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Standard Guide for Radiological Protection Training for Nuclear Facility Workers¹

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1. Scope

1.1 This guide covers general recommendations with respect to standard work practices, procedures, and measurement methods for the radiological protection portion of health and safety training for radiation workers at nuclear facilities. This guide defines the elements of a training program for radiation workers consistent with the philosophy that occupational radiation exposure be kept as low as is reasonably achievable (ALARA). Regulatory agencies have statutory responsibilities to promulgate regulations applying to the training of workers exposed to radiation hazards. This guide shall not take precedence over any such regulations.

1.2 This guide is intended to help ensure that the employer provides the radiation worker with radiological protection training that the worker needs to work safely in a radiologically controlled area and to maintain radiation exposure ALARA.

1.3 The scope of radiological protection training shall be related to the duties and responsibilities of each radiation worker and shall be commensurate with potential radiological protection problems in the radiologically controlled area.

1.4 This guide is also intended to provide guidance that will enable an evaluation of the effectiveness of the radiological protection training program toward achieving the purpose stated in Section 4.

1.5 This guide does not cover the more detailed training requirements for radiation protection professionals or technicians.

1.6 This guide provides reference to the type of radiological protecting training records that should be created, and recommends retention periods for radiological protection training records.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *NCRP Document:*

NCRP Report No. 134 Operational Radiation Safety Training, October 2000²

2.2 *ANSI Standard:*

ANSI/ANS 3.1 American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants³

2.3 *ANI/MAELU Documents:*

Information Bulletin 80-1A, Nuclear Liability Insurance Records Retention⁴

Training and Qualification Criteria for Nuclear Liability Insurance (Section 2.2.1 of "General Employee Training")⁴

2.3 *DOE Document:*

DOE Handbook 1078-04 Training Program Handbook: A Systematic Approach to Training⁵

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *nuclear facility, n*—facility whose operations involve or involved radiation or radioactive materials in such form and quantity that a radiological hazard potentially exists to the employees or the general public. Included are facilities used to produce, process, or store radioactive materials. Some examples are as follows (also see **Note 1**):

² Available online at <https://www.ncrppublications.org>.

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

⁴ Available from American Nuclear Insurers, 29 South Main, (Suite 300S), West Hartford, CT 06107-2445.

⁵ Available from Department of Energy, National Technical Information Services, U.S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

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- 3.1.1.1 Fuel reprocessing plant,
- 3.1.1.2 Fusion research facility,
- 3.1.1.3 Nuclear reactor (power, test, or research),
- 3.1.1.4 Particle accelerator,
- 3.1.1.5 Radioactive waste disposal site,
- 3.1.1.6 Radiochemical laboratory,
- 3.1.1.7 UF₆ production plant, and
- 3.1.1.8 Uranium or thorium mill.

NOTE 1—This guide is intended to apply to nuclear facilities licensed by the U.S. Nuclear Regulatory Commission and the individual agreement states, to nuclear facilities operated by the U.S. Department of Energy, and to those nuclear facilities that are under the control of the U.S. Department of Defense.

3.1.2 *radiation worker, n*—any person who enters a radiologically controlled area to perform work. Radiation workers are sometimes referred to as occupationally exposed workers.

3.1.3 *radiologically controlled area, n*— area where access is controlled for purposes of radiological protection.

4. Significance and Use

4.1 The purpose of this guide is to define the elements of a radiological protection training program that will enable a radiation worker, upon completion of training, to achieve the following:

4.1.1 Understand the relative health and safety risks associated with the types and levels of radiation that may be encountered during the work assignment in radiologically controlled areas,

4.1.2 Complete the forms and records necessary to be permitted to function as a radiation worker,

4.1.3 Practice the necessary monitoring and contamination control techniques to minimize exposure to radiation or radioactive materials, or both, and

4.1.4 Practice work habits that will minimize the impact of radiation or radioactive materials, or both, upon the workplace and surrounding environments.

4.2 The standardization of radiation worker radiological protection training provides the individual radiation worker with a greater assurance that the training received is adequate to minimize radiation exposure, to enable the worker to work safely in a radiologically controlled area, and to meet applicable regulations.

