

ensure that the level of protection is achieved.

The nature of the waste can also affect the time needed for the hazard to diminish. RCRA establishes a minimum period of 30 years for facility maintenance and monitoring after closure of the disposal cell (with extensions as necessary to protect human health and the environment). NRC assumes a minimum period of 100 years for active maintenance, with control of the site continuing for an indefinite period before license termination because of the variety and concentration of radionuclides that could be disposed at such a site. Performance assessments conducted to meet 10 CFR part 61 licensing requirements include projections well beyond both the 30- and 100-year active institutional control periods.

The environment in the disposal cell (e.g., pH, temperature, moisture) can affect the decomposition of many hazardous constituents (primarily organics, as many heavy metals persist essentially forever). Radionuclides, however, break down more predictably than do hazardous constituents. A radionuclide remains radioactive, and will take the same time to decay, regardless of its physical and chemical environment. Because some radionuclides take hundreds or thousands of years to decay, under the AEA, facilities are not expected to maintain perfect containment for these long periods until the waste is no longer radioactive. In fact, evaluations of AEA facilities typically include situations in which the disposal system does not perform as well as expected, with resulting limited releases. These projected limited releases become the basis for performance assessments used to make compliance or licensing decisions. Under NRC regulation, the combination of engineered barriers, waste form requirements, and natural site characteristics are evaluated to assure that the concentration of radionuclides reaching the accessible environment does not exceed regulatory limits. Although AEA regulatory practice focuses on preventing infiltration, if the cell cover degrades it is preferable for infiltrating water to move quickly out of the disposal cell in order to minimize contact time with the waste (avoiding a "bathtub" situation). Thus, this approach of recognizing the potential for limited releases delays and spreads out the releases over time and minimizes peak doses. In practice, many long-lived radionuclides will not move with ground water, but will remain within the general area of disposal because of their chemical

characteristics. (Assumptions and knowledge about the mobility of individual elements in various environments influence the selection of modeling parameters. Typically, conservatism is introduced into performance assessments to help account for uncertainties in long-term modeling. It should also be noted that the behavior of a particular element in the environment will be essentially the same whether it is radioactive or not.) In this vein, NRC regulations expect the evaluation of a potential disposal site for "at least a 500 year time frame" while also considering the "indefinite future."<sup>10</sup>

There are several fundamental issues to be considered in determining the feasibility of an approach involving simplified NRC oversight for RCRA-C facilities, particularly where NRC requirements are more extensive than RCRA requirements. Areas of overlap in which one regulatory regime would take primacy also are important. These issues include:

- *Post-Closure Care*: Should operators be required to maintain the facility for periods longer than the minimum 30 years required by RCRA? (RCRA has discretion to extend this period, and some States have done so.) What about for 100 years, with the expectation of longer site control, as NRC requires?

- *Land Ownership*: RCRA allows private ownership of disposal sites, with the possibility of future sale. NRC licensing under 10 CFR part 61 is contingent on eventual ownership of the site by a Federal or State government entity.

- *Financial Assurance*: AEA disposal facilities generally put up a higher initial financial assurance than RCRA facilities to account for longer periods of care.

- *Ground-Water Monitoring and Corrective Action*: If there are releases of hazardous constituents, RCRA authorizes corrective action (corrective action for hazardous constituents might be effective for AEA materials combined with the hazardous constituents). RCRA regulations have specific requirements for ground-water monitoring of hazardous constituents (40 CFR 264.92–94), which are incorporated into the facility permit. While NRC regulations have general requirements for site monitoring "capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary" (10 CFR 61.53), they do not contain separate ground-water standards. Detailed monitoring

requirements may be developed in the facility license.

This ANPR addresses the possibility of alternate disposal methods for LARW. We will work with NRC to develop appropriate concentration limits that are protective of the general public and that minimize the need for additional NRC requirements. However, NRC may decide that additional requirements on generators or disposal facilities are necessary for NRC to meet its obligations under the AEA. We request comment on these issues.

#### *D. What Methods Could Be Used To Assess the Risk of Disposing of LAMW?*

##### *1. Modeling as a Basis for Establishing Risk or Dose Basis*

Mathematical modeling is a fundamental tool of radioactive waste management. It assists regulators in assessing expected releases (and subsequent doses) to the environment from disposal facilities over periods of hundreds to thousands of years. However, these projections over time should not be viewed as firm predictions. Instead, they can give regulators and the public confidence that certain limits will not be exceeded. Actual "proof" of performance would involve active measures such as facility monitoring.

##### *2. Comparison of Risks From Radioactive and Hazardous Waste Disposal*

The public may not have a good understanding of the relative risks from radiation and hazardous waste. It is probably true that many people would consider radioactive waste to be more of a danger than hazardous waste. It is important that the public be informed of the risks involved in our approach and be satisfied that those risks are managed appropriately. We have included a general discussion of risks from both types of waste below.

The risk from radioactive material depends on the type of radiation emitted and the path(s) of exposure. Gamma radiation is most significant for external exposures. Alpha emissions are of most concern for inhalation. NRC requirements for land disposal typically put limits on radiation doses to the public. Dose can be converted to risk, although risk can also be calculated directly from exposures; the results tend to differ for the two methods, and dose itself can be expressed in several ways that may not be equivalent (a more detailed discussion of various dose standards is located in section II.D.5). As discussed above, facilities seeking an NRC radioactive waste disposal license

<sup>10</sup> 10 CFR 61.7(a).