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Implementation of ANSI 13.36- Radiation Safety Training for Workers

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INTRODUCTION

"Radiation Safety Training for Workers" (ANSI 13.36) specifies a process for developing and implementing radiation safety training using performance-based concepts. In general, radiation safety training includes radiological safety policies, fundamental radiological controls, and the technical functions of specific facilities. Actual training, however, can vary significantly from one site to another, depending on the requirements and potential risks associated with the specific work involved.

Performance-based training focuses on the instruction and practices required to develop job-related knowledge, skills, and abilities, rather than on simply prescribing training content and objectives. The Health Physics Society Standards Committee (HPSSC) working group recommended performance-based training, as opposed to a broad training program with prescribed performance objectives, for two main reasons: 1) the wide range of radiological workers to be trained and 2) the concern that a prescriptive program (i.e., 40 hours of training) could be misapplied. In addition, the working group preferred that the scope and depth of training be based on specific hazards and the magnitude of risk posed by those hazards. The group also proposed that passing scores be based on specified goals and the characteristics of test questions used. For instance, where passing scores are established (e.g., multiple-choice exams), they should be based on an analysis of the test questions rather than simply an arbitrary passing score.

This standard is not intended to replace regulatory or contractual training requirements that establish minimum objectives, topics, class duration, or passing scores. Nor does it address radiation safety training received as part of an academic program of study. Such individuals would still require site-specific and on-the-job training for certain tasks.

TRAINING PROGRAM

In keeping with the principles of good technical instruction, all radiation safety training should:

- Contribute to the retention and improvement of employees' knowledge, skills, and abilities (KSAs).
- Be site-specific and employ, where practical, the actual tools, instruments, and equipment used on the job.
- Include materials for non-job-specific training that have been reviewed and, if possible, critiqued and tested.
- Be delivered by instructors who are competent in both the subject matter and instructional methods established for the program.
- Specify any necessary prerequisites for the training and clearly identify the objectives of and KSAs to be gained from the training.
- Include a mechanism for evaluating the training's effectiveness.

Continuing Training

The purpose of continuing training is to refresh and enhance initial training as well as to maintain radiological worker qualification. To that end, continuing training should:

- Reinforce infrequently used skills.
- Discuss changes in facility conditions, written policies, regulatory changes, and/or procedures, instrumentation, or operation.
- Present site and/or industry lessons learned from accidents or poor work practices.

Worker requalification should be part of continuing training. Moreover, the training program should establish the frequency of such requalification. Topics selected for the requalification process should be based on their significance to the job, whether retraining is required (by regulation or contract), and/or any other criteria considered essential to validate the requalification.

TRAINING SYSTEM DEVELOPMENT

Training priorities should be based on the risks, difficulty, importance, and performance frequency of a given task and the knowledge, skills and abilities required to perform that task. By employing a systematic approach to the design and development of training, it is much easier and more likely that the basic goals of radiation worker training will be met. Training System Development (TSD), Systematic Approach to Training (SAT), and Instructional System Design (ISD) all refer to a systematic approach to creating performance-based training. Basically, this approach consists of five phases:

- Analysis
- Design
- Development
- Implementation
- Evaluation

Analysis Phase

This phase entails evaluating a job or facility to determine what tasks require training and then prioritizing those tasks based on their importance to safety. This can be done through group discussions, structured interviews with experienced individuals, and/or reviews of facility work procedures. It is important that appropriate subject-matter experts validate job evaluations because those evaluations provide the basis for determining the level of training needed. Attachments 1 (Facility Checklist) and 2 (Job Evaluation Checklist) provide helpful lists of training topics/materials. At Lawrence Livermore National Laboratory, we use these checklists in determining whether existing courses need to be revised or new courses need to be developed.

In addition to job and facility evaluations, the new standard calls for assessing the applicability of topics to be addressed. In general, all topics listed in the standard are to be covered unless they are determined—and annotated—to be *not applicable* (e.g., individuals who only operate diagnostic x-ray devices do not require instruction on alpha or beta radiation or contamination control). A Training Topics Checklist is provided in Attachment 3.

Design Phase

The Design Phase consists of:

- Setting the training objective (*Where do we want/need to go?*).
- Identifying the prerequisites needed (*What initial KSAs are necessary to understand the training?*).
- Determining the level of training needed by the target audience (*Who needs to get there?*).
- Designing strategies/methods and materials to facilitate learning (*How do we get there?*).
- Establishing evaluation standards by which to measure performance (*Did we get there?*).

During this phase, information from the checklists is incorporated into the course design. As the structure of the course and its components come together, this information is recorded on a Course Specification Form—a dynamic, working document that will change as the course continues to be developed and refined.

