Potential Future Igneous Activity at Yucca Mountain, Nevada

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Location, timing, and volumes of post-Miocene volcanic activity, along with expert judgement, provide the basis for assessing the probability of future volcanism intersecting a proposed repository for nuclear waste at Yucca Mountain, Nevada. Analog studies of eruptive centers in the region that may represent the style and extent of possible future igneous activity at Yucca Mountain have aided in defining the consequence scenarios for intrusion into and eruption through a proposed repository. Modeling of magmatic processes related to magma/proposed repository interactions has been used to assess the potential consequences of a future igneous event through a proposed repository at Yucca Mountain. Results of work to date indicate future igneous activity in the Yucca Mountain region has a very low probability of intersecting the proposed repository. Probability of a future event intersecting a proposed repository at Yucca Mountain is approximately 1.7×10^{-8} per year. Since completion of the Probabilistic Volcanic Hazard Assessment (PVHA) in 1996, anomalies representing potential buried volcanic centers have been identified from aeromagnetic surveys. A re-assessment of the hazard is currently underway to evaluate the probability of intersection in light of new information and to estimate the probability of one or more volcanic conduits located in the proposed repository along a dike that intersects the proposed repository.

U.S. Nuclear Regulatory Commission regulations for siting and licensing a proposed repository require that the consequences of a disruptive event (igneous event) with annual probability greater than 1×10^{-8} be evaluated. Two consequence scenarios are considered; 1) igneous intrusion-groundwater transport case and 2) volcanic eruptive case. These scenarios equate to a dike or dike swarm intersecting repository drifts containing waste packages, formation of a conduit leading to a volcanic eruption through the repository that carries the contents of the waste packages into the atmosphere, deposition of a tephra sheet, and redistribution of the contaminated ash. In both cases radioactive material is released to the accessible environment either through groundwater transport or through the atmospheric dispersal and deposition.

Six Quaternary volcanic centers exist within 20 km of Yucca Mountain. Lathrop Wells cone (LWC), the youngest (approximately 75,000 yrs), is a well-preserved cinder cone with associated flows and tephra sheet that provides an excellent analogue for consequence studies related to future volcanism. Cone, lavas, hydrovolcanic ash, and ash-fall tephra have been examined to estimate eruptive volume and eruption type. LWC ejecta volumes suggest basaltic volcanism may be waning in the Yucca Mountain region.. The eruptive products indicate a sequence of initial fissure fountaining, early Strombolian ash and lapilli deposition forming the scoria cone, a brief hydrovolcanic pulse (possibly limited to the NW sector), and a violent Strombolian phase.

Mathematical models have been developed to represent magmatic processes and their consequences on proposed repository performance. These models address dike propagation, magma interaction and flow into drifts, eruption through the proposed repository, and post intrusion/eruption effects. These models continue to be refined to reduce the uncertainty associated with the consequences from a possible future igneous event.

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