production of the report entitled "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," (NUREG/CR-6850). Improvements in fire PRA were made across the board by performing analyses of new data, modifying existing methods, and developing new approaches.

The Applications

This state-of-the-art fire PRA method has many technical and regulatory applications. Analysts and reviewers can evaluate the impact on fire risk of both permanent changes to the licensing basis and temporary conditions. Applications extend beyond implementation of 10CFR50.48c and include the Reactor Oversight Program (ROP) and the ANS fire PRA standard. It is expected that NUREG/CR-6850 will provide the groundwork for development of the Standard Review Plan chapter on fire PRA.

NRC and EPRI jointly conducted well-attended general fire PRA workshops based upon NUREG/CR-6850 in both 2005 and 2006, and detailed training in 2007. Additional detailed training is planned for 2008. Pilot plants transitioning to the new rule, 10CFR50.48c, are relying upon NUREG/CR-6850 for upgrading their fire PRA, while the NRC uses it to support reviews. NRC and EPRI have developed resolutions to fire PRA issues related to NUREG/CR-6850 implementation in the NFPA 805 frequently-asked-questions (FAQ) program. Overall, this joint work is producing a significant convergence of technical approaches.

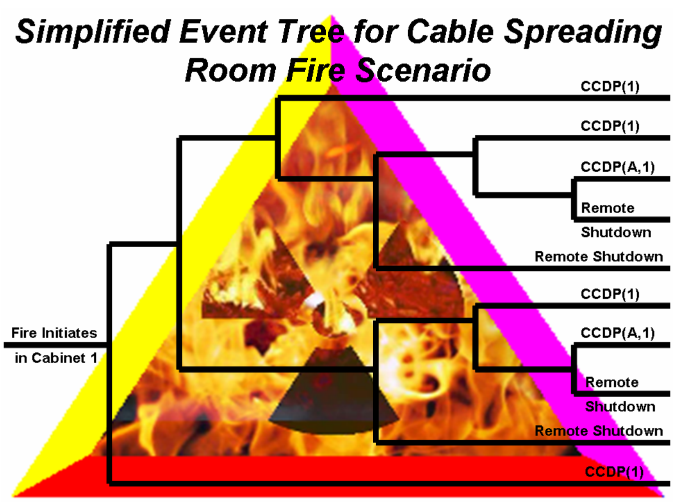

Figure 1: Simplified fire event tree representing different sets of fire damage and plant response. The conditional core damage probability (CCDP) represents failure of only the cabinet in which the fire initiates, the additional fire-induced failure of train A, and fire-induced failure of both trains A and B leading to remote shutdown operations.

Program Management

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