Course Specification Form

1. Course Title
    - A. Drivers/Requirements *[Why we have to get there? What we have to satisfy*?*]*
    - B. Goal/Vision: *[Where are we going?]*
    - C. Target Audience *[Who do we have to get there?]*

2. Course Design *[How do we get there?]*
    - A. Course Description
    - B. Prerequisites
    - C. Course Outline
    - D. Course Objectives
        1. Terminal Objective(s) *[What task needs to be completed?]*
        2. Enabling Objectives *[What steps are required to accomplish the task?]*
    - E. Performance Criteria
    - F. Retraining/Requalification
    - G. Exemptions/Alternates/Equivalencies/Reciprocity

3. Training Methodology and Resources
    - A. Training Delivery
    - B. Course Duration
    - C. Training Materials and Resources
    - D. Student Materials
    - E. Instructor Qualifications

4. References

Implementation Phase

Here, we conduct the training—first as a pilot course, leading ultimately to a finished product. (Though, as anyone in training knows, there is no such thing as a "finished" course).

Evaluation Phase

This is where we evaluate training effectiveness. Course evaluations are analyzed to determine the training's strengths and weaknesses. It should be noted, however, that course evaluations completed at the end of a training session—while often used—may not give a true picture of training retention or application on the job. Such evaluations, therefore, should be considered with care.

INSTRUCTOR QUALIFICATIONS

Instructor qualifications, both technical and instructional, are addressed in the standard. As with all instruction, but particularly with adult training, it is very important to have instructors who are experienced and technically knowledgeable in the subject areas they teach. The instructor qualifications specified in this standard are based on best industry practices.

Instructional Qualifications

Instructors must demonstrate that they can successfully perform instructional tasks. This qualification can be met by evaluating on-the-job performance, by completing an academic program of study, or by attending an approved training program in instructional design technology.

Technical Qualifications

Instructors must be technically competent (i.e., have both theoretical and practical knowledge as well as relevant work experience) in the subject areas they teach. This can be evidenced by:

- A Bachelor of Science degree (or equivalent) in health physics, radiological sciences, or related field; or by an advanced degree in a related field plus three years' work experience.

OR

- Certification by the American Board of Health Physics, the American Board of Medical Physics, or the American Board of Radiology.

OR

- Registration with the National Registry of Radiation Protection Technologists.

OR

- Certification by the National Environmental Training Association in Radiation Protection.

OR

- Being ANSI 3.1 radiation protection group leader 4.4.4 qualified.

OR

- If none of the above apply, having a minimum of 60 semester-hour equivalents in science and technology course work (or equivalent experience) and a minimum of three years' work experience. (Note: Work experience may be included in the 60-semester-hour equivalent, up to a maximum of 48 semester-hour equivalents at 6 hours per year).

This standard does not imply that the technical qualifications listed above are equivalent, only that they should provide a basic level of technical competency. The technical qualifications needed for specific training should be based on the training to be given.

The Radiation Safety Organization should concur with any exemptions or equivalent course work for technical qualifications.

To maintain technical competency in their field(s), instructors should continue to perform satisfactorily on the job and participate in continuing technical training activities.

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Attachment 1

Facility Checklist
Facility:

Target Audience	**Comments**
1. Target Audience From Facility	________
A. Worker categories	
________ 1. Radiological worker >100 mrem/y*	________
________ 2. Radiological worker <100 mrerm/y	________
________ 4. Non-Radiological worker	________
________ (a) Management and supervisory personnel	________
________ (b) Short-term workers	________
________ © Students	________
(d) Emergency Personnel	

* This category includes individuals likely to receive in a year an occupational whole-body dose in excess of 100 mrem, 2% of any applicable dose limit, or whose dose could be significant if the person did not receive training. "Likely to receive" includes evaluation of normal and abnormal situations, but not accidents or emergencies.

Radionuclide Checklist

Material	Liquid	Solid	Gas	Nondis-persible	Disper-sible	μCi	mCi	Ci	kCi
Tritium									
C-14									
P-32									
S-35									
Co-60									
I-125									
Cs-137									
Mixed FP									
Ra-226/radon									
Thorium									
Enriched U									
Natural U									
Depleted U									
Plutonium									
Cm-244									
Other-specify									

Attachment 2

Job Evaluation Checklist

Facility:

Tasks/Controls	Comments
1. Radiological Hazards	
A. Radiation-Generating Devices*	
1. Class II device	
2. Class III device	
3. E-beam device	
4. Accelerator	
5. Radiographic devices	
B. Radioactive material handling	
1. Workbench (low-level laboratory)	
2. Hood (low-level laboratory)	
3. Glovebox	
4. Sealed sources	
5. Other	
C. Radiological Areas	
1. Radioactive material areas	
2. Buffer areas	
3. Contamination Areas	
4. Radiation Areas	
5. High or Very High Radiation Areas	
2. Radiological Monitoring	
A. Contamination surveys	
1. Alpha	
2. Beta/gamma	
3. Other	
B. Radiation-level surveys	
1. Detection	
2. Dose rate	
3. Neutrons	
3. Personnel Protective Equipment	
A. Lab coat/gloves	
B. Full anti-Cs	
C. Double anti-Cs	
D. Respiratory protection	
4. Abnormal Conditions	
A. Alarms	
1. Continuous air monitor	
2. Radiation air monitor	
3. Criticality alarm	
B. Spill of radioactive material	
C. Pyrophoric material	

* Includes: low-intensity flash x-ray, radiographic x-ray devices and diffraction or fluorescence devices.

Attachment 3

Training Topics Checklist
Facility:

Applicability/Addressed		Comments
	1. Basic Radiation Theory and Fundamentals	
	A. Radiation	
________	1. Electromagnetic and Particulate Radiations	________
________	2. Origin of radiation types	________
________	3. Ionizing radiation	________
	B. Quantities and units of measure	
	1. Radioactivity	
________	(a) curie (Ci)	________
________	(b) disintegrations per minute (dpm)	________
________	(c) becquerel (Bq)	________
	2. Exposure	
________	(a) roentgen (R)	________
________	(b) coul/Kg	________
	3. Dose	
________	(a) rad or gray (Gy)	________
________	(b) rem or sievert (Sv)	________
________	(c) absorbed dose	________
________	(d) equivalent dose	________
________	(e) effective dose	________
________	(f) committed dose equivalent	________
________	(g) committed effective dose equivalent (CEDE)	________
________	(h) total effective dose equivalent (TEDE)	________
	C. The types of ionizing radiation	
________	1. Type versus penetrating ability	________
________	2. Internal and external hazard	________
	D. The characteristics of radioactive material	
________	1. Radioactivity	________
	2. Half-life	
________	(a) physical	________
________	(b) biological	________
________	(c) effective	________
________	E. Fission/criticality	________
________	F. The properties of specific radionuclides	________
________	G. The properties of specific RGDs	________
	H. Interaction of radiation with matter	
	2. Sources of Ionizing Radiation	
________	A. Common sources of ionizing radiation	________
________	1. Radiation-generating equipment	________
________	2. Radioactive materials	________
________	B. Sources of background radiation exposure to U.S. population	
________	1. Natural background	________
________	2. Medical diagnosis and treatment	________
________	3. Manufactured	________
________	C. Source of occupational radiation exposure	________
________	D. Radiation hazards at the facility	________
________	1. Type	________
________	2. Location	

3. Biological Effects and Risks of Exposure to Ionizing Radiation			
	A.	Biological response to ionizing radiation	
	1.	Stochastic	
	2.	Deterministic	
	3.	Heritable effects	
	B.	Factors affecting biological response	
	1.	Total dose received	
	2.	Dose rate	
	3.	Type and energy of the radiation	
	4.	Area of the body irradiated	
	5.	Cell sensitivity	
	6.	Individual sensitivity	
	C.	In utero irradiation effects (teratogenic)	
	D.	Radiation risks	
	1.	Quantifying risks	
	2.	The acceptability of risks	
	3.	Perceived risks versus actual risks	
	4.	Studies that might indicate a beneficial effect	
4. Radiation Protection Standards			
	A.	Epidemiological studies	
	B.	Dose response models	
	C.	National and international recommendations	
	D.	Occupational limits	
	E.	Facility control levels	
	F.	Protection of the embryo/fetus	
	G.	Protection of the general public	
	H.	Personal protective equipment	
	I.	Contamination control	
	J.	Decontamination methods	
	K.	Waste management	
5. Radiation/Contamination Monitoring			
	A.	Radiation detection, measurement and instrumentation	
	1.	Principles of detection	
	2.	Portable survey meters	
	3.	Laboratory detectors	
	4.	Personnel dosimeter	
	5.	Air samplers/monitors	
	B.	Personnel monitoring	
	1.	External monitoring	
	2.	Internal monitoring	
	C.	Area Monitoring	
	D.	Environmental Monitoring	
6. Responsibilities for Radiation Protection			
	A.	Management's responsibilities	
	B.	Hazards Control's responsibilities	
	C.	Individual's responsibilities	
	1.	Providing a dose record	
	2.	Following all radiological work requirements	
	D.	Individual's rights	
	1.	Informed of all risks and associated controls	
	2.	Access to dose records	
7. Recent experiences and lessons learned			
8. Emergency response			