YUCCA MOUNTAIN

NWTRB concludes waste corrosion is unlikely

Review board changes its mind about likelihood of corrosion developing on Yucca's waste containers.

LOCALIZED CORROSION IS unlikely to occur on the surface of spent fuel containers in the Yucca Mountain repository because conditions needed for such development would not exist, according to the Nuclear Waste Technical Review Board (NWTRB) in a July 28 letter to the Department of Energy.

The NWTRB reached its conclusion after a review of information presented during a meeting of scientists from the Department of Energy, the Nuclear Regulatory Commission, the Electric Power Research Institute, and the state of Nevada on May 18–19 in Washington, D.C. The conclusion reverses a previous judgment in 2003 by the NWTRB, which had found, as recounted in the July 28 letter, that "deliquescence-induced crevice corrosion would be likely to initiate during the higher-temperature period of the thermal pulse."

The letter noted that the NWTRB's previous conclusion had been based "particularly on corrosion tests conducted in an aqueous environment rich in calcium chloride. Test results showed clearly that corrosion would take place in that environment when temperatures ranged roughly between 140 °C and 160 °C. The results also suggested that the expected mitigating effect of the presence of nitrate ions might not be sufficient to inhibit the corrosion process fully."

Following an evaluation of that scenario by DOE and independent scientists, the letter said, "it appears unlikely that dusts that accumulate on waste package surfaces during the preclosure period would contain significant amounts of calcium chloride or that significant amounts of calcium chloride would evolve on waste package surfaces during the thermal pulse. Consequently, the calcium chloride-rich environment selected for corrosion tests does not appear representative of the conditions that can be expected on waste package surfaces in a Yucca Mountain repository. If calcium chloride is not present, calcium chloride-rich brines will not form by deliquescence, and crevice corrosion due to the presence of such brines in the temperature range of roughly 140 °C to 160 °C will not occur. Thus, the [NWTRB] concludes that deliquescence-induced localized corrosion during the higher-temperature period of the thermal pulse is unlikely."

The thermal pulse is the period of approximately 1000 years after closure of Yucca when temperatures in the repository's tunnels would be above the boiling point of water.

Yucca Mountain: Earlier conclusions based on calcium chloride–rich environment

The NWTRB further noted that corrosion tests should be carried out "both in environments that closely approximate the various conditions to which the waste package alloy will be exposed and in environments that reasonably bound those conditions. The extent to which the DOE has characterized accurately the likely waste package environments (i.e., temperature, relative humidity, and chemical species present) is unclear at this point."

Accurate characterization of probable waste package environments and the corrosion response of the waste package alloy to those environments would continue to be a major focus of the NWTRB's technical and scientific review, the letter said.

The letter, to Margaret Chu, director of the DOE's Office of Civilian Radioactive Waste Management, informed her that several corrosion issues requiring additional analysis were discussed at the May 2004 NWTRB meeting. The first issue, the letter said, regards the DOE's raising "the possibility that when temperatures in repository tunnels fall below boiling, localized corrosion could occur in concentrated sodium chloride solutions with low concentrations of inhibitors. The [NWTRB] believes that further investigation of the possibilities for localized corrosion at below-boiling temperatures is warranted and that such an investigation should focus on (1) possible mechanisms that might create environments that would facilitate localized corrosion and (2) the likelihood that such environments could exist."

Other issues the NWTRB determined as needing analysis include the presence of ammonium ion and the implications of its presence for corrosion or other performance aspects, and the possibility that nitrates could be aggressive corrodents in some circumstances.

The NWTRB's letter also touched on the following subjects:

■ *Integration:* DOE contractors have been performing high-temperature, high-chloride brine corrosion for several years, "presumably because it was thought that the test conditions might occur at Yucca Mountain or might reasonably bound actual conditions," the letter said. As was shown during presentations at the May 2004 meeting, however, "geochemical considerations preclude high-temperature, high-chloride brine conditions at Yucca Mountain, rendering the corrosion tests of limited relevance," it said. The situation, then, "underscores the need for thorough integration and close cooperation among diverse technical disciplines, particularly when 'coupled' processes are involved. For example, excellent integration

among geochemists and corrosion scientists/engineers was evident at the meeting and helped bring clarity to an extremely important corrosion issue. Continuing integration will be necessary for resolving other issues associated with the DOE's current repository design," the letter said.

■ *Hydrology and thermohydrology:* In its report from November 2003, the NWTRB indicated that it agreed with the DOE "that boiling during the thermal pulse and capillarity during and following the thermal pulse would significantly reduce the seepage of water into repository drifts but that the pervasiveness of these barriers throughout repository tunnels is not assured."

At the May 2004 meeting, according to the NWTRB, the DOE had presented descriptions of many field and computer investigations that form the basis for the agency's confidence in the effectiveness of vaporization and capillary barriers in its current repository design. In particular, the "DOE maintains that there would be no seepage during the period when repository rocks are above boiling and that seepage would be limited at lower temperatures," the letter said.

After reviewing the information presented at the May 2004 meeting, the NWTRB said it "continues to question the pervasiveness of vaporization and capillary barriers because of persistent uncertainties related to the expected repository tunnel environments. Examples of uncertainties include (1) the conceptual basis for the drift-scale thermohydrologic seepage analysis, including the axial convective transport of water vapor, air, and thermal energy in drifts; (2) the source of liquid water observed in the bulkheaded part of the cross drift; (3) the effects of drift degradation on the waste package environment; and (4) potentially unrealistic combinations of parameters used in the performance-assessment calculations of seepage."

■ *Seismic update:* In a June 2003 letter to Chu, the NWTRB indicated its concern about "what may be physically unrealizable estimates of very low-probability (annual probabilities of exceedance of 10^{-6} or less) seismic ground motion being calculated for Yucca Mountain by the DOE and its contractors." A new DOE program aimed at deriving more realistic estimates of seismic hazards "appears to be a thoughtful first step," according to the NWTRB. The new program is based on using the extent of fracturing observed in Yucca Mountain's tunnels to limit the ground motions that could have taken place at the site during the last 10 million years.

■ *Transportation planning:* The NWTRB said it looked forward to reviewing the DOE's detailed project plans regarding a transportation system for Yucca Mountain. The plan is to be reviewed at a meeting of the NWTRB's Panel on the Waste Management System, tentatively scheduled for October 13–14, in Salt Lake City, Utah. The NWTRB said it also would like to discuss aircraft hazard and public perceptions of transportation risk at the meeting.