# **American Nuclear Society**

### **REAFFIRMED**

May 28, 1997 ANSI/ANS-57.7-1988 (R1997)

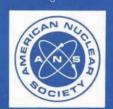
criteria for an independent spent rage installation (water pool type)

# an American National Standard

## **WITHDRAWN**

May 28, 2007 ANSI/ANS-57.7-1988; R1997

No longer being maintained as an American National Standard. This standard may contain outdated material or may have been superseded by another standard. Please contact the ANS Standards Administrator for details.



published by the American Nuclear Society 555 North Kensington Avenue La Grange Park, Illinois 60525 USA

ANSI/ANS-57.7-1988 Revision of ANSI/ANS-57.7-1981

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

Secretariat
American Nuclear Societ

Prepared by the American Nuclear Society Standards Committee Working Group ANS-57.7

Published by the American Nuclear Society 555 North Kensington Avenue La Grange Park, Illinois 60525 USA

Approved March 29, 1989 by the American National Standards Institute, Inc.

#### American National Standard

Designation of this document as an American National Standard attests that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standard has been achieved.

This standard was developed under the procedures of the Standards Committee of the American Nuclear Society; these procedures are accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The consensus committee that approved the standard was balanced to assure that competent, concerned, and varied interests have had an opportunity to participate.

An American National Standard is intended to aid industry, consumers, governmental agencies, and general interest groups. Its use is entirely voluntary. The existence of an American National Standard, in and of itself, does not preclude anyone from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard.

By publication of this standard, the American Nuclear Society does not insure anyone utilizing the standard against liability allegedly arising from or after its use. The content of this standard reflects acceptable practice at the time of its approval and publication. Changes, if any, occurring through developments in the state of the art, may be considered at the time that the standard is subjected to periodic review. It may be reaffirmed, revised, or withdrawn at any time in accordance with established procedures. Users of this standard are cautioned to determine the validity of copies in their possession and to establish that they are of the latest issue.

The American Nuclear Society accepts no responsibility for interpretations of this standard made by any individual or by any ad hoc group of individuals. Requests for interpretation should be sent to the Standards Department at Society Head-quarters. Action will be taken to provide appropriate response in accordance with established procedures that ensure consensus on the interpretation.

Comments on this standard are encouraged and should be sent to Society Headquarters.

Published by

American Nuclear Society
555 North Kensington Avenue, La Grange Park, Illinois 60525 USA

Copyright © 1988 by American Nuclear Society.

Any part of this standard may be quoted. Credit lines should read "Extracted from American National Standard ANSI/ANS-57.7-1988 with permission of the publisher, the American Nuclear Society." Reproduction prohibited under copyright convention unless written permission is granted by the American Nuclear Society.

Printed in the United States of America

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:

- J. A. Nevshemal, Chairman, Toledo Edison Company
- C. L. Brown, Rockwell Hanford Operations
- T. H. Cogburn, Arkansas Power and Light Company
- W. L. Dobson, Gilbert/Commonwealth, Inc.
- E. R. Gilbert, Battelle Pacific Northwest Laboratories
- R. W. Lambert, Electric Power Research Institute
- G. J. Pliml, Commonwealth Edison Company
- J. P. Roberts, U.S. Nuclear Regulatory Commission
- E. E. Voiland, General Electric Company

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

L. J. Cooper, Chairman M. D. Weber, Secretary

W. M. Andrews	Southern Company Services, Inc.
	Pacific Gas & Electric Company
	Nebraska Public Power District
za ot cooperition in the cooperities in the cooperition in the cooperi	(for the American Nuclear Society)
I D Crawford	
	NUS Corporation, Inc.
C. J. Gill	Bechtel National, Inc.
R. T. Lancet	Rockwell International Corporation
J. F. Mallay	Management Analysis Company*
	Pacific Gas & Electric Company
	Duke Power Company
J. A. Nevshemal	
	Stearns Catalytic. Inc.*
	Duke Power Company (retired)
	(for the Institute of Electrical & Electronics Engineers)
I C Saldarini	Ebasco Services, Inc.
J. D. Stevenson	Stevenson & Associates
m	(for the American Society of Civil Engineers)
	Institute of Nuclear Power Operations
	Yankee Atomic Electric Company
	Philadelphia Electric Company
G. L. Wessman	Torrey Pines Technology
G. J. Wrobel	Rochester Gas & Electric Corporation

<sup>\*</sup>Affiliation at time of balloting.

