American Nuclear Society

REAFFIRMED
May 27, 2004
ANSI/ANS-15.11-1993
(R2004)

radiation protection at research reactor facilities

an American National Standard

WITHDRAWN
October 8, 2009
ANSI/ANS-15.11-1993
(R2004)

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

ANSI/ANS-15.11-1993

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American National Standard for Radiation Protection at Research Reactor Facilities

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-15.11

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

Approved July 23, 1993
by the
American National Standards Institute, Inc.

American National Standard

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Published by

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

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard for Radiation Protection at Research Reactor Facilities, ANSI/ANS-15.11-1993.)

In the fall of 1970, the American Nuclear Society Standards Committee established ANS-15, Operation of Research Reactors, under the auspices of Consensus Committee N17, Research Reactors, Reactor Physics, Radiation Shielding, and Computational Methods, to provide needed standards for the operation, use, and regulation of research reactors. Since then, numerous standards have been developed and several working groups have been established, among them ANS-15.11, Radiation Protection at Research Reactor Facilities.

In 1977, two standards dealing with radiation protection at research reactors were published: ANSI/ANS-15.11-1977 (N628), "Radiological Control at Research Reactor Facilities," and ANSI/ANS-15.12-1977 (N647), "Design Objectives for, and Monitoring of Systems Controlling Research Reactor Effluents." These two standards were revised later and combined into a single standard, ANSI/ANS 15.11-1987, "Radiation Protection at Research Reactor Facilities." Since then, major changes to the regulations on standards for radiation protection and to the recommendations of the National Council on Radiation Protection and Management (NCRP) and the International Commission on Radiological Protection (ICRP), significantly impacting research reactors, have taken place. The current revision addresses applicable changes and provides directions on implementation, including meeting the objectives and principles of as low as is reasonably achievable (ALARA) levels of radiation.

The membership of ANS-15.11 at the time of completion of the standard was:

T. M. Raby, Chairman, *National Institute of Standards and Technology*
W. J. Brynda, *Brookhaven National Laboratory*
D. E. Feltz, *Consultant (formerly Texas A&M University)*
R. W. Granlund, *Pennsylvania State University*
J. E. Hyder, *Los Alamos National Laboratory*
A. G. Johnson, *Oregon State University*
S. Langhorst, *University of Missouri, Columbia*
H. Peterson, U.S. Department of Energy
W. J. Richards, *U.S. Department of Defense*
R. M. Ryan, *Rensselaer Polytechnic Institute*
T. R. Schmidt, *Sandia National Laboratories*
L. A. Slaback, *National Institute of Standards and Technology*
S. H. Weiss, U.S. Nuclear Regulatory Commission

In preparing this standard, the intent has been to specify objectives that will achieve the following results;

a. Establish a comprehensive radiation protection program that deals with all matters involving radiation and radioactive materials at research reactors.

b. Limit exposures and releases to ALARA levels without seriously restricting the operation of existing reactors, inhibiting growth and upgrade, or discouraging the development of new research reactors.

c. Set a reasonably low activity level threshold, above which measurements will be required that will allow for the use of readily available instrumentation without resorting to extraordinary means.

In the process of creating standards with respect to existing and varied practices in many operating facilities, it is important to consider the following:

a. It is not intended that the standard be used as a demand model for backfitting purposes.

b. The standard can be a significant aid for existing and new owners or operators.

c. The standard can be helpful for the facility undergoing change or modification.

d. The standard's considered use can assist in implementing regulatory requirements.

Prior to using the standard, individual facilities ought to carefully examine their license, permit, or other requirements for limiting conditions that might not be compatible with the standard or new regulatory requirements, and that might require change, amendment, or special authorization. Care also ought to be exercised in using appropriate units as might be specified by authorities.

The standard does not address certain conditions that do not occur or are known not to exist at research reactor facilities. Among these are planned special exposures, facilities-specific public dose limits, hot particle contamination, etc. Individual facilities ought to address these issues, if needed, in their programs.

The family of American National Standards developed by ANS-15 for research reactors are the following:

ANSI/ANS-15.1-1990, *The Development of Technical Specifications for Research Reactors*
ANSI/ANS-15.2-1990, *Quality Control for Plate-Type Uranium-Aluminum Fuel Elements*
ANSI/ANS-15.4-1988, *Selection and Training of Personnel for Research Reactors*
ANSI/ANS-15.7-1977(R1986), *Research Reactor Site Evaluation*
ANSI/ANS-15.8-1976(R1986), *Quality Assurance Program Requirements for Research Reactors*
ANSI/ANS-15.10-1981(R1987), *Decommissioning of Research Reactors*
ANSI/ANS-15.15-1978(R1986), *Criteria for the Reactor Safety Systems of Research Reactors*
ANSI/ANS-15.16(R1988), *Emergency Planning for Research Reactors*
ANSI/ANS-15.17(R1987), *Fire Protection Program Criteria for Research Reactors*
ANSI/ANS-15.19-1991, *Shipment and Receipt of Special Nuclear Material (SNM) by Research Reactor Facilities*

