BURNUP CREDIT APPROACH FOR THE PROPOSED UNITED STATES REPOSITORY AT YUCCA MOUNTAIN

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Abstract - The United States Department of Energy, Office of Civilian Radioactive Waste Management has submitted a license application for construction authorization of a deep, geologic repository at Yucca Mountain, Nevada. The license application is currently under review by the United State Nuclear Regulatory Commission. This paper will describe the methodology and approach used to address the issue of criticality and the role of burnup credit in the proposed repository at Yucca Mountain during the postclosure disposal time period. The most significant and effective measures for prevention of criticality in the repository include: multiple, redundant barriers that act to isolate the fissionable material from water (which can act as a moderator, corrosive agent, and transporter of fissile material); inherent geometry of the waste package internals and waste forms; presence of fixed neutron absorbers in the waste package internals; and fuel burnup for commercial SNF. A probabilistic approach has been used to screen criticality from the total system performance assessment. Within the probabilistic approach, criticality is considered an event, and the total probability of a criticality event during the disposal time period is calculated and compared against the regulatory criterion. The total probability of criticality includes contributions associated with both internal (within the waste package) and external (external to the waste package) criticality for each of the initiating events that could lead to waste package breach. The occurrence of and conditions necessary for criticality in the repository have been thoroughly evaluated using a comprehensive range of parameter distributions. A simplified design basis modeling approach has been used to evaluate the probability of criticality by using numerous significant and conservative assumptions. Burnup credit is only used for evaluations of in-package configurations, and uses a combination of conservative and bounding modeling approximations to ensure conservatism. This paper will review the United States Nuclear Regulatory Commission regulatory criteria relevant to postclosure criticality, explain the role of criticality within the overall repository performance assessment, describe the strategy for preventing criticality via design features and waste form properties, and discuss the numerous considerations relevant to criticality and burnup credit for spent fuel during disposal in a geologic repository, with emphasis on the burnup credit approach and analyses.

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