

Defining a baseline for the frequency of occurrences at underground natural gas storage facilities is critical to maintaining safe operation and to the development of appropriate risk management plans and regulatory approaches. Currently used frequency-estimation methods are reviewed and broadened in this article to include critical factors of cause, severity, and uncertainty that contribute to risk. A Bayesian probabilistic analysis characterizes the aleatoric historical occurrence frequencies given imperfect sampling. Frequencies for the three main storage facility types in the United States (depleted oil-and-gas field storage, aquifer storage, solution-mined salt cavern storage) are generally on the order of 3 to 9×10^{-2} occurrences, of all causes (surface, well integrity, subsurface integrity) and severities (nuisance, serious, catastrophic), per facility-year. Loss of well integrity is associated with many, but not all, occurrences either within the subsurface or from there up to the surface. The probability of one serious or catastrophic leakage occurrence to the ground surface within the next 10 years, assuming constant number of facilities, is approximately 0.1–0.3% for any facility type. Storage operators and industry regulators can use occurrence frequencies, their associated probabilities and uncertainties, and forecasts of severity magnitudes to better prioritize resources, establish a baseline against which progress toward achieving a reduction target could be measured, and develop more effective mitigation/monitoring/reduction programs in a risk management plan.