

which is designated the *postclosure controlled area*, within which DOE is to exercise specified controls to prevent adverse human actions following permanent closure. The location of the controlled area is the *site*. The *accessible environment* is the atmosphere, land surface, surface water, oceans, and the portion of the lithosphere that is outside the controlled area. There is an area, designated the *geologic setting*, which includes the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located. The geologic repository operations area plus the portion of the geologic setting that provides isolation of the radioactive waste make up the *geologic repository*.

(d) *Stages in the licensing process.* There are several stages in the licensing process. The *site characterization* stage, though begun before submission of a license application, may result in consequences requiring evaluation in the license review. The *construction stage* would follow, after issuance of a construction authorization. A *period of operations* follows the issuance of a license by the Commission. The period of operations includes the time during which *emplacement* of wastes occurs; any subsequent period before permanent closure during which the emplaced wastes are *retrievable*; and *permanent closure*, which includes sealing of shafts. Permanent closure represents the end of active human intervention with respect to the engineered barrier system.

(e) *Isolation of waste.* (1) During the first several hundred years following permanent closure of a geologic repository, when radiation and thermal levels are high and the uncertainties in assessing repository performance are large, special emphasis is placed upon the ability to contain the wastes by waste packages within an *engineered barrier system*. This is known as the *containment period*. The *engineered barrier system* includes the waste packages and the underground facility. A *waste package* is composed of the waste form and any containers, shielding, packing, and absorbent materials immediately surrounding an individual waste container. The *underground facility* means

the underground structure, including openings and backfill materials, but excluding, shafts, boreholes, and their seals.

(2) Following the containment period special emphasis is placed upon the ability to achieve isolation of the wastes by virtue of the characteristics of the geologic repository. The engineered barrier system works to control the release of radioactive material to the geologic setting and the geologic setting works to control the release of radioactive material to the accessible environment. *Isolation* means inhibiting the transport of radioactive material so that amounts and concentrations of the materials entering the accessible environment will be kept within prescribed limits.

[48 FR 28222, June 21, 1983, as amended at 61 FR 64268, Dec. 4, 1996]

PERFORMANCE OBJECTIVES

§ 60.111 Performance of the geologic repository operations area through permanent closure.

(a) *Protection against radiation exposures and releases of radioactive material.* The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will be maintained within the limits specified in part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.

(b) *Retrievability of waste.* (1) The geologic repository operations area shall be designed to preserve the option of waste retrieval throughout the period during which wastes are being emplaced and, thereafter, until the completion of a performance confirmation program and Commission review of the information obtained from such a program. To satisfy this objective, the geologic repository operations area shall be designed so that any or all of the emplaced waste could be retrieved on a reasonable schedule starting at any time up to 50 years after waste emplacement operations are initiated, unless a different time period is approved

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or specified by the Commission. This different time period may be established on a case-by-case basis consistent with the emplacement schedule and the planned performance confirmation program.

(2) This requirement shall not preclude decisions by the Commission to allow backfilling part or all of, or permanent closure of, the geologic repository operations area prior to the end of the period of design for retrievability.

(3) For purposes of this paragraph, a reasonable schedule for retrieval is one that would permit retrieval in about the same time as that devoted to construction of the geologic repository operations area and the emplacement of wastes.

[48 FR 28222, June 21, 1983, as amended at 61 FR 64268, Dec. 4, 1996; 62 FR 59276, Nov. 3, 1997]

§ 60.112 Overall system performance objective for the geologic repository after permanent closure.

The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events.

§ 60.113 Performance of particular barriers after permanent closure.

(a) *General provisions*—(1) *Engineered barrier system.* (i) The engineered barrier system shall be designed so that assuming anticipated processes and events: (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay; and (B) any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times. For disposal in the saturated zone, both the partial and complete filling with groundwater of available

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void spaces in the underground facility shall be appropriately considered and analysed among the anticipated processes and events in designing the engineered barrier system.

(ii) In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated processes and events, so that:

(A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in § 60.113(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository; and

(B) The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

(2) *Geologic setting.* The geologic repository shall be located so that pre-waste-emplacment groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1,000 years or such other travel time as may be approved or specified by the Commission.

(b) On a case-by-case basis, the Commission may approve or specify some other radionuclide release rate, designed containment period or pre-waste-emplacment groundwater travel time, provided that the overall system performance objective, as it relates to anticipated processes and events, is satisfied. Among the factors that the Commission may take into account are: