

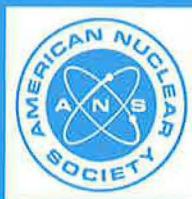
American Nuclear Society

WITHDRAWN

**radiation protection at research
reactor facilities**

an American National Standard

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American National Standard
for Radiation Protection at Research Reactor Facilities

Secretariat
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Foreword

(This Foreword is not a part of American National Standard for Radiation Protection at Research Reactor Facilities, ANSI/ANS-15.11-1987.)

The ANS Standards Secretariat established Subcommittee ANS-15 in the fall of 1970 with the task of preparing a standard for the operation of research reactors. In January 1972, this charter was expanded to the multiple tasks of preparing all standards for research reactors. To implement this enlarged responsibility, a number of subcommittee working groups has been established to develop standards for consideration and complementary action by Subcommittee ANS-15.

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. In 1982, during the 5-year maintenance review, Subcommittee ANS-15 decided that both standards should be revised and combined into a single standard. Accordingly, a new work group, ANS-15.11, was established in the fall of 1982 under the chairmanship of Dr. Richard D. Neff of Texas A&M University, to develop an updated and comprehensive standard for radiation protection at research reactors that combines the two previously published standards. Under Dr. Neff's leadership, extensive revisions and major improvements were incorporated into a framework for a new standard. The work continued until Dr. Neff's untimely death in the spring of 1984. His many contributions to this and other standards and his dedication to the research reactor community are remembered and appreciated. The final work group draft of the standard designated ANS-15.11, Radiation Protection at Research Reactor Facilities, was completed and reviewed by ANS-15 in the summer of 1985. The standard was approved by ANS-15 in December 1985, and presented for processing by Consensus Committee N17 in August 1986.

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

T. M. Raby, Chairman, <i>National Bureau of Standards</i>	R. W. Granlund, <i>Pennsylvania State University</i>
E. F. Bates, <i>U.S. Nuclear Regulatory Commission</i>	J. E. Hyder, <i>Los Alamos National Laboratory</i>
W. J. Brynda, <i>Brookhaven National Laboratory</i>	R. M. Ryan, <i>Rensselaer Polytechnic Institute</i>
D. E. Feltz, <i>Texas A&M University</i>	T. R. Schmidt, <i>Sandia National Laboratories</i>

Several of the requirements of this standard are based on the collective judgment and experience of the work group as applied to this class of reactors. The composition of the work group offers a broad spectrum of expertise in radiation protection and research reactor management, operation, and engineering. The members represent a wide variety of research reactors, large and small, and come from universities, national laboratories, and government. Therefore, the requirements and limits specified in this standard represent a reasonable and responsible approach to establishing an effective radiation protection program at research reactors and to meeting as low as reasonably achievable (ALARA) principles.

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 a level which is as low as reasonably achievable without seriously restricting the operation of existing reactors, inhibiting growth and

upgrade, or discouraging the development of new research reactors. In most cases, specified values are a small fraction of those recommended by the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP). In the case of airborne effluents, for example, they represent no more than the variation in the natural background across the United States.

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.

Many of the requirements and recommendations contained in the standard are based on the recommendations of NCRP and ICRP. Identical or similar information may also be found in Title 10, Part 20 of the Code of Federal Regulations (10 CFR 20), "Standards for Protection Against Radiation." Research reactor facilities should also use the provisions of the regulations as applicable.

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

- a. It is not intended that the standard be used as a demand model for backfitting purposes.
- b. It should be a significant aid for existing and new owner/operator.
- c. It should be helpful for the facility undergoing change/modification.
- d. Its considered use should assist in implementing regulatory requirements.

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

ANSI/ANS-15.1-1982—Standard for the Development of Technical Specifications for Research Reactors

ANSI/ANS-15.2-1982—Quality Control for Plate-Type Uranium-Aluminum Fuel Elements

ANSI/ANS-15.4-1977—Selection of Personnel for Research Reactors

ANSI/ANS-15.7-1986—Research Reactor Site Evaluation

ANSI/ANS-15.8-1986—Quality Assurance Program Requirements for Research Reactors

ANSI/ANS-15.10-1981—Decommissioning of Research Reactors

ANSI/ANS-15.15-1978—Criteria for the Reactor Safety Systems of Research Reactors

ANSI/ANS-15.16-1982—Standard for Emergency Planning for Research Reactors

ANSI/ANS-15.17-1981—Fire Protection Program Criteria for Research Reactors.

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

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L. C. Brinkerhoff, <i>U.S. Department of Energy</i>	R. J. McCord, <i>Oak Ridge National Laboratory</i>
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Consensus Committee N17, Research Reactors, Reactor Physics, and Radiation Shielding, had the following membership at the time it reviewed and approved this standard:

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Radiation Protection at Research Reactor Facilities

1. Scope

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

2. Definitions

as low as reasonably achievable (ALARA). The term "as low as reasonably achievable" when applied to radiation exposures and releases of radioactive materials in effluents means as low as reasonably achievable taking into account the state of technology, and the economics of improvements in relation to the benefits to the public health and safety and other societal and socioeconomic considerations, and in relation to the utilization of nuclear energy in the public interest.

calibration. Calibration is the determination of response of an instrument or system over its range to that its output can be correlated, with acceptable accuracy, to true values of the measured parameter.

controlled area. (See **restricted area**.)

effluents. Effluents are airborne and liquid releases from onsite to the offsite environment.

exposure to a major portion of the body. That exposure to a major portion of the body which occurs at a distance of 18 inches (50 cm) from a radiation source or from any external surface from which the radiation emerges. A major portion of the body, for the purpose of defining radiation and high radiation areas, means head, trunk, arms above the elbow, and legs above the knees.

function test. A function test is the introduction of an input signal into an instrument to verify that it is operable.

high radiation area. High radiation area means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

location of interest. The term "location of interest" is that location in an unrestricted area where the maximum dose or concentration is likely to occur.

management. Management means those persons within the research reactor organization whose responsibility and authority includes the radiation protection program. The levels of management are as described in the American National Standard for Development of Technical Specifications for Research Reactors, ANSI/ANS-15.1-1982 [1].¹

radiation area. Radiation area means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any five consecutive days a dose in excess of 100 millirems.

research reactor. Research reactor is a device designed to support a self-sustaining neutron chain reaction for research, developmental, educational, training, or experimental purposes and which may have provision for the production of radioisotopes.

research reactor facility. Research reactor facility includes all areas within which the owner/operator directs authorized activities associated with the reactor.

response check. A response check is a qualitative verification of acceptable performance by observation of the behavior of an instrument or system while it is exposed to an appropriate radiation source.

¹Numbers in brackets refer to corresponding numbers in Section 11, References.

restricted area. Restricted area means any area to which access is controlled by management for purposes of protection of individuals from exposure to radiation and radioactive materials.

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.

true value. The true value is the actual value of a parameter.

3. Policy and Organization

3.1 Management Policy. The radiation protection program shall include a written statement by management of the commitment to keep exposures to personnel and the general public as low as reasonably achievable (ALARA). A clear statement of this policy shall be included in the operating procedures or in the procedures on radiation protection.

Management shall address each of the following and implement to the extent applicable:

- (1) Specify administrative review levels for personnel exposures.
- (2) Conduct an annual evaluation of exposures and releases to determine if they are as low as reasonably achievable.
- (3) Ensure that there is a radiation protection organization with clearly defined responsibilities.
- (4) Provide radiation protection personnel sufficient authority to carry out assigned responsibilities as defined in the radiation protection program.
- (5) Ensure that research reactor personnel receive radiation protection training.
- (6) Consider suggestions and recommendations for modifications to operating and maintenance procedures and to reactor equipment and facilities to achieve reductions in radiation exposure.
- (7) Provide the equipment and supplies necessary for the implementation of the radiation protection program.

3.2 Radiation Protection Responsibilities. A specific, qualified individual shall be given explicit responsibility and authority to implement the radiation protection program. Such individual shall have direct access to and support of manage-

ment. The individual may be a member of the reactor operations group, but shall have the organizational freedom and authority necessary to carry out defined radiation protection responsibilities. The qualification and training of this individual shall be commensurate with the radiation protection considerations of the facility as established by management. Minimum requirements of education, training, and experience shall be specified.

