REGULATORY GUIDE 8.JB

RADIATION PROTECTION TRAINING FOR LWR NUCLEAR POWER PLANT PERSONNEL

A. INTRODUCTION

Section 19 12 of 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," requires that individuals be given instruction in radiation protection that is commensurate with the potential radiological health protection problems they may encounter in restricted areas. Paragraph 20.1(c) of 10 CFR Part 20, "Standards for Protection Against Radiation," states that occupational radiation exposure should be kept "as low as is reasonably achievable" (ALARA). Appropriate training is an essential aspect of an ALARA program. This guide describes an acceptable radiation protection training program for meeting the training requirement of 10 CFR Part 19 and the ALARA objective with respect to individuals that enter restricted areas at nuclear power plants (NPPs). Regulatory Guides 8.8 and 8.10 (References 1 and 2) should be consulted with respect to training within a complete ALARA program.

B. DISCUSSION

Almost every job entails the acceptance of some risk. Many of these risks are obvious and easily recognized. Other hazards are more subtle and may not be recognized or appreciated without specific instruction.

Radiation exposure is one of the subtle hazards. A person may be exposed to significant levels of radiation or radioactive materials without knowing it, since human senses will not detect ionizing radiation. For these reasons, instruction in basic radiation protection is essential to the understanding of the occupational risks of NPP work.

Work at a nuclear power plant involves the potential for exposure to significant levels of ionizing radiation. The policy of the NRC is that radiation exposure should be kept "as low as is reasonably achievable" (ALARA). (ALARA programs at NPP's are covered in Regulatory Guide 8.8, reference 1.) Proper training in radiation protection is an essential part of an ALARA program.

It is not necessary for all NPP personnel to become experts in radiation protection. However, it is important that every person receive training that is commensurate with his or her duties and responsibilities with respect to restricted areas.

C. REGULATORY POSITION

1. General

Each individual's primary duties and responsibilities as well as any secondary duties and responsibilities should be carefully considered in determining appropriate training for that individual.

Training should include both classroom and on-the-job instruction and experience. Such training should be provided by instructors and examiners whose knowledge of the subject they are teaching is far in excess of the knowledge to be expected of trainees completing the training. Personnel

qualifications are covered by reference 3, Regulatory Guide 1.8, "Personnel Selection and Training."

Although credit may be taken for applicable training received offsite (when such training is documented with respect to its nature and applicability to onsite duties and responsibilities) plant-specific training should also be received with respect to those topics listed in Section C.5. Minimum training may vary from a few minutes for a visitor, through a few hours for onsite orientation of a radiation protection professional, to a week (40 hours) or more for workers without prior training in radiation protection and radiation work techniques.

The training program should be approved by the NPP radiation protection manager (see reference 3), conducted under the manager's continuing cognizance, and reviewed and updated at least once every 3 years under the manager's direction.

2. Who Should Receive Radiation Protection Training

The radiation protection training program should include all personnel who may enter restricted areas whether or not they are employees of the licensee. This includes visitors and transient workers.

Visitors are defined as people who enter the plant for purposes other than work for the licensee and who are not expected to receive significant radiation doses although they may occasionally enter restricted areas (e.g., sales persons or students). Transient workers are defined as people who enter the plant to work in restricted areas for a limited period of time (whether or not they are employees of the licensee).

Examples are equipment manufacturers' representatives; individuals employed in maintenance work; NSSS vendor personnel who assist with refueling, startup or maintenance; and licensee employees temporarily assigned to the NPP. Transient workers should receive onsite plant-specific training and should have a background of training in the more general (non-plant-specific) areas of radiation protection, and the biological risks involved, of the same scope, depth and quality as full-time onsite radiation workers doing the same or similar work.

3. Objectives

The primary objectives of the radiation protection training program (RPT) should be to:

a. Ensure that all personnel involved are instructed about the biological effects of radiation (including both immediate and latent radiation effects) and the risks associated with the acceptance of radiation exposure.

b. Provide the information needed to enable each person to comply with plant rules and respond properly to warnings and alarms under both normal and accident conditions.

c. Provide the information needed to ensure that individuals can keep their own exposures ALARA and ensure that ALARA considerations can be appropriately reflected in decisions which affect the exposure of others.

d. Provide the information needed to enable each person to comply with NRC regulations and license conditions.