4.3 The standardization of radiation worker radiological protection training prevents unnecessary retraining of radiation workers.

4.4 This guide should be used as the basis for establishing a radiological protection training program for radiation workers at nuclear facilities.

5. Training Administration

5.1 *Training Program Objectives*—The objectives of the radiological protection training program shall be to accomplish the following:

5.1.1 Provide guidance and training to enable each radiation worker to ensure ALARA.

5.1.2 Ensure that radiation workers are instructed in and physically can demonstrate the proper use of commonly used

radiation protection instrumentation, personal protective equipment, respirators, and personal exposure monitoring devices necessary to that individual's work assignment.

5.1.3 Train every radiation worker to enable compliance with appropriate safety and health postings and procedures and the proper reaction to warnings, alarms, and emergency situations.

5.1.4 Inform every radiation worker about the immediate and the long-term health risks associated with the acceptance of radiation exposure, and about the basis for health risk estimates.

5.1.5 Provide the information needed to enable each radiation worker to comply with applicable regulations.

5.1.6 Ensure that the program can be reviewed and revised as needed to meet changing conditions, and that the instruction is sufficiently understood to permit its practical application.

5.1.7 Ensure that radiation workers receive adequate radiological protection training for each job to which they are assigned.

5.1.8 Ensure that training is not repeated needlessly on site or at other facilities where the trained radiation worker may be employed.

5.1.9 Conduct training in such a way that the radiation worker knows the specific objectives of the training and can determine whether or not the training has been completed satisfactorily.

5.2 *Training Program Content:*

5.2.1 The content of the radiological protection training program shall be commensurate with potential radiological protection problems in the radiologically controlled area. The content of the program also shall reflect the type of nuclear facility (see 3.1) for which the training is being provided. The inclusion of topics in Section 6 and the emphasis of each topic within the training program shall be based on the needs of each individual or group requiring training. Hands-on or practical training shall be included in addition to classroom training where appropriate.

5.2.2 Credit may be given for prior applicable training received off site. Documentation of that training shall be in accordance with 5.6. It is appropriate to determine the applicability of an individual's prior training and experience, with respect to the present job requirements, by means of a test. If the prior applicable training was received before the period specified for requalification (see 5.5), then refresher training as described in 5.5 shall be given prior to the administration of the test. This refresher training may be combined with site-specific training.

5.2.3 Site-specific training shall be provided. Site-specific training shall include those topics in Section 6, the details of which may vary from one nuclear facility to another. Some examples are identification of and response to various alarms, evacuation routes, administrative limits and procedures, and radiological hazards unique to the facility.

5.3 *Scheduling:*

5.3.1 The radiological protection training program shall be scheduled so that each individual is trained in radiological protection to the degree necessary to perform his/her tasks safely before entering a radiologically controlled area.

5.3.2 For special cases in which an individual must enter a radiologically controlled area before completion of his training, the individual shall be escorted by a fully trained and qualified person. Such entries may be necessary for on-the-job training, for example. A brief radiological protection orientation should be provided to escorted individuals prior to entry into a radiologically controlled area.

5.4 Testing:

5.4.1 A radiation worker's knowledge of, competency in, and understanding of the basic principles and methods of radiological protection shall be evaluated through a written or computer-based objective test. Oral tests shall not be substituted for written or computer-based tests unless the impracticality of administering a written test is established and documented on an individual basis. The worker shall be retrained and retested on any subject of which he has insufficient knowledge. The testing shall be designed to establish whether or not the worker has the knowledge, understanding, and skill to work safely.

5.4.2 All radiation workers whose radiological protection depends on their effective use of equipment, facilities, or specialized procedures shall be observed by a qualified trainer while using such equipment or facilities or performing such procedures, and shall be individually graded on a pass-fail basis, that is, the worker performs the task satisfactorily or is given additional training until satisfactory performance is achieved or until the worker is found unsuitable for the job.

5.4.3 All written, computer-based, oral, and practical tests shall have carefully developed bases in order to ensure that appropriate areas of knowledge and skill are covered. Tests should cover information presented to the radiation worker and shall emphasize knowledge and practices directly related to day-to-day radiological protection.

