Hazard analyses for critical facilities such as high hazard hydro-dams and nuclear power plants, and other nuclear fuel cycle facilities are typically assessed against 1 in 10,000 year return period hazard parameters for events such as earthquake shaking, regional uplift, flood flows, tsunami inundation or fault displacement. Geological or earth process models that underpin these hazard assessments typically assume the future 10,000 years will be a continuation of earth processes occurring in the past. As requirements for geological storage of high level waste have evolved, the expectation that hazard models relevant for periods up to 1 million years, has emerged. Over these time scales the assumption that contemporary geological processes will continue indefinitely into the future cannot be assured because the driving forces resulting from plate tectonics and climate vary considerably. Thus, hazardous event frequency and magnitude may vary by much more than the uncertainty indicated by recent past rates. Thus, new approaches to future hazard evaluation that explicitly incorporates the evolution of plate movements and climate change, and what this might lead to in terms of future tectonic, volcanic, and climatic events and processes, are required. We illustrate a procedure that allows for the evolution of volcanic and tectonic processes in a probabilistic framework that lends itself to soliciting expert opinion and to quantitative time-varying spatial probability.