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Information Sheet: **Fire Human Reliability Analysis Methods Development**,
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Background

The Individual Plant Examination of External Events program and the experience from actual fire events identified that fire, depending on design and operational conditions, can be a significant or dominant contributor to nuclear power plant (NPP) risk. Human actions and, subsequently, human error also have been shown to be a significant contributor to overall plant risk (including the risk from fires) due to the significant role that operators play in the fire protection strategy on safety. Human reliability analysis (HRA) is the tool used to assess the implications of various aspects of human performance on risk. Currently, existing HRA methods are being expanded to provide an approach to evaluate the impact of human failures in the fire protection defense-in-depth safety strategy.

In 2004, NRC amended its fire protection requirements to allow existing reactor licensees to voluntarily adopt the risk-informed, performance-based rule, 10 CFR 50.48c. This rule endorses NFPA 805 "Performance Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" as an alternative to the existing prescriptive fire protection requirements. To realize the full benefits of transitioning to the risk-informed/performance-based standard, plants will need to perform a fire probabilistic risk assessment (PRA) that should include quantitative human reliability analysis for post-fire mitigative human actions modeled in a fire PRA.

Approach

In 2001, the Electric Power Research Institute (EPRI) and NRC's Office of Nuclear Regulatory Research (RES) embarked on a cooperative project to improve the state-of-the-art in fire risk assessment to support this new risk-informed environment in fire protection. This project produced a consensus document, NUREG/CR-6850 (EPRI 1011989) "Fire PRA Methodology for Nuclear Power Facilities," which addresses fire risk for at-power operations.

This report provides high-level qualitative guidance and quantitative screening guidance for conducting a fire HRA. However, this document does not provide a detailed quantitative methodology to develop best-estimate human error probabilities (HEPs) for human failure events under fire generated conditions. To fulfill this need, NRC/RES has worked collaboratively with EPRI to develop a methodology and associated guidance for performing quantitative HRA for post-fire mitigative human actions modeled in a fire PRA. The report, NUREG-1921 (EPRI 1019196) "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines" was issued as a draft for public comment in December 2009. It provides three approaches to quantification: screening, scoping and detailed HRA. Screening is based on the guidance in NUREG/CR-6850, with some additional guidance for scenarios with long time windows. Scoping is a new approach to quantification developed specifically to support the iterative nature of fire PRA quantification. Scoping is intended to provide less conservative HEPs than screening, but requires fewer resources than a detailed HRA analysis. For detailed HRA quantification, guidance has been developed on how to apply existing methods to assess post-fire HEPs.

The fire HRA guidance is intended to support plants transitioning to 10 CFR 50.48c as well as NRC reviewers evaluating the adequacy of submittals from licensees in the process of transitioning to this rule.

Figure 1. Operators in a NPP Control Room.

Program Management

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