5.5 Requalification:

5.5.1 The training program shall include periodic refresher training as required by the appropriate regulatory authority, or at least every two years, for any work description. High-risk work, for example, glove box operation, high-radiation entry, or radiography sources shall require at least annual requalification (see **Note 2**).

5.5.2 Requalification testing shall be carried out in conjunction with refresher training.

5.5.3 Those radiation workers requiring new or refreshed knowledge because of reassignment shall be given appropriate training and testing.

5.5.4 Supervisors and radiological protection personnel should be alert to radiation worker performance that indicates the need for further instruction, and shall design or revise training programs to meet those needs.

NOTE 2—Refresher training is generally less detailed than initial training, because refresher training usually highlights and reviews the material that was covered in initial training.

5.6 **Records**—Adequate training records help to avoid unnecessary repetition of an individual's training and may be used to determine the adequacy of an individual's training before each new work assignment. Training records shall be required for initial training and refresher training. These

records, which are used to document compliance with training requirements for health and safety, shall be maintained by the organization providing the training or by the organization to which the radiation worker belongs. Records referenced throughout this guide could be beneficial in future defense litigation. Legal counsel of the training organization should be consulted for determination of retention requirements and retention periods.

5.6.1 An individual's training records shall include the following information:

5.6.1.1 The radiation worker's name and a unique identification code (such as a social security number or passport number),

5.6.1.2 Inclusive dates and instructor's name for each segment of training or for each different training program,

5.6.1.3 The type of nuclear facility (see 3.1) for which the training program was developed,

5.6.1.4 A specific description of all training completed satisfactorily, such as references to pertinent lesson plans, course outlines, syllabuses, and other subject-specific descriptive information. Specific reference usually is made to such materials by date, edition, or issue,

5.6.1.5 A performance rating for each segment of training or each different training program satisfactorily completed by the radiation worker. This rating normally consists of a numerical or letter grade or a written evaluation,

5.6.1.6 Checklists that document the radiation worker's performance on an on-the-job training segment, where applicable, and

5.6.1.7 The name and location of the training facility.

5.6.2 On completion of training, each radiation worker shall receive a certificate of satisfactory completion, signed by the training department manager (or equivalent), that shall include the training dates and locations, the type of nuclear facility for which the training program content was developed, the name and location of the facility at which the training records are maintained, and a statement that the training is in accordance with this guide. This certificate allows the worker's previous training to be taken into account when determining training needs at another site.

5.6.3 In order for there to be an adequate basis for periodic evaluation of the training program, the following training program records shall be required:

5.6.3.1 Training materials such as outlines, syllabuses, brochures, videotapes, texts, tests (including test questions and oral and on-the-job checklists), or specific descriptions of these items to serve as a basis for determining the depth and scope of training given in each subject area. Specific reference usually is made to such materials by date, edition, or issue, and

5.6.3.2 The name and qualifications of each instructor and examiner involved in each training segment or each training program.

5.7 **Program Evaluations**—The training program shall be evaluated periodically by an assessor independent of the training program. The extent of such evaluations should determine the following:

5.7.1 Program objectives are being achieved,

5.7.2 Each radiation worker is receiving training related to his/her work,

5.7.3 Initial training and refresher training are timely,

5.7.4 Adequate training records are being created and maintained to ensure accessibility, completeness, and usefulness,

5.7.5 The program is supported by management with adequate facilities, number and quality of instructors, and training aids,

5.7.6 The program is responsive to the radiation worker's need for knowledge and skills, and

5.7.7 Each radiation worker's on-the-job performance confirms training effectiveness (see **Note 3**).

NOTE 3—Appropriate methods for examining on-the-job performance that confirms training effectiveness include conducting random worker interviews at the work site, direct observation of worker performance, and an examination of those nuclear facility records that may indicate deficiencies in specific training areas.

5.8 *Training Program Development*—NCRP Report No. 134 and DOE Handbook 1078-04 provide systematic processes for the development of training programs and provides a description of the activities that should be considered in developing effective training programs (see **Note 4**).

NOTE 4—NRC Regulatory Guide 8.27 **(1)**⁶ and INPO/NANT computer-based training **(2)** provide additional information on radiological protection training program development and implementation.

