

# American Nuclear Society

**WITHDRAWN**

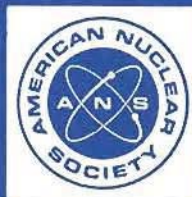
April, 1990

ANSI/ANS-55.1-1979

**id radioactive waste processing system  
for light water cooled reactor plants**

**an American National Standard**

**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standard may contain outdated material  
or may have been superseded by  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

**American National Standard  
for Solid Radioactive Waste Processing System  
for Light Water Cooled Reactor Plants**

**Secretariat  
American Nuclear Society**

**Prepared by the  
American Nuclear Society  
Standards Committee  
Working Group ANS-55.1**

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

**Approved March 26, 1979  
by the  
American National Standards Institute, Inc.**

**Abstract**

This standard establishes minimum requirements and provides recommendations and guidelines for the design, construction, and performance with due consideration for operation of solid radioactive waste processing systems for commercial nuclear power reactors. Design requirements and recommendations as well as quality requirements are presented. Various process steps and alternate methods of handling and disposing of input quantities of solid radioactive waste are discussed along with sizing, capacity, arrangements, and redundancy of the system. Instrumentation and control requirements are also provided, as well as operating guidance, to assure that the performance, safety, and operational objectives of this standard are met.

## **American National Standard**

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

**CAUTION NOTICE:** This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of this standard may receive current information, including interpretation, on all standards published by the American Nuclear Society by calling or writing to the Society.

Published by

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

Price: \$28.00

Copyright © 1979 by American Nuclear Society.

Any part of this Standard may be quoted. Credit lines should read "Extracted from American National Standard, ANSI/ANS-55.1-1979, 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 for Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants, ANSI/ANS-55.1-1979)

A major aspect of nuclear power plant operation is management of the solid radioactive waste generated as a by-product of commercial nuclear power. The development of facilities and equipment to handle and process solid radioactive waste has provided the nuclear industry with the capability to assure that shipments of radioactive solid wastes are within applicable regulatory requirements.

It is the purpose of this standard to establish uniform practices and minimum requirements for design, construction, and performance, with due consideration for operation of solid radioactive waste processing systems, to reduce radiation exposures to operating personnel and to reduce the probability of releases of radioactivity from accidents. It is not the intent of this standard to develop a "standard system" for processing solid radioactive waste; it is clearly recognized that there is a wide variety of systems and equipment in use and others are continually being developed.

A number of designs, concepts, operating system histories, and practices were reviewed in preparation of this standard. In addition, applicable Nuclear Regulatory Commission (NRC) Regulatory Guides were considered in the development of this standard. It is not intended that this standard should limit the development or application of alternate methods of processing provided that such alternate methods meet the design and performance requirements of this standard.

Various quantities of solid radioactive waste are generated by operation and maintenance activities and are dependent upon several factors, including design conditions, type of equipment, equipment arrangements, and operating philosophy. The origin (input sources), the normal expected (averages) and maximum (short-term) quantities, method of handling, processing, and disposing of these wastes are the subjects of this standard.

The requirements of this standard consider that the solid radioactive waste processing systems are operated on a level commensurate with other facility operations. This standard establishes the minimum quality requirements for the design, construction, and performance of the system.

This standard employs a technique using a discrimination device called "boxing." This technique indicates those statements which are nuclear safety related. The term "nuclear safety" includes those requirements that are felt by the writing group to arise from official and implied NRC policies (including regulations, regulatory guides, branch positions, the Standard Review Plan, and past practice on applications) *as well as* other requirements the group believes are related to nuclear safety. Non-nuclear safety related requirements include the following types of needs as they exclusively apply to areas not considered to be nuclear safety related: conventional safety, equipment reliability, plant availability, good engineering practice, and contractual (commercial) requirements.

The standard was prepared by Working Group ANS-55.1 of the Standards Committee of the American Nuclear Society. The members of the Working Group ANS-55.1 are:

- |  |   |
|--|---|
| L. J. Cooper, Chairman, <i>Nebraska Public Power District</i>    | A. Gundersen, Jr., <i>New York State Gas &amp; Electric Company</i> |
| R. A. Burns, <i>Power Authority of the State of New York</i>     | D. M. Hopper, <i>Virginia Electric Power Company</i>                |
| H. S. Cohen, <i>Ebasco Services, Inc.</i>                        | L. C. Oyen, <i>Sargent &amp; Lundy Engineers</i>                    |
| B. V. Coplan, <i>Stone &amp; Webster Engineering Corporation</i> | R. A. Weller, <i>U.S. Nuclear Regulatory Commission</i>             |

A significant contribution was also made by the following former members of Working Group ANS-55.1:

