Yucca Mountain Groundwater Protection Standards

Groundwater Protection Standards

The standards being used at Yucca Mountain are summarized below in order to indicate the possible sequence of events that could occur if a repository were sited in Wisconsin. The Yucca Mountain Nuclear Waste Repository adheres to the groundwater standards of the Safe Drinking Water Act of 1976. These enforceable standards are not to exceed the following maximum contaminant levels: radium-226 and radium-228, 5pCi/l; gross alpha particle activity, including radium-226 but not including radon and uranium, 15pCi/l, and beta and photon emitting radionuclides annual dose to the entire body or any one internal organ, less than 40mrem (Evaluation 1-14 – 1-15). These standards must be maintained for 10,000 years after closure of the repository.

Natural Barriers

One reason why Yucca Mountain was chosen as a high-level nuclear waste disposal site was mostly because its natural barriers withstand the 10,000 year limit. The major natural barrier is the geology and the lack of groundwater. Yucca Mountain is located in an arid climate with little precipitation, and the water table in this area is about 1000 feet below the surface; the repository would be located above the water table in the unsaturated zone. The unsaturated zone still contains water except that all pores in the rock matrix are not saturated with water. Water moves more slowly in the unsaturated zone and usually percolates down into the saturated zone. Early studies found that if the precipitation rate is about 15cm annually, only 0.1 to 0.5mm per year of water would

percolate through the tuff, consolidated volcanic ash, and reach the repository, which could be located 800-1000 feet above the water table. Sinnock's et. al. findings for the SCP (Site Characterization Plan) concluded that if infiltration were 0.5mm/year, a travel time through the unsaturated zone would be 9,345 years, so the lack of groundwater movement alone would practically fulfill the 10,000 year requirement. (Evaluation 3-4). The SCP concluded that,

> "...based on an upper-bound flux of .5mm/year, groundwater travel time within the unsaturated zone from the proposed repository to the water table is estimated to range from about 9,000 to 80,000 years, " and "...the minimum groundwater travel time from the edge of the repository to the accessible environment (5km) under present conditions is approximately 9,200 years, well in excess of the 1,000 year limits required by 10CFRPart 60.113(a)(2) (Evaluation 3-7)"

The 1,000 year limit in this quote refers to the lifetime of the engineered canister in which the nuclear waste will be encased. In Yucca Mountain, the natural barriers far exceed the lifetime of the engineered barriers. The Total Systems Performance Assessment Site Recommendation Report (TSPA-SR) concluded that "...groundwater concentrations are projected to be zero for the first 10,000 years."

On the other hand, peer assessment disagrees. Flint et al. (1996) concluded that infiltration rates were more on the magnitude of 1-10mm/year which increases the amount of water coming into contact with the repository (Evaluation 4-3). Other peer reviewers raised concerns that the travel time is higher than calculated, the dilution of radionuclide concentrations are less than predicted, and fractures allow for faster groundwater travel.

In addition to the limited amount of groundwater infiltration acting as a natural barrier, a major contributing factor to the limited groundwater supply is the Topopah

Spring member of the Paintbrush Tuff Formation. The Topopah Spring member of the Paintbrush Tuff, which is where the repository will be located, consists of a layer of welded tuff. The Paintbrush Tuff Formation consists of several layers of welded and nonwelded tuff. Welded tuff is found at ground surface and alternates with nonwelded tuff above and below the repository level. The welded tuff does not have many fractures; thus water cannot easily seep into the ground. Even in the nonwelded tuff where fractures are common, water tends to remain in the fractures rather than migrating. Also, this tuff contains zeolites, which have absorption characteristics and could absorb the radionuclides if they escaped from the engineered barriers around the waste and moved into the tuff fractures (OCRWM 2/ 24/2003).