

or in the sealing of boreholes and shafts.

(21) Geomechanical properties that do not permit design of underground opening that will remain stable through permanent closure.

(22) Potential for the water table to rise sufficiently so as to cause saturation of an underground facility located in the unsaturated zone.

(23) Potential for existing or future perched water bodies that may saturate portions of the underground facility or provide a faster flow path from an underground facility located in the unsaturated zone to the accessible environment.

(24) Potential for the movement of radionuclides in a gaseous state through air-filled pore spaces of an unsaturated geologic medium to the accessible environment.

[48 FR 28222, June 21, 1983, as amended at 50 FR 29647, July 22, 1985; 61 FR 64269, Dec. 4, 1996]

DESIGN CRITERIA FOR THE GEOLOGIC REPOSITORY OPERATIONS AREA

§ 60.130 General considerations.

(a) Pursuant to the provisions of § 60.21(c)(2)(i), an application for construction authorization for a high-level radioactive waste repository at a geologic repository operations area, and an application for a license to receive, possess, store, and dispose of high-level radioactive waste in the geologic repository operations area, must include the principal design criteria for a proposed facility. The principal design criteria establish the necessary design, fabrication, construction, testing, maintenance, and performance requirements for structures, systems, and components important to safety and/or important to waste isolation. Sections 60.131 through 60.134 specify minimum requirements for the principal design criteria for the geologic repository operations area.

(b) These design criteria are not intended to be exhaustive. However, omissions in §§ 60.131 through 60.134 do not relieve DOE from any obligation to provide such features in a specific facility needed to achieve the performance objectives.

[69 FR 2280, Jan. 14, 2004]

§ 60.131 General design criteria for the geologic repository operations area.

(a) *Radiological protection.* The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in part 20 of this chapter. Design shall include:

(1) Means to limit concentrations of radioactive material in air;

(2) Means to limit the time required to perform work in the vicinity of radioactive materials, including, as appropriate, designing equipment for ease of repair and replacement and providing adequate space for ease of operation;

(3) Suitable shielding;

(4) Means to monitor and control the dispersal of radioactive contamination;

(5) Means to control access to high radiation areas or airborne radioactivity areas; and

(6) A radiation alarm system to warn of significant increases in radiation levels, concentrations of radioactive material in air, and of increased radioactivity released in effluents. The alarm system shall be designed with provisions for calibration and for testing its operability.

(b) *Protection against design basis events.* The structures, systems, and components important to safety shall be designed so that they will perform their necessary safety functions, assuming occurrence of design basis events.

(c) *Protection against dynamic effects of equipment failure and similar events.* The structures, systems, and components important to safety shall be designed to withstand dynamic effects such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.

(d) *Protection against fires and explosions.* (1) The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area.

(2) To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of

noncombustible and heat resistant materials.

(3) The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety.

(4) The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems.

(e) *Emergency capability.* (1) The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste and radioactive effluents, and permit prompt termination of operations and evacuation of personnel during an emergency.

(2) The geologic repository operations area shall be designed to include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical, and ambulance service) that may aid in recovery from emergencies.

(f) *Utility services.* (1) Each utility service system that is important to safety shall be designed so that essential safety functions can be performed, assuming occurrence of the design basis events.

(2) The utility services important to safety shall include redundant systems to the extent necessary to maintain, with adequate capacity, the ability to perform their safety functions.

(3) Provisions shall be made so that, if there is a loss of the primary electric power source or circuit, reliable and timely emergency power can be provided to instruments, utility service systems, and operating systems, including alarm systems, important to safety.

(g) *Inspection, testing, and maintenance.* The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as nec-

essary, to ensure their continued functioning and readiness.

(h) *Criticality control.* All systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of radioactive waste shall be designed to ensure that nuclear criticality is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each system must be designed for criticality safety assuming occurrence of design basis events. The calculated effective multiplication factor (k_{eff}) must be sufficiently below unity to show at least a 5 percent margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

(i) *Instrumentation and control systems.* The design shall include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety, assuming occurrence of design basis events.

(j) *Compliance with mining regulations.* To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations area, the design of the geologic repository operations area shall nevertheless include provisions for worker protection necessary to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions. Any deviation from relevant design requirements in 30 CFR, chapter I, subchapters D, E, and N will give rise to a rebuttable presumption that this requirement has not been met.

(k) *Shaft conveyances used in radioactive waste handling.* (1) Hoists important to safety shall be designed to preclude cage free fall.

(2) Hoists important to safety shall be designed with a reliable cage location system.

(3) Loading and unloading systems for hoists important to safety shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

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(4) Hoists important to safety shall be designed to include two independent indicators to indicate when waste packages are in place and ready for transfer.

[48 FR 28222, June 21, 1983, as amended at 61 FR 64269, Dec. 4, 1996]

§ 60.132 Additional design criteria for surface facilities in the geologic repository operations area.

(a) *Facilities for receipt and retrieval of waste.* Surface facilities in the geologic repository operations area shall be designed to allow safe handling and storage of wastes at the geologic repository operations area, whether these wastes are on the surface before emplacement or as a result of retrieval from the underground facility.

(b) *Surface facility ventilation.* Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, or packaging shall be designed to provide protection against radiation exposures and offsite releases as provided in § 60.111(a).

(c) *Radiation control and monitoring—*
(1) *Effluent control.* The surface facilities shall be designed to control the release of radioactive materials in effluents during Category 1 design basis events so as to meet the performance objectives of § 60.111(a).

(2) *Effluent monitoring.* The effluent monitoring systems shall be designed to measure the amount and concentration of radionuclides in any effluent with sufficient precision to determine whether releases conform to the design requirement for effluent control. The monitoring systems shall be designed to include alarms that can be periodically tested.

(d) *Waste treatment.* Radioactive waste treatment facilities shall be designed to process any radioactive wastes generated at the geologic repository operations area into a form suitable to permit safe disposal at the geologic repository operations area or to permit safe transportation and conversion to a form suitable for disposal at an alternative site in accordance with any regulations that are applicable.

(e) *Consideration of decommissioning.* The surface facility shall be designed to facilitate decontamination or dismantlement to the same extent as

would be required, under other parts of this chapter, with respect to equivalent activities licensed thereunder.

[48 FR 28222, June 21, 1983, as amended at 61 FR 64270, Dec. 4, 1996]

§ 60.133 Additional design criteria for the underground facility.

(a) *General criteria for the underground facility.* (1) The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides.

(2) The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility.

(b) *Flexibility of design.* The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

(c) *Retrieval of waste.* The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of § 60.111.

(d) *Control of water and gas.* The design of the underground facility shall provide for control of water or gas intrusion.

(e) *Underground openings.* (1) Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained.

(2) Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

(f) *Rock excavation.* The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

(g) *Underground facility ventilation.* The ventilation system shall be designed to: