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radiation protection at research reactor facilities

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American National Standard Radiation Protection at Research Reactor Facilities

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Foreword

(This Foreword is not a part of American National Standard "Radiation Protection at Research Reactor Facilities," ANSI/ANS-15.11-2009.)

In the fall of 1970, the American Nuclear Society Standards Committee established ANS-15, Operation of Research Reactors, under the auspices of the N17 Consensus Committee, 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.

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." Major changes to the regulations on standards for radiation protection and to the recommendations of the National Council on Radiation Protection and Management and the International Commission on Radiological Protection, significantly impacting research reactors, were incorporated into the revision, ANSI/ANS-15.11-1993

Work on this standard began in January of 2003 and culminated in July of 2009 with unanimous approval by the N17 Consensus Committee. 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.

This standard might reference documents and other standards that have been superseded or withdrawn at the time the standard is applied. A statement has been included in the "References" section that provides guidance on the use of references.

The membership of ANS-15.11 contributing to this standard is as follows:

S. R. Reese (Chair), *Oregon State University*

C. H. Bassett, *U.S. Nuclear Regulatory Commission*
D. R. Brown, *National Institute of Standards and Technology*
D. Feltz, *Individual*
S. G. Frantz, *Reed College*
S. A. Menn, *Oregon State University*
D. S. O'Kelly, *University of Texas at Austin*
P. B. Perez, *AREVA NP*
T. M. Raby, *National Institute of Standards and Technology*
W. J. Richards, *National Institute of Standards and Technology*
T. R. Schmidt, *Individual*

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

(1) Establish a comprehensive radiation protection program that deals with all matters involving radiation and radioactive materials at research reactors;

(2) 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;

(3) 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:

(1) It is not intended that the standard be used as a demand model for backfitting purposes;

(2) The standard can be a significant aid for existing and new owners or operators;

(3) The standard can be helpful for a facility undergoing change or modification;

(4) 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 such as planned special exposures, facilities-specific public dose limits, and hot particle contamination. 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-15.1-2007, "The Development of Technical Specifications for Research Reactors";

ANSI/ANS-15.2-1999 (R2009), "Quality Control for Plate-Type Uranium-Aluminum Fuel Elements";

ANSI/ANS-15.4-2007, "Selection and Training of Personnel for Research Reactors";

ANSI/ANS-15.7-1977, "Research Reactor Site Evaluation" (withdrawn);

ANSI/ANS-15.8-1995; R2005, "Quality Assurance Program Requirements for Research Reactors";

ANSI/ANS-15.10-1981, "Decommissioning of Research Reactors" (withdrawn);

ANSI/ANS-15.11-2009, "Radiation Protection at Research Reactor Facilities";

ANSI/ANS-15.15-1978, "Criteria for the Reactor Safety Systems of Research Reactors" (withdrawn);

ANSI/ANS-15.16-2008, "Emergency Planning for Research Reactors";

ANSI/ANS-15.17-1981; R1987; R2000, "Fire Protection Program Criteria for Research Reactors";

ANSI/ANS-15.19-1991, "Shipment and Receipt of Special Nuclear Material (SNM) by Research Reactor Facilities" (withdrawn);

ANS-15.20-20xx, "Criteria for the Reactor Control of Safety Systems of Research Reactors" (under development);

ANSI/ANS-15.21-1996; R2006, "Format and Content for Safety Analysis Reports for Research Reactors"

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

W. J. Richards (Chair), *National Institute of Standards and Technology*

A. Adams, Jr., *U.S. Nuclear Regulatory Commission*
L. M. Bobek, *University of Massachusetts Lowell*
J. Bryson, *Sandia National Laboratories*
C. D. Cooper, *Bechtel BWXT*
M. L. Gildner, *Oak Ridge National Laboratory*
J. Jenkins, *Purdue University*
M. Krause, *University of Texas*
C. McKibben, *University of Missouri–Columbia*
S. Miller, *AFRRI/NMC*
T. Myers, *National Institute of Standards and Technology*
D. S. O'Kelly, *University of Texas at Austin*
S. R. Reese, *Oregon State University*

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 (Chair), *National Institute of Standards and Technology*
A. Weitzberg (Vice Chair), *Individual*

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(Alt. R. D. Zimmerman, *American Institute of Chemical Engineers*)
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L. I. Kopp, *Individual*
P. M. Madden, *U.S. Nuclear Regulatory Commission*
(Alt. A. Adams, Jr., *U.S. Nuclear Regulatory Commission*)
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A. O. Smetana, *Savannah River National Laboratory*
R. Tsukimura, *Aerotest Operations*
S. H. Weiss, *National Institute of Standards and Technology*
(Alt. T. J. Myers, *National Institute of Standards and Technology)*
A. R. Veca, *General Atomics*

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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 this document are nevertheless 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, *Code of Federal Regulations*, Part 20 (10 CFR 20) [1].[1)] In no case has any wording from that source been deleted. A few have been amplified to make them more generally applicable to all research reactors. These are noted in the text.

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 (Gy).

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).

Act: The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended.

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

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, Secs. 20.1001 to 20.2401, Appendix B [1][2]; 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 1 week (7 consecutive days), 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). See "Note 1" at the end of this section.

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, Secs. 20.1001 to 20.2401, Appendix B, Table 1, columns 1 and 2 [1].)

as low as is reasonably achievable (ALARA): To make every reasonable effort to maintain

[1)]Numbers in brackets refer to corresponding numbers in Sec. 11, "References."