5.9 *Qualification of Training Personnel*—ANSI/ANS 3.1 provides guidance on the qualification of training department personnel (that is, managers, coordinators, and instructors).

6. Course Content

6.1 This section identifies the topics that should be addressed in a radiological protection training program to ensure that the program objectives as described in **5.1** are achieved. The inclusion of a given topic and the emphasis placed on that topic shall be consistent with **5.2**. Additional guidance on radiological protection training is provided in ANI/MAELU Training and Qualification Criteria for Nuclear Liability Insurance (Section 2.2.1 of "General Employee Training").

6.2 *General Requirements* (see **Note 5**):

6.2.1 *Completion of Radiation Dose History Forms with Assistance*:

6.2.1.1 State the reasons for maintaining individual radiation dose records.

6.2.1.2 State the location of the repository, and explain how to obtain radiation dose records.

6.2.2 *Description of Workers' Rights Protected by Applicable Requirements*:

6.2.2.1 State the location of notices to workers, instructions for workers, reports to individuals, and regulatory agency site inspection information.

6.2.2.2 State the facility's responsibility to instruct workers in radiological protection.

6.2.3 *Permissible Radiation Dose Limits*:

6.2.3.1 Define radiation measurement and dose units.

6.2.3.2 State the applicable regulatory radiation dose limits for whole body, extremity, and skin dose, and the applicability of the limits.

6.2.3.3 Explain the basis for the dose limits.

6.2.3.4 Discuss the relationship of occupational dose limits to those for the general population.

6.2.3.5 State the dose limitations for planned special exposures and guidance for exposure during emergency conditions.

6.2.3.6 Explain the potential consequences and probability of consequences for exceeding dose limits given the best available risk estimates.

6.2.3.7 Relate the ALARA principle to dose limits and dose control.

6.2.4 *Determination of Internal Exposure*:

6.2.4.1 Define derived air concentration (DAC) and annual limit on intake (ALI).

6.2.4.2 State the basis of the DAC and ALI. Discuss the internal dosimetry models that relate DAC and ALI to internal exposure.

6.2.4.3 Explain how DACs and ALIs are used for internal dosimetry. Discuss various bioassay monitoring techniques used to verify the presence (or absence) of internal contamination derived from a DAC analysis.

6.2.5 *Posted Radiological Warning Signs and Labels*:

6.2.5.1 Explain the purpose and appropriate response to all prescribed warning signs and labels.

6.2.5.2 State the requirements that must be met before entering areas posted with prescribed warning signs.

6.2.5.3 Explain the consequences of disregarding warning signs and labels.

6.2.5.4 Explain the consequences of unauthorized movement of posted warning signs and labels.

6.2.6 *Possible Health Effects of Exposure to Ionizing Radiation*:

6.2.6.1 Explain the mechanisms of biological injury to cells and organ systems and how these mechanisms are related to radiation type and source of dose (internal versus external).

6.2.6.2 Define stochastic effects versus deterministic effects of radiation exposure and how this is related to dose limits for the various organs and tissues of the body.

6.2.6.3 Explain the risk basis for occupational dose limits and how this relates to other types of occupational and societal risks.

6.2.7 *Recommended Practices Concerning Prenatal Radiation Exposure*:

6.2.7.1 Explain the possible risks of radiation exposure to the developing embryo and fetus.

6.2.7.2 State the recommendations with respect to the radiation exposure of a woman who might be pregnant.

6.2.7.3 State the importance of informing supervisors of pregnancy.

6.2.7.4 Describe the options for a pregnant employee with respect to radiation exposure.

NOTE 5—U.S. NRC Regulatory Guides 8.8 **(3)**, 8.10 **(4)**, 8.13 **(5)**, and 8.29 **(6)**, 10 CFR Part 19 **(7)** Part 20 **(8)**, and Part 835 **(9)**, ICRP Publications 60 **(10)**, NCRP Report Number 116 **(11)**, and BEIR VII **(12)** all provide additional background information for some of the general requirements topics.

⁶ The boldface numbers in parentheses refer to the list of references at the end of this guide.