<b>Contents</b>	Se	ection	· · · · · · · · · · · · · · · · · · ·	Page
Jointonto	1.	Intro	duction and Scope	1
		1.1	Introduction	1
		1.2	Scope	1
		1.3	Limits of Application	1
		1.4	Overall Design Considerations	1
	2.	Defin	nitions	2
		2.1	Design Events	2
		2.2	Design Phenomena	2
		2.3	Fuel Units	2
		2.4	Important Confinement Features	
		2.5	Independent Spent Fuel Storage Installation (ISFSI)	
		2.6	Movable Storage Racks	
		2.7	Non-interruptible	
		2.8	Nuclear Criticality Safety	
			Nuclear Facility	
			Passive Failure	
			Primary Criticality Control	
			Shall, Should and May	
		2.13	Spent Fuel Assembly	3
	3.	Insta	llation Function	3
	4	Insta	llation System Descriptions	4
	1.	4.1	Fuel Unit Storage and Cask Unloading Pools	
		4.2	Fuel Unit Storage Racks	
		4.3	Fuel Unit Pool Water Makeup, Cooling and Cleanup	
		4.4	Fuel Unit Cask Handling	
		4.5	Fuel Unit Handling	
		4.6	Heating, Ventilating and Air-Conditioning	
		4.7	Buildings	
		4.8	Radwaste Treatment	4
		4.9	Electrical Power, I&C and Communications	4
		Incta	llation Performance Requirements	1
	Ο.		Fuel Unit Storage and Cask Unloading Pools	
		5.2	Fuel Unit Storage Racks	
		5.3	Fuel Unit Pool Water Makeup, Cooling and Cleanup	5
		5.4	Fuel Unit Cask Handling	
		5.5	Fuel Unit Handling	
		5.6	Heating, Ventilating, and Air-Conditioning	
		5.7	Buildings	
		5.8	Radwaste Treatment	6
		5.9	Electrical Power, I&C and Communications	6
		5.10	Nuclear Criticality Safety	6
		5.11	Physical Security	6
	6	Desig	gn Requirements	6
	٥.	6.1	Fuel Unit Storage and Cask Unloading Pools	
		6.2	Fuel Unit Storage Racks	
		6.3	Fuel Unit Pool Water Makeup, Cooling and Cleanup	
		6.4	Fuel Unit Cask Handling	
		6.5	Fuel Unit Handling	

6.6 Heatii	Heating, Ventilating and Air-Conditioning		
	Buildings		
6.8 Radwa	aste Treatment		
6.9 Electr	ical Power, I&C and Comunications		
	ar Criticality Safety		
	eal Security		
	y Assurance		
	missioning		
	aces for an ISFSI Located at an Existing Nuclear Facility18		
	ural Analysis		
7. References	21		
Appendices			
Appendix A	Typical Diagrams and Features		
Appendix B	A-4 Typical Fuel Pool Cooling System		
	B-1 Typical Dose Rates33B-2 Pool Water Characteristics33B-3 Decay Heat Generation Rates34		
Appendix C	Seismic Analysis		
Appendix D	Background Comments Pertaining to Burnup Credit in Nuclear Criticality Safety Analyses for an ISFSI		
Appendix E	Typical Normal Temperature Ranges in an ISFSI39		
Appendix F	Characteristics of Typical LWR Spent Fuel Shipping Casks that May Interface With an ISFSI (Wet)40		
Appendix G	Physical Characteristics of Typical LWR Fuel Assemblies 41		
Tables			
Table 1	Design Limitations on Liner and its Anchor		
Table B3	Typical PWR Decay Heat Generation Rates		