3.3 Organizational Relationships. The relationships that are to exist between the individual responsible for the radiation protection program and other persons and committees within the research reactor organization shall be clearly defined in the operating procedures for the facility, or in a separate document relating to radiation protection. Organizational charts showing these interrelationships may be used. Liaison between these individuals or groups shall be maintained to ensure effective radiation protection and maintenance of exposure and releases as low as reasonably achievable.

3.4 Review and Audit. Provisions for periodic review and audit of elements of the radiation protection program shall be established in accordance with ANSI/ANS-15.1-1982 [1].

4. Training

4.1 Introduction. All personnel and visitors entering restricted areas shall either receive training in radiation protection sufficient for the work or visit or shall be escorted by an individual who has received such training.

4.2 Initial Training. All personnel permitted unescorted access shall receive training in radiation protection. The initial training should cover the following areas in sufficient depth for the specific functions.

- (1) Access and egress control and escort procedures.
- (2) Radiological safety principles, policies and procedures.
- (3) Personnel dosimetry.
- (4) Monitoring instruments and protective devices.
- (5) Protective equipment.
- (6) Radiation areas and high radiation areas.

- (7) Use, storage, and transfer of radioactive materials.
- (8) Posting and labeling requirements.
- (9) ALARA and exposure limits.
- (10) Radiation hazards and health risks.
- (11) Emergency response requirements for individual action.

4.3 Retraining. The need for retraining in radiation protection shall be determined by facility management in consultation with radiation protection personnel. Such retraining should be conducted at least biennially and should include a condensed version of the initial training with emphasis on changes in policies, procedures, requirements, and facilities. Operations personnel who participate in a requalification program that includes radiation protection need not participate in the retraining program.

5. Radioactive Material Control

A program to control radioactive material at research reactor facilities shall be established. Identification, storage in identified areas, and inventories of radioactive materials should be used to maintain materials control. For certain radioactive materials, containment, isolation, shielding and ventilation may be of vital importance and shall be provided as necessary to satisfy ALARA requirements. Transfers shall be made only to authorized recipients.

The following categories shall be addressed in a radioactive materials control program:

5.1 Special Nuclear Material. This category includes new, in-core and spent fuel elements and other special nuclear material. These materials shall be located in a restricted area or under the control of authorized individuals. Individual items shall have a unique identification if the U^{233} , U^{235} , or plutonium content is 0.5 g or greater; except for Pu^{238} for which a unique identification shall be used if the content is 0.05 g or greater. Records of inventories and transfers shall be maintained.

5.2 Byproduct Materials. These materials shall be maintained or stored in a restricted area or be under the control of authorized individuals until they are transferred or disposed of as waste. Records of transfers out of the facility, or disposal

shall be maintained.

5.3 Radioactive Waste. Materials, other than effluents, designated as radioactive waste shall be maintained in a restricted area or under the control of authorized individuals until they are transferred for disposal. Records of transfers and disposal shall be maintained.

5.4 Other Radioactive Material. Radioactive reactor components, experimental facilities, contaminated tools and fixtures and other radioactive materials shall be included in the program as required on the basis of radiation or contamination levels. These materials shall be maintained in a restricted area or be under the control of authorized individuals. They may be released by authorized individuals upon decontamination or may be disposed of as waste.

6. Radiation Monitoring

The radiation protection program shall provide for detection and evaluation of occupational and nonoccupational radiation exposures resulting from facility operations. Radiation and radioactivity measurements shall be made as necessary with acceptable levels of sensitivity and accuracy to maintain exposures to radiation and effluent releases within an established ALARA program. Specific procedures shall be available for the following monitoring categories where applicable.

6.1 Radioactive Effluent Monitoring. A program for monitoring airborne and liquid effluent shall be established. If it can be shown by analytical or other methods that airborne emissions of radionuclides to the environment do not exceed those amounts that cause a dose equivalent of 25 mrem/y to the whole body, at the location of interest, monitoring is not required.

