# American Nuclear Society

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## design criteria for an independent spent fuel storage installation (dry type)

## an American National Standard

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# American National Standard Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)

Secretariat
**American Nuclear Society**

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**American National Standard**

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## Foreword

(This Foreword is not part of American National Standard Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type), ANSI/ANS-57.9-1992.)

This standard provides design criteria for an independent spent fuel storage installation (ISFSI) for light water reactor spent fuel that incorporates one or more of the dry storage concepts. The dry storage concepts covered include three major types: cask (silo), drywell (caisson), and vault (canyon). The standard sets down performance and design requirements along with general guidelines that will assist in the design and licensing efforts. Also presented are interface requirements where the installation is located at an existing nuclear facility. The standard is intended to be consistent with and provide guidance in meeting the requirements of the regulations in Title 10, "Energy," Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

An ISFSI provides for the custody of spent fuel in a stable and quiescent state pending its future disposition. This does not preclude mechanical handling activities related to fuel storage, such as rod consolidation and the canning of assemblies or consolidated fuel rods. Such activities do not involve the exposure of the fuel itself to an uncontrolled environment.

Although the spent fuel is in passive storage, decay heat and the small volume of pressurized gas within the fuel rods are mechanisms that have the potential for causing off-site release of the radionuclides contained in the spent fuel. To lessen the effect of these mechanisms, the spent fuel is kept in storage at the nuclear power plant for at least 1 yr after reactor discharge before being transferred to an ISFSI. The radiological protection requirements for personnel occupancy of the storage area set forth in the standard are based on the principle of maintaining occupational exposure consistent with the as low as reasonably achievable (ALARA) principle.

In general, the safe storage of spent fuel assemblies is achieved by maintaining a minimum of two independent barriers between the fuel and the environs. The fuel cladding is considered the primary barrier for undamaged fuel. Fuel cladding is designed to withstand a far more severe environment in the reactor than in the low-temperature conditions of static storage at an ISFSI. The confinement integrity of the cladding is to be maintained during handling and storage in the ISFSI. In addition, the complete confinement system for the stored fuel is conservatively designed to withstand damaging events, including earthquake or other extreme natural phenomena, so that there is an effective secondary barrier(s) to the release of radioactive materials under all credible conditions.

A section is provided that identifies interface considerations for shared systems and facilities in those cases where the ISFSI is located at or near an existing nuclear facility. An ISFSI that cannot be demonstrated to be independent of a nuclear facility in respect to all support services that are important to confinement cannot be licensed under 10 CFR 72. In such cases, the criteria and performance requirements set forth herein might not be applicable. Appendices that are not part of the mandatory criteria of the standard are provided for information and clarification.

American National Standard Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement, ANSI/ANS-8.10-1983(R1988), provides general guidelines for nuclear criticality safety in shielded facilities. It permits a single failure to result in criticality in facilities where personnel are adequately protected by radiation shielding. The ISFSI standard requires that the more conservative criterion be utilized in the nuclear power industry so that no single failure can result in nuclear criticality.

The membership of Working Group ANS-57.9 of the Standards Committee of the American Nuclear Society during the development of this document was as follows:

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The American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) had the following membership at the time of its ballot for approval of this standard:

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## Contents

# Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)

## 1. Introduction

This standard provides design criteria for systems and equipment of an installation for the receipt and storage of spent fuel from light water reactors (LWRs) or from water pool–type independent spent fuel storage installations. The standard addresses only dry storage, which includes vault, metal cask, concrete silo, and drywell. The standard also addresses the preparation and reshipment of spent fuel to a geological repository. The standard presents interface requirements for shared systems and facilities for the situation where the installation is located at or near an existing nuclear facility.

Consolidation of whole fuel assemblies at the installation is covered by the standard. This installation is independent of nuclear power stations and reprocessing facilities and may or may not be located at an existing nuclear power station or reprocessing site. This installation is designed to receive and indefinitely store spent fuel elements that have experienced cooling times in excess of 1 yr at an in-plant facility, at another independent spent fuel storage installation, or both.

**1.1 Scope.** This standard is intended to be used by the owner and operator of a dry storage–type independent spent fuel storage installation (ISFSI) in specifying the design requirements and by the designer to meet the minimum requirements of such installations.

The standard includes requirements for the following: the design of major buildings and structures, shipping cask unloading and handling facilities, cask decontamination, loading and unloading areas, spent fuel storage areas and racks, fuel handling equipment, radiation shielding, special equipment and area layout configurations, air or gas quality, storage area integrity, air or gas cleanup, fuel inspection, ventilation, residual heat removal, radiation monitoring, prevention of criticality, radwaste control and monitoring systems, provisions to facilitate decommissioning, quality assurance, materials accountability, and physical security.

This standard continues the set of American National Standards on spent fuel storage. Similar standards are:

(1) Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants, ANSI/ANS-57.2-1983 [1][1];

(2) Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type), ANSI/ANS-57.7-1988 [2];

(3) Guidelines for Establishing Site-Related Parameters for Site Selection and Design of an Independent Spent Fuel Storage Installation (Water Pool Type), ANSI/ANS-2.19-1988(R1990) [3]; and

(4) Design Criteria for Consolidation of LWR Spent Fuel, ANSI/ANS-57.10-1987 [4].

**1.2 Limits of Application.** This standard applies to the design of an ISFSI that has the following limitations:

(1) Dry storage only.

(2) The spent fuel to be stored

(a) is only commercial LWR $UO_2$ fuel.

(b) has aged a minimum of 1 yr after discharge from the reactor core.

(c) can arrive at the installation in three forms: undamaged whole fuel assemblies, canned damaged whole fuel assemblies, and close-packed consolidated fuel rods.

(3) Fuel will be received from off-site locations in a U.S. Nuclear Regulatory Commission (NRC) certificated transportation package that is physically compatible with the systems of the installation.

**1.3 Operating Functions.** The operating functions are:

(1) Transportation package receiving and handling.

(2) Transportation package unloading.

(3) Decontamination, minor maintenance, and temporary storage of the transportation package.

(4) Fuel unit lag storage.

(5) Fuel unit preparation (which could include canisterization or rod consolidation) for storage and transfer to and from lag storage.

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