Secondary objectives of the RPT program should be to:

a. Ensure that the program is fully documented (see Section C.8) so that it can be reviewed and revised as needed to meet changing conditions.

b. Produce evidence that the instruction is sufficiently well understood to permit its practical application.

c. Result in evidence of training completed by each individual so that training is not repeated needlessly onsite or at other facilities where the trained person may be employed (see Section C.8).

4. Timing

The RPT program should be scheduled so that each individual is trained in radiation protection prior to working in a restricted area. A worker required to enter any restricted area prior to completion of the training should be escorted by a fully trained and qualified person (such entries may be necessary for on-the-job training, etc.). Those individuals who will routinely be required to work in restricted areas should receive onsite "field instruction" concerning the radiation protection aspects of their jobs prior to working in such areas.

The RPT program should include periodic refresher training as necessary to maintain awareness of the need for, and each individual's role in, ALARA activities, and to update and renew each individual's knowledge of appropriate subjects as listed in Table 1. Refresher training should occur annually, as a minimum. Also, frequent (e.g., once per month), brief discussions should be held to furnish an opportunity for workers to

get answers to radiation protection questions and to discuss recent developments in radiation protection procedures, equipment, and regulations. Recent plant radiation protection problems and the solutions to such problems should be discussed at these meetings.

5. Radiation Protection Training Program Content

The RPT program should include the general topics listed in Table 1 and discussed below. Emphasis on each topic should be varied to meet the needs of each individual or group as mentioned in Section C.2. Appropriate documents covering essential facts, requirements, regulations, procedures, and plant organization should be given to each trainee for future reference and guidance.

a. Biological Effects of Radiation

Each trainee should be informed about the somatic and genetic risks to exposed individuals, their progeny, and exposed embryos/fetuses (see Reference 4), and should be given instruction with respect to the collective dose concept of risk.* Further, each should be informed of the risks associated with very high doses, which might occur in an accident. To the extent practicable, each individual should be informed of the magnitudes of radiation risks relative to other more familiar risks encountered in life. References 5 through 7 are some appropriate sources of information.

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*The collective dose concept applies to total man-rem doses to exposed groups. These doses, as well as individual doses, must be given due consideration in any radiation control plan, and especially a plan such as the plant ALARA program.

Individuals who work in restricted areas or who make decisions affecting such work should be taught enough about radiation effects to permit appreciation of the importance and the implications of ALARA programs and requirements. Such persons should also be informed about the levels of radiation doses that individuals working in restricted areas may normally receive (within the constraints of 10 CFR Part 20 and an appropriate ALARA program) and the risks associated with such doses.

b. Radiation Exposure Measurement and Control

Each trainee should be informed that radiation can be measured at levels significantly below regulatory limits and controlled by means of suitable design and procedural techniques. Workers and their supervisors should understand the elements of radiation measurement and control well enough to implement the measurement and control programs in a manner consistent with the ALARA principle. Emphasis in RPT should be on (1) proper use of dosimeters for measurement of beta, gamma, and neutron radiations, (2) use of time, distance, and shielding to reduce doses, (3) sources of radiation, and (4) contamination control. The importance of performing work in accordance with preplanned procedures so as to minimize radiation doses to the worker and others who may be exposed to radiation as a result of the worker's actions should be stressed.

c. Radiation Protection Program

Each trainee should understand that personnel outside restricted areas should not be significantly affected by activities involving radioactive materials or radiation in restricted areas. The meaning and importance

of posted instructions, including radiation warning signs and tags, and the importance of following instructions should also be understood.

Workers and their supervisors should have a thorough understanding of the program, including applicable Federal regulations and plant radiation protection rules and operating procedures. Emphasis should be placed on ALARA concepts, philosophy, and implementation within the radiation protection program (see References 1 and 2). This emphasis should include management's commitment to ALARA, the manner in which the radiation protection staff will implement ALARA concepts and philosophy, and the responsibilities of the individual worker within the ALARA program. RPT should include special attention to the use of respiratory protection devices and procedures. It is essential that workers be trained in the proper use of these devices prior to their use. (See Reference 8.)

d. Emergency Preparations

Each trainee should know the appropriate response to alarms and signals.

