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SAFETY ASSESSMENT TOOL DEVELOPED FOR NUCLEAR FUEL HANDLING FACILITIES

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Many nations are investigating deep geologic repositories for permanent disposal of their spent nuclear fuel and high-level waste. The repository performance period consists of two periods: preclosure and postclosure. The preclosure period of geologic repository operations is the period before such a repository is permanently sealed and closed. During the preclosure period, waste is transferred from transportation casks to waste packages, prepared for disposal, and moved to its emplacement location. Although international research primarily focuses on postclosure repository performance, public and worker safety from facility operations during the preclosure period represent potential risks to workers and the public.

This paper presents a risk-informed performance-based approach for evaluating the risks that may be present during waste handling operations. This approach has been implemented in a computer code referred to as the Preclosure Safety Analysis (PCSA) Tool. The PCSA Tool can be used to conduct confirmatory independent analyses and perform regulatory reviews involving nuclear waste handling operations at a potential repository.

The Center for Nuclear Waste Regulatory Analyses developed the PCSA Tool for the Nuclear Regulatory Commission (NRC) to assess preclosure safety for the potential nuclear waste repository at Yucca Mountain, Nevada (Dasgupta et. al, 2003, Benke et al., 2004). The tool combines appropriate components of integrated safety analyses commonly used in the chemical industry (American Institute of Chemical Engineers, 1992) with probabilistic risk assessment techniques (NRC, 1983) used in evaluating nuclear power reactors. The tool incorporates capabilities of existing software, including: SAPHIRE, RSAC, and MELCOR. The tool is capable of (i) facilitating identification of potential hazards, including human errors; (ii) analyzing sequences of events that may result in radioactive dose to workers, the public, or both; (iii) facilitating identification/estimation of events and event sequences frequencies; (iv) calculating radiological consequences (for event sequences) to off-site members of the public, radiation workers, and other facility workers; (v) estimating system risk; and (vi) investigating dose-based importance measures.

The PCSA Tool may be used in either deterministic and probabilistic frequency and radiological dose evaluations. Recognizing that in many cases data used in safety assessments is uncertain, the tool has the capability to perform probabilistic calculations for system reliability assessment, event sequence frequency estimation, and off-site radiological dose. These probabilistic analyses provide valuable risk insights and may assist analysts and regulatory authorities in understanding the importance of systems and components.

An example application of the preclosure safety analysis methodology and its implementation through the use of the PCSA Tool is presented in this paper. The example is illustrative of the methodology for assessing nuclear waste handling operations at a potential geologic repository.

Acknowledgment

This is an independent product of the CNWRA and does not necessarily reflect the views or regulatory positions of the NRC. The NRC staff views expressed here are preliminary and do not represent a final judgment or determination of the matters addressed or of the acceptability of a license application for a geologic repository at Yucca Mountain.

References

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