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Effect of coupled processes driven by the radioactive decay heat on the performance of the proposed repository at Yucca Mountain

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Heat released by the radioactive decay of high-level waste sets in motion coupled thermal (T), hydrological (H), mechanical (M), and chemical (C) processes that impact the performance of the proposed geological repository in its ability to isolate waste. Understanding of the coupled THMC processes has been greatly advanced because of the extensive set of data from large scale *in situ* heater tests at the Yucca Mountain. Coupled-process modeling using the current design shows that temperature in the rock mass near an emplacement drift may rise above boiling for several thousand years, during which time water is prevented from entering the drifts (because of vaporization of the downward percolation flux). Direct observation of the presence of this vaporization barrier for water flux has yet to be verified in additional field tests. If confirmed, then the elevated temperature from decay heat reduces the likelihood of waste canister corrosion. Drying below the drift (from heating) also reduces the potential of radionuclides from being carried away in water from the drift. Modeling indicates that dissolution and precipitation of rock minerals at elevated temperature do not greatly alter the flow paths that lead to seepage water entering the waste emplacement drifts. This also needs to be verified by laboratory measurements. Coupled processes do not result in concentrating the chemistry of the water seeping into the drift to adversely impact the corrosion rates of waste canisters. Thermal-mechanical changes are small and tend to enhance diversion of water around an emplacement drift. All these considerations indicate that the decay heat has a beneficial effect on the performance of the proposed repository.