Analysis of the concentration of radioactive material shall be made on a representative sample of each release, or routinely in the case of continuous or routine releases. Analysis for specific isotopes is recommended.

6.1.1 Noble Gas Effluents. Acceptable methods of monitoring include:

- (1) Measurement of the dose at the location of interest using integrating dosimeters, assuming adequate consideration is given to background

measurements and calibration.

(2) Measurement of the concentration at some point in the release pathway and, using realistic dispersion factors, calculation of the concentration at the location of interest.

(3) Measurement of concentration at the location of interest.

6.1.2 Gaseous or Airborne Radioactive Materials (other than noble gases). Acceptable methods of monitoring include:

(1) Measurement of the concentration at some point in the release pathway and, using realistic dispersion factors and deposition velocities, calculation of the concentration at the location of interest,

(2) Measurement of concentration and deposition at the location of interest.

6.1.3 Liquid Effluents. Acceptable methods of monitoring include:

(1) Measurement of the concentration at some point in the release pathway and, using realistic dilution factors, calculation of the concentration at the location of interest.

(2) Measurement of concentration at the location of interest.

6.2 Facility Monitoring

6.2.1 Airborne Radioactivity Monitoring.

(1) The monitoring equipment and procedures shall be commensurate with projected airborne radioactivities resulting from facility operations.

(2) Airborne radioactivity should be monitored whenever the exposure in restricted areas is expected to exceed 10 MPC-hr in seven consecutive days and shall be monitored if the exposure is expected to exceed 40 MPC-hr in seven consecutive days. MPS is Maximum Permissible Concentration.

Acceptable methods of monitoring include:

a. Use of a continuous air monitor capable of measuring the MPC of particulate or gaseous radioactivity, or 10 MPC-hr over seven consecutive days,

b. Analysis of a representative sample, using equipment that is capable of measuring the MPC.

6.2.2 Area Radiation Monitoring

(1) Monitoring shall be provided for high radiation areas. This may be accomplished with radiation area monitors with remote readout or with portable instruments to be used when the area is made accessible to personnel.

(2) Monitoring shall be provided for radiation

areas as needed to identify potentially changing conditions or parameters.

6.2.3 Radioactive Contamination Monitoring

(1) Personnel shall monitor their hands and feet for contamination when leaving known contaminated areas, or restricted areas that are potentially contaminated. If contamination is detected then a check of exposed areas of the body and clothing should be made. Monitoring control points shall be established for this purpose.

(2) Tools and equipment shall be surveyed for contamination before removal from contaminated areas or restricted areas where contamination is likely.

(3) Contaminated areas and restricted areas where contamination is likely shall be surveyed routinely for contamination levels. Monitoring frequency and method shall be adequate to reveal significant changes, to allow accurate assessment of working conditions, and to provide an accurate basis for protective equipment requirements.

(4) Specific limits shall be established for removable and fixed contamination of personnel and equipment. Instruments with sufficient sensitivity to measure contamination within the limits shall be provided. Contamination levels for unconditional release shall not exceed the limits specified in Table 6-1, Acceptable Surface Contamination Levels for Unconditional Release (see ORNLOEPA4 [2]). This table does not apply to materials with induced radioactivity.

6.3 Personnel Monitoring. The radiation protection program shall provide for personnel dosimetry. The personnel dosimetry program shall provide a means to measure, assess, and record personnel exposures to ionizing radiation from external and internal sources as required.

Acceptable monitoring methods include:

(1) Personnel dosimeters such as film badges, thermoluminescence dosimeters (TLDs), and direct and indirect reading pocket dosimeters.

(2) Bioassay by urinalysis or other appropriate techniques, including in vivo or whole body counting.