Workers and their supervisors should be familiar with the details of emergency procedures and preparations so they will know what is expected of them and from whom they can expect guidance. Preparations for emergencies that may be anticipated should be emphasized; these include accidents such as those involving severe personal contamination combined with injury and localized fires in restricted areas.

The RPT should emphasize the emergency facilities and equipment as well as emergency exits, escape routes, and safe assembly points.

e. Special or Nonroutine Work

Short-term training will be required from time to time in association with special or nonroutine work. The work may be considered special because of the equipment to be used, the procedures to be followed, or the radiation protection problems involved. Such training would normally be very limited in scope and should be considered as a supplement to, rather than a substitute for, the training described above.

f. Training with Mockups

Experience has established that training effectiveness is greatly enhanced when equipment or facility mockups are used, allowing trainees to practice repair and maintenance procedures in a realistic context prior to entering areas in which high radiation levels exist. This type of training is especially valuable in the case of repair and maintenance work involving tasks that may result in high doses to personnel in relatively short periods of time.

A mockup of each piece of equipment and facility on which, or in which, high man-rem tasks may be anticipated should be used in plant-specific training for those workers who are most likely to perform maintenance or repair work on the equipment or in the facility. Facility mockups are valuable in those cases in which work on a piece of equipment (e.g., a valve) requires the worker to gain access to, or work in, confined areas or areas containing complex equipment and strong sources of radiation. A facility mockup will allow the worker to practice entry, egress, and positioning within the facility so as to perform the necessary work in accordance with the ALARA principle.

When practicable, the mockups should be made to full scale and incorporate components similar to those to be encountered in work on the equipment to be serviced.

6. Evaluation of Trainee Performance

Each trainee's knowledge, competency and understanding should be tested, specifically with regard to the radiation safety aspects of specific jobs to be performed. This may consist of a written test only, but should, in most cases, consist of a written test, an oral test, and a "practical" or on-the-job performance test. Requalification testing should be carried out in conjunction with refresher training (see Section C.4).

High test grades (80% or higher) should be required since tests should cover only radiation protection information relevant to the individual's needs. The trainee should be reinstructed and retested in any areas in which the trainee's knowledge is shown to be deficient.

Tests should cover all information presented in a training course, but should emphasize knowledge and practices directly related to the day-to-day radiation protection practices for a particular worker's job. As plant operating experience is gained, test questions should reflect radiation protection problems actually experienced at the plant.

True-false and multiple choice questions are easy to grade and preferred by those taking tests, but lend themselves to guessing. Therefore, at least 50% of any written test should consist of essay or calculational questions. Questions should be of the type included in training session exercises or "homework". "Situation" type questions are especially desirable.

In this type question a hypothetical (but credible) situation is described and questions based on actual case histories are asked.

"Practical" or on-the-job tests should not only stress knowledge, but also proper performance on the job. An individual may know what to do but be unable to do it in a timely manner when faced with a situation demanding expeditious action without a trial-and-error procedure. Practical tests should also give the examiner the opportunity to determine a trainee's attitude toward radiation protection and the ALARA concept. In preparing a test, consideration should be given to individual job responsibilities, training received, and radiation protection experience.

All tests should be designed to:

a. Measure the individual's ability to recognize and cope with radiation hazards that may be encountered on the job.

b. Stress the importance of being prepared for work in restricted areas.

c. Assess the individual's knowledge of, and attitude toward, the individual's rights and obligations as a worker.

7. Radiation Protection Staff

The radiation protection staff, both professionals and technicians, should be thoroughly conversant with the materials discussed in Section C.5. Their knowledge should be of such depth as to qualify the radiation protection staff to develop and conduct the RPT for all others. Further, they must be prepared to develop, modify, and implement the radiation protection program competently.

8. Records

Except for periodic refresher type training, it is desirable to avoid repetition of training. Adequate training records will help eliminate unnecessary repetition. Also, some workers (especially transient workers) may work in several different NPP's at different times. Because of this, and in the interest of improving the effectivenss of training and eliminating redundancy, training programs should be structured so that site-specific training and non-site-specific training may be readily identified in training outlines, syllabuses, other training materials, and records.