- |  |  |
|--|--|
| L. H. Barrett, <i>U.S. Nuclear Regulatory Commission</i> | B. R. Sylvia, <i>Virginia Electric Power Company</i> |
|--|--|

The membership of ANS-50, the Power Reactor Systems Committee, at the time of its approval of this standard was:

- |   |   |
|---|---|
| J. F. Mallay, Chairman, <i>Babcock &amp; Wilcox Company</i> | L. E. Newhart, Jr., <i>Catalytic, Inc.</i>                  |
| R. F. Ash, <i>Baltimore Gas &amp; Electric Company</i>      | J. H. Noble, <i>Stone &amp; Webster Engineering Company</i> |
| D. A. Campbell, <i>Westinghouse Electric Corporation</i>    | T. J. Pashos, <i>Nuclear Services Corporation</i>           |
| C. O. Coffey, <i>Kaiser Engineers</i>                       | D. R. Patterson, <i>Tennessee Valley Authority</i>          |
| W. H. D'Ardenne, <i>General Electric Company</i>            | R. E. Schreiber, <i>Westinghouse Electric Corporation</i>   |
| F. A. Dougherty, <i>EDS Nuclear Inc.</i>                    | J. W. Stacey, <i>Yankee Atomic Electric Company</i>         |
| J. R. Floyd, <i>Metropolitan Edison Company</i>             | G. C. Vellender, <i>Fluor-Pioneer, Inc.</i>                 |
| C. J. Gill, <i>Bechtel Power Corporation</i>                | G. P. Wagner, <i>Commonwealth Edison Company</i>            |
| W. H. House, <i>Virginia Electric Power Company</i>         | M. D. Weber, <i>American Nuclear Society</i>                |
| A. R. Kasper, <i>Combustion Engineering, Inc.</i>           | G. L. Wessman, <i>General Atomic Company</i>                |
| R. W. Keaten, <i>Atomics International</i>                  | J. E. Windhorst, <i>Southern Company Services</i>           |
| M. Kehnemuyi, <i>U.S. Nuclear Regulatory Commission</i>     | F. C. Zapp, <i>Oak Ridge National Laboratory</i>            |
|   | C. B. Zitek, <i>Commonwealth Edison Company</i>             |

The membership of American National Standards Committee N18, Nuclear Design Criteria, at the time it approved this standard was:

- G. L. Wessman, *Chairman*  
M. D. Weber, *Secretary*

<i>Organization Represented</i>	<i>Name of Representatives</i>
American Chemical Society .....	C. E. Stevenson P. L. Roggenkamp (Alt)
American Concrete Institute .....	P. E. Mast
American Nuclear Society .....	G. L. Wessman
American Society of Civil Engineers .....	M. I. Goldman C. Gogolick (Alt)
American Society of Mechanical Engineers .....	J. S. Bitel R. H. Holyoak (Alt)
American Public Health Association, Inc. ....	J. R. Coleman
American Welding Society .....	J. R. McGuffey
Atomic Industrial Forum .....	G. G. Sherwood
Electric Light & Power Group .....	J. E. Howard J. E. Sohngen (Alt)
Federal Power Commission .....	A. P. Donnell E. P. Chew (Alt)
Health Physics Society .....	J. M. Smith, Jr. R. L. Clark (Alt)
Institute of Electrical & Electronics Engineers .....	R. G. Denham O. W. Bilharz, Jr. (Alt)
Institute of Nuclear Materials Management .....	J. Arendt L. A. Strom (Alt)
Nuclear Energy Liability & Property Insurance Association .....	F. Catudal L. P. Mariani (Alt)
U.S. Energy Research & Development Administration .....	F. X. Gavigan
U.S. Environmental Protection Agency .....	R. Sullivan G. Burley (Alt)
U.S. Nuclear Regulatory Commission .....	G. A. Arlotto M. Kehnemuyi (Alt)
<i>Individual Members</i> .....	E. N. Cramer R. J. Creagan J. F. Gibbons T. D. Jones T. J. Pashos D. Patterson A. H. Redding G. C. Robinson R. P. Schmitz J. F. West