6.4 Emergency Radiation Monitoring. Provisions shall be made to ensure that emergency radiation monitoring can be done in a manner to provide pertinent information rapidly and in a format that will allow timely decisions regarding protective measures to be taken to minimize ra-

Table 6-1
Acceptable Surface Contamination Levels
for Unconditional Release

Nuclide ^a	Average fixed ^{b c}	Maximum fixed ^{b d}	Removable ^{b e}
U-nat, U-235, U-238, and associated decay products	5,000 dpm α /100 cm ²	15,000 dpm α /100 cm ²	1,000 dpm α /100 cm ²
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm ²	300 dpm/100 cm ²	20 dpm/100 cm ²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm ²	3,000 dpm/100 cm ²	200 dpm/100 cm ²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β - γ /100 cm ²	15,000 dpm β - γ /100 cm ²	1,000 dpm β - γ /100 cm ²

- ^a Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.
- ^b As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
- ^c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
- ^d The maximum contamination level applies to an area of not more than 100 cm².
- ^e The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination or objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

diation exposures. Emergency planning guidance is provided in American National Standard Emergency Planning for Research Reactors, ANSI/ANS-15.16-1982 [3].

7. Instrumentation

7.1 Instrument Categories. Radiation measuring instruments for routine operations, abnormal conditions, and emergency situations shall be provided. Instrument categories include: fixed area radiation monitors, airborne radioactivity monitors, and liquid radioactivity monitors. Portable instrumentation, representative sampling, or dosimeters may be substituted where applicable. These monitors shall be required within the reactor facility except where it can be demonstrated that the radiation protection program can maintain personnel exposures and effluent releases within an established ALARA program's limits without the use of monitors.

7.2 Range and Spectral Response. The range and spectral response of the instrumentation provided shall reliably cover the kinds of radiation and the levels expected during normal operations and shall extend from these levels through radiation levels postulated for emergency situations. Full coverage of this projected range of radiation levels need not be present in a single instrument.

7.3 Calibration. Instruments shall be calibrated at least annually. Calibration shall also be performed if a response check or a function test indicates that the calibration has changed. More frequent calibrations shall be performed if the instrument is subjected to extreme operating conditions, hard usage or corrosive environment. Recalibration shall be performed following maintenance or significant adjustment.

8. ALARA Program

The objectives of the ALARA program are to maintain exposures to radiation, and releases of radioactive effluents at levels that are as low as reasonably achievable within the established dose equivalent and effluent release recommendations of the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP). These dose equivalents and release recommendations are to be considered as upper limits and

are not to be considered acceptable if it is reasonable to reduce these levels. The following design features and operational methods shall be considered for research reactors to achieve the ALARA objectives.

8.1 Facility Design. The following design objectives and features shall be considered, and utilized to the extent applicable for the control of radiation, contamination, and radioactive effluents.

8.1.1 Radiation Control

(1) Design Objective

The recommended maximum whole-body dose equivalent or effective dose equivalent for occupational exposure currently given in NCRP Report No. 39, "Basic Radiation Protection Criteria" [4] and ICRP Report No. 26, "Recommendations of the International Commission on Radiological Protection" [5] is 5 rem per year. The design objective for research reactors should be well below this value and should not exceed one rem per year. Identical or similar information to those recommendations of NCRP and ICRP is found in the Code of Federal Regulations, Title 10, Part 20, "Standards for Protection Against Radiation" [6].

(2) Design Features

- (a) Shielding
- (b) Materials of construction
- (c) Radioactive material processing, storage, and disposal facilities
- (d) Radiation monitoring systems
- (e) Facility layout for personnel traffic and equipment maintainability and accessibility.

8.1.2 Contamination Control

(1) Design Objective

The design objectives for contamination control are to select features and materials with radioactivity retention characteristics so as to minimize the spread of contamination and facilitate decontamination.

(2) Design Features

- (a) Ventilation and filter systems
- (b) Confinements to minimize the spread of contamination
- (c) Containments to prevent the spread of contamination
- (d) Materials of construction.

8.1.3 Radioactive Effluent Control

(1) Design Objective

The recommended maximum whole-body dose equivalent for individuals in the general public given in NCRP No. 39 [4] and ICRP No. 26 [5] is 500 mrem per year above natural background.

The design objective for research reactors should be well below this value and should not exceed 100 mrem per year from all facilities contributing to the exposure. Identical or similar information to those recommendations of NCRP and ICRP is found in 10 CFR 20 [6].

(2) Design Features

(a) Airborne effluents are controlled by building confinement or containment integrity, radioactive gaseous waste system disposal capabilities, and exhaust system features.