The membership of Subcommittee ANS-15 at the time of its approval of this standard was as follows:

W. J. Richards, Chairman, *U.S. Department of Defense*
A. Adams Jr., *U.S. Nuclear Regulatory Commission*
T. L. Bauer, *University of Texas*
S. K. Bhatnager, *U.S. Department of Energy*
W. J. Brynda, *Brookhaven National Laboratory*
B. L. Corbett, *Oak Ridge National Laboratory*
J. P. Farrar, *University of Virginia*
M. L. Gilder, *Oak Ridge National Laboratory*
D. E. Hughes, *Pennsylvania State University*
R. C. Nelson, *EG&G Idaho*
D. P. Pruett, *Argonne National Laboratory-West*
T. M. Raby, *National Institute of Standards and Technology*
T. R. Schmidt, *Sandia National Laboratory*
M. H. Voth, *Pennsylvania State University*
R. R. Walston, *U.S. Department of Energy*
J. Razvi, *General Atomics*

Consensus Committee N17, Research Reactors, Reactor Physics, Radiation Shielding, and Computational Methods, had the following membership at the time it reviewed and approved this standard:

T. M. Raby, Chairman
A. Weitzberg, Vice-Chairman

J. D. Buchanan ..... Individual
A. D. Callihan ..... Individual
R. E. Carter ..... Individual
D. Cokinos ..... Brookhaven National Laboratory
A. De La Paz ..... Vista Technology
D. Duffey ..... American Institute of Chemical Engineers
H. Goldstein ..... American Physical Society
S. Hartzell ..... Power Computing Company
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L. I. Kopp ..... Individual
J. Miller ..... Institute of Electrical & Electronics Engineers, Inc.
J. E. Olhoeft ..... Individual
T. M. Raby ..... American Nuclear Society
W. Richards ..... U. S. Department of Defense
M. M. Ter Pogossian ..... American College of Radiology
J. F. Torrence ..... National Institute of Standards and Technology
D. K. Trubey ..... Individual
S. H. Weiss ..... U. S. Nuclear Regulatory Commission
A. Adams Jr. (Alt.)
A. Weitzberg ..... Halliburton NUS Corporation
W. L. Whittemore ..... GA Technologies, Inc.

Contents

Tables

Radiation Protection at Research Reactor Facilities

1. Scope

This standard establishes the elements of a radiation protection program and the criteria necessary to provide an acceptable level of radiation protection for personnel at research reactor facilities and the public consistent with keeping exposures and releases as low as is reasonably achievable (ALARA).

2. Definitions

For radiation quantities, the definitions herein do not conflict with those of the International Commission on Radiation Units and Measurements (ICRU), and the ICRU definitions may be used where appropriate. A number of definitions not used in that document are included for completeness and reference. The definitions of shall, should, and may are listed under "shall."

Many of the definitions are based on those in Title 10, "Energy," Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," [1].[1] In no case has any wording from that source been deleted. A few have been amplified by the addition of appropriate phrases to make them more generally applicable to all research reactors. These are noted by an asterisk.

absorbed dose. The energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray.

accessible area. The area that can reasonably be occupied by a significant portion of an individual's body (see also radiation area, high radiation area, significant portion).

activity. The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie and the becquerel.

adult. An individual 18 or more years of age.

airborne radioactive material. Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases; also commonly referred to as airborne radioactivity.

airborne radioactivity area.* A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of permitted or licensed material, exist in concentrations
(1) in excess of the derived air concentrations (DACs) for controlling occupational exposures, e.g., those specified in 10 CFR 20, Appendix B to § § 20.1001–20.2401, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," and in U.S. Environmental Protection Agency Federal Report No. 11, EPA-520/1-88-20 [2,3] or
(2) to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6% of the annual limit on intake (ALI) or 12 DAC-hours, or, in the case of submersion nuclides, exceed an effective dose equivalent of 30 mrem (0.3 mSv).

as low as is reasonably achievable (ALARA). To make every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical, consistent with the purpose for which the permitted or licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and permitted or licensed materials in the public interest.

annual limit on intake (ALI). The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rem (0.05 Sv) or a committed dose equivalent of 50 rem (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in 10 CFR 20.1001–20.2401, Appendix B, Table 1, "Occupational Values," Columns 1 and 2 [2].)

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