<b>Contents</b>	<b>Section</b>	<b>Page</b>
	1. Scope .....	1
	2. Definitions .....	1
	2.1 Limitations .....	1
	2.2 Glossary of Terms .....	1
	3. Objectives .....	2
	3.1 Performance Objectives .....	2
	3.2 Safety Objectives .....	2
	4. System Requirements .....	2
	4.1 Process Design .....	2
	4.2 System Design .....	3
	Figure 4-1, Process Flow .....	5
	Table 4-1, Equipment Codes .....	6
	5. Equipment Requirements and Recommendations .....	7
	5.1 General .....	7
	5.2 Tanks .....	7
	5.3 Pumps .....	7
	5.4 Valves and Piping .....	8
	5.5 Waste Pretreatment Equipment .....	8
	5.6 Solidification Agent Handling System .....	9
	5.7 Mixing/Packaging .....	9
	5.8 Container Handling .....	10
	5.9 Cartridge Filter Disposal .....	10
	5.10 Dry Solid Waste Compactor .....	10
	6. Controls and Instrumentation .....	11
	6.1 System Control .....	11
	6.2 Requirements .....	11
	Table 6-1, Controls and Instrumentation .....	12
	7. Physical Arrangement .....	11
	7.1 General Requirements .....	11
	7.2 Arrangement for Maintenance .....	14
	7.3 Shielding .....	14
	7.4 Equipment Arrangement .....	14
	7.5 Fire Protection .....	15
	Table 7-1, Radiation Zone Classifications .....	15
	8. System Capacity and Redundancy .....	15
	8.1 System Inputs .....	16
	8.2 System Capacity Design Basis .....	16
	8.3 Redundancy of Components .....	17
	Table 8-1, Compressible Dry Waste Inputs (Uncompacted) .....	16
	Table 8-2, BWR Radioactive Solid Waste Processing Design Basis Inputs .....	17
	Table 8-3, PWR Radioactive Solid Waste Processing Design Basis Inputs .....	19
	9. Operation and Maintenance .....	21
	9.1 Operational Considerations .....	21
	9.2 Maintenance Considerations .....	22
	Figure 9-1, Solid Radwaste - Data Logging Sheet .....	22

10. System Construction and Testing .....	22
10.1 Construction.....	22
10.2 System Integrity Testing .....	23
10.3 Cleaning and Flushing .....	23
10.4 System Tests .....	23
11. References .....	23
Appendix 1 - Federal Regulations.....	25
Appendix 2 - Leakage Testing .....	27

# Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants

## 1. Scope

This standard sets forth design, construction, and performance requirements with due consideration for operation of the Solid Radioactive Waste Processing System for light water-cooled reactor plants for design basis inputs. For the purpose of this standard, the Solid Radioactive Waste Processing System begins at the interface with the liquid radioactive waste processing system boundary, at the inlets to the spent resin, filter sludge, evaporator concentrate, and phase separator tanks. All radioactive or contaminated materials, including spent air and liquid filter elements, spent bead resins, filter sludge, spent powdered resins, evaporator and reverse osmosis concentrates, and dry radioactive wastes shall be processed in appropriate portions of the solid radioactive waste system. The system terminates at the point of loading the filled drums and other containers on a vehicle for shipping off-site to a licensed burial site. The Solid Radioactive Waste Processing System is not a safety class system as defined by American National Standard Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants, N18.2-1973/ANS-51.1 and its revision, N18.2a-1975/ANS-51.8, Sections 2.2 and 2.3. [1,2]<sup>1</sup>, and the similar draft standards for boiling water reactor plants.<sup>2</sup> The provisions contained in this standard, therefore, shall take precedence over the aforementioned standards.

The product resulting from the solid radioactive waste processing system will meet the criteria imposed by standards and regulations for transportation and burial.<sup>3</sup>

<sup>1</sup>Numbers in brackets refer to corresponding numbers in Section 11, References.

<sup>2</sup>"Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactors", proposed American National Standard N212 trial use and comment, May 1975. Correspondence should be sent to: Mr. W. D. Gilbert, General Electric Company, Atomic Power Equipment Department, 175 Curtner Avenue, San Jose, California 95125.

<sup>3</sup>See Appendix 1 for additional information.

## 2. Definitions

**2.1 Limitations.** The definitions given below are of a restricted nature for the purposes of this standard.

### 2.2 Glossary of Terms

**container.** The primary containment receptacle in which the solidified wastes are contained.

**dewatered.** Liquid or slurry wastes that have had excess water removed.

**encapsulation.** To cover and surround an object with solidification agent.

**free liquid.** Uncombined liquid not bound by the solid matrix of the solid waste mass.

**homogeneous.** Of uniform composition; the waste is uniformly distributed throughout the package.

**normalized inputs.** Those average annual quantities generated on a per day basis prorated to the design basis values noted in Tables 8-2 and 8-3 which are for a single 3800 MWt unit.

**shall, should, and may.** The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission, neither a requirement nor a recommendation. The Solid Radioactive Waste Processing System shall be designed, constructed, and operated in accordance with the requirements of this standard, but not necessarily with its recommendations.

**short-lived isotopes.** Radionuclides with half lives less than eight days.

**slurry wastes.** Liquid radioactive wastes of high insoluble content (greater than 0.1 percent solids by weight).

**solidification agent.** Material which, when