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FOREWORD

For earth structures, it is recognized that the use of nominal material parameters and design assumption alone is often inadequate. Coupled with these should be site verification of design assumptions and materials parameters, evaluation of the interrelationship between construction methods and analytical treatment, and verification testing (to assure compliance with project specifications based on the design and monitoring of the earth structures—both during and subsequent to construction). Because of the need for continuity from design and analysis through actual construction, Section 7.0 (which deals with inspection, instrumentation and monitoring) is included in this standard, although the standard itself is primarily concerned with design and analysis.

Sampling, testing and interpretation of data, appropriate recognition of results and their limitations, and recognition of the interrelationship of the many sets of data; characteristics and other parameters are crucial to the proper performance of the design and construction discussed in this standard.

It is for these reasons that responsibility for the design and construction of safety-related earth structures rest only with engineers who are experienced in one or more of the various phases of earth structures design and construction (including soil and rock mechanics, geology, field sampling, laboratory testing, analytical methods, specifications, construction control and instrumentation). Such engineers shall also have adequate understanding of the hydrological aspects of impoundments, fluid motion effects and of seismological inputs to the site.

This standard includes administrative requirements dealing with responsibilities and peer review, as well as scope, in Section 1.0. Section 2.0 includes a reasonable breadth of definitions to make the standard usable for individuals knowledgeable in the geotechnical and foundation design field.

Site investigations cannot in themselves be standardized with regard to application to a particular project because of the wide range in soil and rock conditions that exist in nature, and the innumerable design alternatives that are typically present for the design of earth structures. Therefore, informative references have been included in Section 3.0 on Site Investigation, with additional pertinent references in specific sections of the standard.

The essential elements of the standard are:

(1) Section 4.0 covers earth structures used to form the ultimate heat sink (reservoirs) including dams, dikes, and baffles;

(2) Section 5.0 covers earth structures normally used to protect the nuclear plant site from extreme hydrodynamic loads including dams, dikes, breakwaters, seawalls, and revetments;

(3) Section 6.0 covers earth structures used to maintain site contours, the stability of natural and cut slopes, fills and retaining walls.

Section 7.0, Inspection and Monitoring, relates to unique problems associated with geotechnical site conditions and construction necessitating a close relationship between geotechnical studies and design, construction aspects and related monitoring, and onsite verification of actual conditions encountered with regard to original studies and design assumption. Because variability of geotechnical conditions from point to point on a site is expected, the geotechnical study cannot be completed until the project is completed, with monitoring providing additional design verification.

Earth structures involve unique construction processes for each project. And soil conditions present a contrast to many elements of nuclear power plants that are manufactured (and can be held to narrow limits of variability and tested for approval within those limits). This prevents, in this standard, use of restrictive or defini-

tive requirements that might be entirely feasible for other aspects of nuclear power plant construction.

Natural soil and rock conditions are subject to considerable variability. This element is not typical of the kind of structural problems inherent to nuclear power plants. Such natural variability must be recognized. There are also numerous analytical procedures available, some of which may be particularly applicable to particular soil or foundation conditions while not applicable to others. For these reasons, Section 1.2.3 on Peer Review is incorporated with this standard. It is recommended as the process most likely to minimize major problems and at the same time minimize overdesign.

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N-725 GUIDELINE FOR DESIGN AND ANALYSIS OF NUCLEAR SAFETY RELATED EARTH STRUCTURES

1.0 Purpose, Scope and Administrative Requirements

1.1 Purpose and Scope. The purpose of this standard is to describe parameters and present guidelines and criteria to be used in construction of those earth structures forming part of the ultimate heat sink or act to protect nuclear power plant sites from flood, storm surge or other types of natural or manmade extreme load phenomena. Such structures are identified as safety related (Seismic Category I[1]) structures. Also included are earth structures required to maintain finished grade and ground contours at nuclear power plant sites.

Construction includes all administrative, quality assurance and regulatory requirements, material selection, design, installation, examination and monitoring associated with the safety related earth structures. Included in this standard are requirements for earth dams, dikes, baffles, breakwaters, seawalls, revetments, cut and natural slopes, retaining walls, and compacted fills, whether of natural or cement stabilized materials. It includes identification of design margins of safety.

1.2 Administrative Requirements

1.2.1 Responsibilities. The Owner shall prepare a Design Specification for earth structures which shall define the basis of design and other applicable criteria. The Design Specification shall include the following:

(1) the function and boundaries of the earth structure
(2) the specific load requirements (including load combination) to be considered in design of the earth structure
(3) behavior and operational requirements for the earth structure
(4) the design life
(5) acceptance testing requirements (if any)
(6) monitoring and construction process review required of the Geotechnical Engineer.

The Geotechnical Engineer shall have the responsibility of preparing the Construction Specification as described in Section 7.3. In accordance with the scope of this standard, several of the above activities are discussed herein as they pertain to the construction of nuclear safety-related earth structures.

1.2.2 Quality Assurance. Quality Assurance programs that comply with the Code of Federal Regulations 10 CFR 50, Appendix B,[1] shall be established with regard to all elements in the design and construction of safety related earth structures of nuclear power plants. The design, inspection, and review services performed by the owner or his agent do not relieve a contractor of the responsibility for performing the work in accordance with the criteria, plans and specifications and applicable regulatory requirements. Each contractor shall retain responsibility for the quality control of his own services and workmanship.

1.2.3 Peer Review

1.2.3.1 Initiation of Review. Independent reviews shall be conducted by the Owner to provide assurance that the quality of safety related earth structures is in accordance with the standards of the profession, that objectives of the work are met and the safety of the public is provided for. The owner should select one or more peer reviewers and define the depth of the review.

1.2.3.2 Qualification of Reviewer. Peer reviewers shall possess the technical qualifications, practical experience, and professional judgment required of the work to be reviewed.

1.2.3.3 Review Requirements. Peer review shall include a critical independent assessment of the validity of the following items as used in the development of the design:

(1) design basis loads
(2) material properties
(3) design concepts
(4) methods of analysis
(5) safety factors.