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American National Standard Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)

Secretariat
American Nuclear Society

Prepared by the
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American National Standard

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Foreword

(This Foreword is not a part of American National Standard Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type), ANSI/ANS-57.7-1988.)

This standard provides criteria for the design of a water basin Independent Spent Fuel Storage Installation (ISFSI) for Light Water Reactor (LWR) spent fuel. It sets forth performance and design requirements as well as general guidelines which will assist in both design and licensing efforts. The standard also presents interface requirements in the event the installation is located at an existing nuclear facility.

ISFSIs represent a new step in the nuclear fuel cycle. This new or additional step is required in order for the industry to develop and analyze alternate methods and approaches to the back-end of the fuel cycle.

An ISFSI could be substantially larger than any existing spent fuel storage facility associated with either a nuclear power plant or a fuel reprocessing plant.

An ISFSI would function solely in a protective custodial capacity, providing stable safe storage conditions pending some future disposition of the spent fuel. The stored spent fuel would be maintained in a quiescent state by the activities conducted at an ISFSI. This does not preclude mechanical handling activities related to fuel storage, such as the canning of damaged fuel assemblies and rod consolidation. Such activities do not involve the exposure of the fuel itself to the storage environment other than that resulting from defective fuel cladding.

While the spent fuel is in passive storage, decay heat and the modest pressure within the fuel rods would be the only driving forces for dispersal offsite of the radionuclides contained in the spent fuel. To minimize even these forces, the spent fuel is kept under water for at least a year after discharge from a reactor before being transferred to an ISFSI. The shielding requirements for personnel occupancy of the storage area assure a depth of water over the stored fuel which also contributes to heat storage capability. The design requirements set forth in the standard are based on the principals of maintaining occupational exposure ALARA.

The provisions of this standard are based on the assumption that the storage pools would be operated with their water level required for in-storage radiation shielding being at or below grade.

The heat storage capability of the storage pool would allow adequate time to take corrective action in case of a breakdown of the cooling system. In the event of an earthquake or other extreme natural phenomena, sufficient makeup water will be available to maintain safe storage conditions.

In general, the safe storage of spent fuel assemblies is achieved by maintaining the integrity of the fuel cladding. Fuel cladding is designed to withstand a far more severe environment in a reactor than in storage in an ISFSI. Under the low temperature conditions of static storage, the cladding will provide an effective primary barrier to the escape of fission products and fissile materials from the stored fuel. The pool water will be an effective secondary barrier for the confinement of the small amounts of radioactive materials that may be released from the spent fuel.

A section is provided which identifies interface considerations for shared systems and facilities for situations where the installation is located at or near an existing nuclear facility. Appendices are provided for informational and clarification purposes. The appendices are not part of the mandatory criteria of the standard. Use of the appendices by the designer is optional.

It should be noted that although American National Standard Criteria for Nuclear Criticality Safety Controls in Operations Where Shielding Protects Personnel, ANSI/ANS-8.10-1983 (R 1988) provides general guidance for nuclear criticality safety controls, the standard is not directly applicable to ISFSI criticality control because it permits a single failure to result in criticality in facilities where personnel are adequately protected from the results of criticality by radiation shielding. This standard follows the more conservative criterion utilized in the nuclear power industry that no single failure can result in nuclear criticality.

The membership of Working Group ANS-57.7 of the Standards Committee of the American Nuclear Society for its revision was:

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G. J. Wrobel .... Rochester Gas & Electric Corporation

*Affiliation at time of balloting.

Contents

Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)

1. Introduction and Scope

1.1 Introduction. This standard is intended to be used by those involved in the ownership and operation of an Independent Spent Fuel Storage Installation (ISFSI) in specifying the design requirements and by the designer in meeting the minimum design requirements of such installations.

This standard continues the set of American National Standards on spent fuel storage design. Similar standards are: Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations, ANSI/ANS-57.2-1983 [1]; Design Objectives for Highly Radioactive Solid Material Handling and Storage Facilities in a Reprocessing Plant, ANSI/AIChE N305-1975 [2]; Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type), ANSI/ANS-57.9-1984 [3]; Design Criteria for Consolidation of LWR Spent Fuel, ANSI/ANS-57.10-1987 [4]; and Guidelines for Establishing Site-Related Parameters for Site Selection and Design of an Independent Spent Fuel Storage Installation (Water Pool Type), ANSI/ANS-2.19-1981 [5].[1]

1.2 Scope. This standard provides design criteria for systems and equipment of a facility for the receipt and storage of spent fuel from light water reactors. It contains requirements for the design of major buildings and structures including the shipping cask unloading and spent fuel storage pools, cask decontamination, unloading and loading areas, and the surrounding buildings which contain radwaste treatment, heating, ventilation and air conditioning, and other auxiliary systems. It contains requirements and recommendations for spent fuel storage racks, special equipment and area layout configurations, the pool structure and its integrity, pool water cleanup, ventilation, residual heat removal, radiation monitoring, fuel handling equipment, cask handling equipment, prevention of criticality, radwaste control and monitoring systems, quality assurance requirements, materials accountability, and physical security.

1.3 Limits of Application. This standard applies for use in the design of an ISFSI which has the following limitations:

(a) The installation is for underwater storage of spent fuel.

(b) The fuel unit to be stored
- (1) is only commercial LWR UO_2 fuels,
- (2) has aged a minimum of one (1) year after discharge from the reactor core.

(c) The normal water level of the storage pool is at or near final design grade level.

(d) Operating functions include:
- (1) Cask receiving and washdown,
- (2) Cask monitoring, cooling, and decontamination,
- (3) Cask unloading,
- (4) Cask decontamination and minor maintenance,
- (5) Fuel unit storage, transfer, and incidental handling as required,
- (6) Water treatment and waste handling,
- (7) Cask loading and preparation for shipping,
- (8) Spent fuel assembly canning, and
- (9) Related activities such as, rod consolidation.

(e) The installation design life is forty (40) years. (This does not necessarily mean that the fuel units will be stored for that period of time.)

(f) Cask crane travel does not pass over fuel unit storage pool(s), or any other locations where fuel units are stored.

(g) Casks received shall have been analyzed for use in this installation.

1.4 Overall Design Considerations

(a) Short-lived high specific activity radionuclides, particularly those of Iodine and Xenon are no longer present in significant quantities in spent fuel that has aged for more than one (1) year since discharge from the reactor core.

(b) The underwater storage of aged spent fuel is a low hazard potential activity. Very little of the radioactivity present is available in a dispersible form and there is no mechanism present to cause the release of radioactive materials in significant quantities from the installation.

(c) Decay heat is not a significant design consideration in an ISFSI because the spent fuel shall have aged a minimum of one (1) year since discharge from the reactor core.

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[1]Numbers in brackets refer to corresponding numbers in Section 7, References.