

Qualitative Human Reliability Analysis for Spent Fuel Handling

By

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Human reliability analysis (HRA) methods have been developed primarily to provide information for use in probabilistic risk assessments (PRAs) that analyze nuclear power plant (NPP) operations. Given the original emphasis of these methods, it is understandable that many HRAs have not ventured far from NPP control room applications. Despite this historical focus on the control room, there has been growing interest and discussion regarding the application of HRA methods to other NPP activities such as spent fuel handling (SFH) or operations in different types of facilities. One recently developed HRA method, 'A Technique for Human Event Analysis' (ATHEANA) has been proposed as a promising candidate for diverse applications due to its particular approach for systematically uncovering the dynamic, contextual conditions influencing human performance. This paper describes one successful test of this proposition by presenting portions of a recently completed project in which a scoping study was performed to accomplish the following goals: (1) investigate what should be included in a qualitative human reliability analysis (HRA) for spent fuel and cask handling operations; and (2) demonstrate that the ATHEANA HRA technique can be usefully applied to these operations.

The preliminary, scoping qualitative HRA examined, in a generic manner, how human performance of SFH and dry cask storage operations (DCSOs) can plausibly lead to radiological consequences that impact the public and the environment. The study involved the performance of typical, qualitative HRA tasks such as collecting relevant information and the preliminary identification of human failure events or unsafe actions, relevant influences (e.g., performance shaping factors, other contextual factors), event scenario development and categorization of HFE scenario groupings. Information from relevant literature sources was augmented with subject matter expert interviews and analysis of an edited video of selected operations. Elements of NUREG-1792, *Good Practices for Implementing Human Reliability Analyses (HRA)* and NUREG-1624, Rev. 1, *Technical Basis and Implementation Guidelines for A Technique for Human Event Analysis (ATHEANA)* formed critical parts of the technical basis for the preliminary analysis. Misloading of spent fuel into a cask and dropping of a loaded cask were the two human failure event groupings of primary interest, although all human performance aspects of DCSOs were considered to some extent.

Of important note is that HRA is typically performed in the context of a plant-specific probabilistic risk assessment (PRA) study. This analysis was performed without benefit of the context provided by a larger PRA study, nor was it plant specific, and so it investigated only generic HRA issues relevant to SFH. However, the improved understanding of human performance issues provided by the study will likely enhance the ability to carry out a detailed qualitative HRA for a specific nuclear power plant (NPP) at some point in the future. Furthermore, support was obtained regarding the potential for applying ATHEANA beyond NPP settings. This paper provides a description of the process followed during the analysis, a description of the HFE scenario groupings, discussion regarding general human performance vulnerabilities, and a detailed examination of one HFE scenario developed in the study.