(b) Liquid effluents are controlled by the radioactive waste disposal facilities.

(c) Radioactivity monitoring systems are used to monitor radioactive effluents, and radioactive waste prior to disposal.

8.2 Facility Operation. The following methods and factors shall be considered, and implemented to the extent applicable for the control of radiation exposures, contamination, and radioactive effluents during routine and special operations.

8.2.1 Planning

(1) Assessments of radiation, contamination, airborne radioactivity and mechanical difficulties which might be encountered in performing the operation.

(2) Consideration of radioactive decay time.

(3) Assessment of the feasibility of reducing the existing radiation levels by draining, flushing, or other decontamination methods, or by removing and transporting the component to a lower radiation area.

(4) Consideration of personnel ingress and egress to work areas.

(5) Assessment of the response capability for coping with abnormal operational occurrences.

(6) Providing portable or temporary shielding.

(7) Providing portable or temporary ventilation systems, or temporary enclosures and covering, or both.

(8) Providing for personnel preoperational briefing for those assigned to perform tasks in high radiation areas.

(9) Performing "dry runs" or mock-up equipment to train personnel and identify problems that may be encountered in the actual situation, and to select and qualify special tools and procedures.

(10) Providing special communication systems.

(11) Providing radiation monitoring instruments in adequate numbers to permit accurate measurements and rapid evaluations of the radiation and contamination levels encountered.

8.2.2 Operations

(1) Supervision and surveillance to assure that appropriate procedures are followed and that planned precautions are observed.

(2) Prompt notification to management when dose limits are approached or when unanticipated problems develop during the course of the work.

(3) Use of and proper functioning of protective equipment.

8.2.3 Review and Audit

(1) Review activities after completion to verify that planning was sufficient.

(2) Review occupational exposures. Such review shall be conducted at least quarterly by the individual responsible for the radiation protection program. Management review shall be initiated for any individual exposures greater than those established as required in 3.1.

(3) Periodic review and audit of the ALARA program by management. Such review should be conducted at least annually.

(4) Periodic assessment by management of the effectiveness of the radiation protection program in order to institute possible changes and improvements to reduce overall exposures and releases. This assessment should be conducted at least annually.

9. Records

Documentation shall be required to assure the reliability and effectiveness of the radiation protection program. Records should be retained until their disposition is authorized by responsible authorities. If the retention period is not specified by the responsible authorities, the provisions of ANSI/ANS-15.1-1982 [1] should be used, and where no requirement is specified, the records should be retained for at least two years. In addition, where insurance requirements apply, all records should be retained for the duration of the nuclear liability coverage plus the discovery period stated therein, now ten years, unless otherwise stated. Listed below are the records that should be maintained.

(1) Dose equivalent and bioassay data where applicable for all personnel who have worked at the facility.

(2) Radioactive material inventory, transfer, and disposal.

(3) Radiation survey results.

(4) Surface contamination survey results.

(5) Airborne radioactivity survey results.

- (6) Radioactive effluent results.
- (7) Training program descriptions and attendance.
- (8) Environmental monitoring results.
- (9) Instrument calibration results.
- (10) Records of review and evaluation of unusual radiological occurrences.

10. Emergency Response and Exposure Guidelines

(1) Response to radiological emergencies is provided in ANSI/ANS-15.16-1982 [3].

(2) The following guidelines from NCRP No. 39 [4] are established for planned voluntary exposure under emergency conditions. Such exposures shall be included in the individual's lifetime accumulation.

(a) Life Saving Actions

1. Planned dose to the whole body shall not exceed 100 rems.

2. Hands and forearms may receive additional dose of up to 200 rems (i.e. a total of 300 rems).

3. Rescue personnel should be volunteers or professional rescue personnel (e.g. firemen who "volunteer" by choice of employment).

4. Rescue personnel should be broadly familiar with the consequences of exposure.

5. Women capable of reproduction should not take part in these actions.

6. Other things being equal, volunteers above the age of 45 should be selected.

7. Internal exposure should be minimized by the use of the best available respiratory protection, and contamination should be controlled by the use of available protective clothing.

