

from RCRA-C facilities across the nation; the most comprehensive approach would probably be to create a combined data set to ensure that the modeled sites reasonably address the range of potential waste disposal facilities subject to RCRA-C landfill requirements. We would expect to adopt a conservative approach to selecting model parameters, as described in more detail later. Additional sensitivity studies would be done to identify the variables that most prominently control disposal cell performance and exposures to the hypothetical receptor outside the facility.

We expect to address a variety of site characteristics and exposure scenarios in the analyses described below. These analyses will encompass a broad range of potential conditions from which waste concentrations could be derived for uniform waste acceptance criteria nationwide. It is possible that some hazardous waste landfills could dispose of waste containing higher concentrations of radionuclides than would be appropriate for the "average" facility while maintaining the appropriate level of protection for the public and environment. For example, waste acceptance criteria could be derived by explicitly examining site characteristics, such as annual precipitation levels. Alternatively, disposal facilities with unique features, such as very deep ground-water tables, may be able to safely contain wastes with higher radionuclide content than the levels defined in a broadly applicable standard. Therefore, we request comment on whether individual disposal facilities should be given the opportunity to demonstrate that they can accept waste with radionuclide concentrations that exceed those that would be established by such a standard.

The basic scenario to model would be an expected performance case, in which the disposal cell degrades over time and radionuclide releases from the bottom of the cell infiltrate the underlying unsaturated zone and move into the saturated zone. From that point, the ground-water flow in the saturated zone carries radionuclides laterally to a well supplying the water needs of a defined receptor (person) living near the former disposal cell. The modeling would allow us to calculate exposures to the receptor from direct ingestion of drinking water and ingestion of food produced using contaminated ground water from hypothetical wells. We could also examine the impact of volatile radionuclides, such as might be encountered during irrigation. These radionuclides can sometimes give

significant exposures through inhalation. However, we would expect ingestion exposures from various ground-water uses to be much higher than those from inhalation of volatile radionuclides.

We believe that the modeling approach should be appropriately conservative. By "conservative," we mean that we would select modeling parameters so that releases from the disposal cell are more likely to be over-estimated than under-estimated. This approach helps to account for uncertainty by incorporating an additional margin of safety. However, it would not be appropriate to be overly conservative. Focusing on "worst case" conditions leads to reliance on unrealistic modeling results. Major areas of conservatism could include:

- The distance from the disposal cell to the receptor well could be assumed to be short—
  - Prevents expected dilution of the contamination plume with larger volumes of "clean" ground water
  - Less radionuclide retardation by soils along ground-water flow path
  - Institutional control over site may prevent a well close to the disposal cell
- Early detection of radionuclide release could trigger facility closure and corrective action
  - Radionuclide retardation parameters could be selected for less retardation and faster transport
  - Disposal facility cap and liner could be assumed to fail sooner than normally anticipated after facility closure
- Cap and liner designed to exceed RCRA 30-year post-closure monitoring period
- Assumption of failure introduces infiltration and flow through disposal cell earlier than normal, when radionuclide inventories are highest.

As stated above, a primary purpose of modeling the long-term performance of the RCRA-C disposal cell would be to derive radionuclide concentrations in wastes that would assure that exposures from any disposal cell releases would be at acceptably low levels to support a simpler NRC regulatory process for the disposal of low-activity radioactive waste at RCRA-permitted hazardous waste landfills. We expect that modeling will show that some radionuclides reach the receptor well within the modeling period. For these radionuclides, waste concentration limits would likely be calculated by simply scaling the exposures calculated in the modeling exercise to the acceptable level of protection (we request comment on the appropriate

level of protection to consider for this approach in section II.D.5). These limits would function as waste concentration limits for implementing the RCRA-C disposal option. Wastes with radionuclide concentrations higher than established in the rule would not be eligible for disposal in the RCRA-C disposal cell, although consideration could be given to including in the rule specific additional conditions that would permit such disposal (essentially, a "graded" approach in which more extensive radiation protection measures are applied as radionuclide concentrations increase). Another alternative would be to allow a disposal facility to petition to have higher waste concentration limits based upon the results of site-specific performance assessments. However, this would make it more difficult for NRC to pursue a simplified regulatory approach.

ii. "Wet" and "Dry" Sites. We believe that using a conservative modeling approach will incorporate a significant margin of safety sufficient to compensate for any uncertainties in the eventual performance of the RCRA-C disposal design. Assessing just how significant the margin of safety will be depends on how waste radionuclide concentrations will be applied to disposal facilities. We see two basic approaches, discussed generally below. We request comment on these and other potential approaches.

The first option ("Option 1") would be to have all disposal facilities use the same waste concentration limits regardless of the projected disposal cell performance. Experience tells us we would expect to see significant variation in performance under the wide range of climatic and hydrogeologic conditions that we model. Essentially, Option 1 imposes the concentration limits determined for the worst case disposal cell we would model on all potential disposal sites, regardless of the relative merits of any particular site conditions. Option 1 would thus add an additional level of conservatism to an already conservative approach. This approach has the potential to significantly decrease the usefulness of the rule by placing additional limitations on the waste streams addressed by our proposal (*i.e.*, waste concentration limits based on a "worst case" situation). An advantage of Option 1 is that it is simple to implement, in the sense that no variations in the waste concentration limits would be permitted.

Option 2 would allow different concentration limits to be used depending on the projected performance of the disposal facility. For example,