Training records should include:

a. The student's name,

b. Inclusive dates for each segment of training or for each different training program,

c. A specific description of all training completed satisfactorily, including references to pertinent course outlines, syllabuses, and other subject-specific descriptive information,

d. A performance rating for each segment of training or each different training program satisfactorily completed by the student. This rating should consist of a numerical or letter grade and/or a written evaluation.

In order to help prevent needless retraining of personnel, a statement containing the information described in items a, b, c, and d above on training received that may be applicable to work at another NPP should be given to the student for use when and if work is to be done by the student at a different NPP. This procedure will allow the person responsible for

training at the second NPP to take the student's previous training into account and thereby avoid needless repetition. In order that such records may be most useful to the worker in the new position, they should clearly and explicitly describe all training received and clearly identify training segments that may be applicable to work at the new position.

In order that there may be an adequate basis for periodic evaluation of the training program, the following additional records should be maintained:

a. Training materials such as outlines, syllabuses, brochures, video tapes, texts, etc., or specific descriptions of these, to serve as a basis for determining the depth and scope of training given in each subject area.

b. The name of each instructor and examiner involved in each segment of training or each different training program.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with Section 19.12 of 10 CFR Part 19 of the Commission's regulations, the method described herein will be used in the evaluation of submittals in connection with operating license or construction permit applications docketed after _____ unless this guide is revised as a result of suggestions from the public or additional staff review.

If an applicant wishes to use this regultory guide in developing submittals for applications docketed on or before _____, the pertinent portions of the application will be evaluated on the basis of this guide.

In the case of training programs at operating reactors, appropriate modifications to such programs should be made, consistent with this guide, as soon as practicable and no later than one year after publication of this guide.

REFERENCES

1. U.S. Nuclear Regulatory Commission, Regulatory Guide 8.8, "Information Relevent to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

2. U.S. Nuclear Regulatory Commission, Regulatory Guide 8.10, "Operating Philosophy For Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable."

3. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.8, "Personnel Selection and Training."

4. U.S. Nuclear Regulatory Commission, Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure."

5. National Academy of Sciences, National Research Council, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," November 1972.

6. ICRP-26, "Recommendations of the International Commission on Radiological Protection," January 1977.

7. National Safety Council, "Accident Facts."

8. U.S. Nuclear Regulatory Commission, Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," and NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials," October 1976.

9. U.S. Nuclear Regulatory Commission, NUREG 75/087, LWR Edition, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," September 1975.

10. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

11. ICRP-27, "Problems Involved in Developing an Index of Harm," May 1977.

12. Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation."

13. Title 10, Code of Federal Regulations, Part 19, "Notices, Instructions and Reports to Workers; Inspections."

TABLE 1

TOPICS TO BE COVERED IN THE RADIATION PROTECTION TRAINING PROGRAM

Radiation Biology

- Carcinogenesis
- Genetic Effects
- Acute Effects
- Latent Effects
- Collective Dose Concept
  - Group Total Man-Rem Risk
  - Individual Dose Risk
- Dose-Effect Relationship
  - External Radiation
  - Internal Radiation

Radiation Exposure and Radioactive Material Measurement and Control

- Types of Radiation and Their Characteristics
- External Dosimetry
- Exposure Time Limitation
- Distance Between People and Radiation Sources
- Shielding
- Source Identification and Control
- Source Strength Reduction
- Types and Forms of Radioactive Materials
- Sources (Origins) of Radioactive Materials and Radiations
- Detection and Control of Contamination
- Radiation Measurement and Survey Instruments
- Bioassay: Whole Body Counting, Urinalysis, and Fecal Analysis

Radiation Protection Program

- ALARA Program
- Radiation Zones
- Signs and Labels
- Personnel Monitoring
- Air and Area Monitoring
- Protective Apparel
- Respiratory Protective Devices
- Rules and Procedures
- NRC Regulations

TABLE 1 (continued

- Dose Limits
- Concentration Values
- Reporting Requirements

- Professional Guidance and Assistance
- Control and Removal of Contamination and Contaminated Equipment

Emergency Preparations

- Plant Safety and Accident Control Features
- Signals and Alarms
- Evacuation Routes and Procedures
- Assembly Points
- Communications
- Guidance and Direction
- Emergency Equipment