8. Normally, exposure under these conditions shall be limited to once in a lifetime.

9. Persons receiving exposures as previously indicated, should avoid procreation for a period up to a few months.

(b) Actions in Less Urgent Emergencies

This applies under less stressful circumstances where it is still desirable to enter a hazardous area to protect facilities, eliminate further escape of effluents, or to control fires.

1. Planned whole body dose shall not exceed 25 rems.

2. Planned dose of hands and forearms shall not exceed 100 rems (including the whole body component).

3. Persons performing the planned actions

should be volunteers broadly familiar with exposure consequences.

4. Women capable of reproduction shall not take part.

5. Internal exposure shall be minimized by respiratory protection, and contamination controlled by the use of protective clothing.

6. Normally, if the retrospective dose from these actions is a substantial fraction of the prospective limits, the actions should be limited to once in a lifetime.

11. References

- [1] American National Standard for the Development of Technical Specifications for Research Reactors, ANSI/ANS-15.1-1982. American Nuclear Society, La Grange Park, Ill.
- [2] ORNLOEPA4, Standards and Guidelines Pertinent to the Development of Decommissioning Criteria for Sites Contaminated with Radioactive Material. National Technical Information Service, Springfield, Virginia.
- [3] American National Standard Emergency Planning for Research Reactors, ANSI/ANS-15.16-1982. American Nuclear Society, La Grange Park, Ill.
- [4] National Council on Radiation Protection and Measurements, NCRP Report No. 39 (1971). National Council on Radiation Protection and Measurements Publications, Bethesda, Maryland.
- [5] Recommendations of the International Commission on Radiological Protection, ICRP Publication 26, Volume 1 No. 3 (1977). International Commission on Radiological Protection, Elmsford, N.Y.
- [6] Code of Federal Regulations, Title 10, Part 20, "Standards for Protection Against Radiation." Government Printing Office, Washington, D.C.

Only the standards explicitly referred to in this document qualify as references. Subsequent revisions of these standards shall not be used.

Appendix

(This Appendix is not part of American National Standard for Radiation Protection at Research Reactor Facilities, ANSI/ANS-15.11-1987, but is included for information only.)

Supplementary References

The following supplementary references are American National Standards and provide additional information that would be useful in formulating a radiation protection program for research reactors. This is not a complete listing.

1. Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities, ANSI N13.1-1982.
2. Dosimetry for Criticality Accidents, ANSI N13.3-1981.
3. Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation, ANSI N13.5-1982.
4. Practice for Occupational Radiation Exposure Record Systems, ANSI N13.6-1982.
5. Criteria for Film Dosimeter Performance, ANSI N13.7-1983.
6. Criteria for Testing Personnel Dosimetry Performance, ANSI N13.11-1983.
7. Internal Dosimeter Techniques for Tritium, ANSI N13.14-1983.
8. Performance of Personnel Thermoluminescence Dosimetry Systems, ANSI N13.15-1985.
9. Performance Specifications for Pocket-Sized Alarming Dosimeters and Ratemeters, ANSI N13.27-1981.
10. Specification and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents, ANSI N42.18-1985.
11. Performance Specifications for Personnel Neutron Dosimeters (Neutron Energies Less Than 20 MeV), ANSI N319-1984.
12. Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation, ANSI N320-1984.
13. Inspection and Test Specifications for Direct and Indirect Reading Quartz Fiber Pocket Dosimeters, ANSI N322-1983.
14. Radiation Protection Instrumentation Test and Calibrations, ANSI N323-1983.
15. Testing of Nuclear Air Cleaning Systems, ANSI N510-1980.
16. Protective Coatings for the Nuclear Industry, ANSI N512-1974.
17. Performance Test, and Procedural Spec for Thermoluminescence Dosimetry: Environ Applications, ANSI N545-1982.
18. Respiratory Protection, ANSI Z88.2-1980.

The preceding American National Standards—with the exception of 12, 13, 14 and 15—are available from:

American National Standards Institute, Inc.
1430 Broadway
New York, N.Y. 10018

References 12, 13 and 14 are available from:

The Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, N.Y. 10017

Reference 15 is available from:

American Society of Mechanical Engineers
345 E. 47th St.
New York, N.Y. 10017