Part 531 – Geology

Subpart B – Geologic Investigation of Specific Geologic Hazards

531.20 Structures With Permanent Storage

A. For dams designed for permanent storage, undisturbed samples for consolidation tests must be obtained of all compressible, fine-grained materials occurring under the foundation within a depth equivalent to the maximum height of the dam, as measured from low point on centerline. If compressible materials are suspected to occur at greater depths, the drilling and sampling must extend to depths within the zone of influence.

B. Samples for compaction and shear tests must be obtained from the borrow areas and auxiliary spillway areas.

C. Potential effects, including damages, of seepage from a reservoir on lands adjacent to or downstream from the structure must be evaluated.

531.21 Dams Subject to Deep Subsidence

A. A geologist must determine whether sinkholes, solution cavities, underground mine collapse, or the removal of fluids such as petroleum, water, and natural gas could impact the design, function, and safety of the dams, particularly by abrupt differential settlement. The geologist must provide recommendations to the design engineer on identified geologic concerns that need to be addressed in the operations and management plan for the structure.

B. Subordination of mineral rights within a limited area at the site does not necessarily prevent subsidence of the structure. If studies indicate that the predicted subsidence cannot be remedied, the site must be abandoned.

531.22 Dams Underlain by Economic Mineral Deposits

A. The geologist must identify and any economic mineral deposits underlying the dam site that might be mined in the future. Geologic investigation must encompass an area that extends outward beyond the base of the dam, a horizontal distance equivalent to the depth of the deepest mineral deposit below ground surface. This requirement may be modified as a result of a detailed, site-specific study by, and at the consequent recommendation of, a qualified mining engineer.

B. Results of the investigation may be used to recommend measures to—

(1) Prevent the development or removal of such minerals from unmined areas in order to prevent subsidence of the structure.
(2) Preserve or build and maintain adequate support to ensure against future subsidence of the structure foundation for mined areas.

531.23 Auxiliary Earth Spillways

A. For all dams that designed with an auxiliary earth spillway, the geologist must provide specific geologic information to the design engineer for the stability analysis and integrity analysis of auxiliary spillways, as explained in 210-NEH, Part 628, Chapter 50, “Earth Spillway Design,” and Chapter 51, “Earth Spillway Erosion Model, SITES Program.”

B. All earth materials occurring beneath the spillway down to the elevation of the floodplain must be mapped by the headcut erodibility index, K_h in accordance with 210-NEH, Part 628, Chapter 52, and with 210-NEH, Part 631, Chapter 4. The investigation must be sufficiently detailed to provide all input parameters for the index, and must include a plan view map and longitudinal sections. The investigating geologist and responsible engineer must jointly determine the engineering significance of all material that has a K_h less than or equal to 10.

531.24 Investigation of Seismic Hazards

A. Evaluation of seismic hazards must comply with local, State, and Federal laws and regulations. For non-Federal dams, the State dam safety office must be consulted to determine seismic hazard evaluation requirements.

B. Geologic investigations of faults must document the existence or absence of faults at the site that are classified as Holocene-active, with evidence of fault rupture within the past 12,000 years, or conditionally active, with evidence of Quaternary fault rupture during the last 35,000 years but without a history of displacement. Dams may not be located on Holocene-active faults without the concurrence of the Director, Conservation Engineering Division (CED). High-hazard dams with permanent storage may not be located on conditionally active faults without specific design features that address potential fault movement.

C Earthquake Loading.—Earthquake loading must be evaluated for all dams in accordance with requirements in 210-NEH, Part 631, Chapter 2, Section 631.0207. If a field seismic evaluation is required, the geologist and responsible engineer must jointly determine sampling, testing, and other data requirements for a detailed earthquake loading analysis. The method and scope of the seismic evaluation and analysis must address regional seismic hazards, the potential consequences of dam failure, and other site-specific characteristics that could influence pool functions.

D For Group-A structures, a site-specific seismotectonic study must be conducted in accordance with the Federal Guidelines for Dam Safety. Earthquake analysis and design of dams must be performed as allowed by State or local laws.

531.25 Liquefaction Potential

A. For dam sites where additional seismic evaluation is required based on criteria set forth in 210-NEH, Part 631, Chapter 2, Section 631.0207, or as required by State or local law, a preliminary geotechnical assessment must be conducted by the geologist in consultation with the geotechnical engineer, design engineer, or both, to support an engineering analysis of liquefaction potential. The investigation must—

(1) Determine whether liquefaction has occurred during historical earthquakes.
(2) Determine whether poorly compacted fills containing liquefaction-susceptible materials are saturated, moist, or may become saturated.
(3) Identify and evaluate any unconsolidated sediments in active depositional environments where the highest anticipated groundwater level is less than 40 feet from the ground surface and the anticipated earthquake probable ground acceleration (PGA) that has a 10-percent probability of being exceeded in 50 years is greater than 0.1g.
(4) Identify and evaluate moderately consolidated Holocene-age sediments in inactive depositional environments, such as terraces, where the highest anticipated groundwater is less than 30 feet from the ground surface, and the 10-percent-per-50-year PGA is greater than 0.2g.

(5) Identify and evaluate Late Pleistocene-age deposits that are approximately 15,000 to 12,000 years old, where the highest anticipated groundwater level is less than 20 feet from the ground surface and the 10-percent-per-50-year PGA is greater than 0.3g.

B. For geotechnical field testing of liquefaction potential, the standard penetration test (SPT) is the preferred method. If other field tests are used, they must be calibrated with SPT measurements taken from the project site.