DOE Rad Worker Training

- The purpose of Radiological Worker I & II training is required if you:
  - Operate radiation-producing devices
  - Work with radioactive material
  - Are likely to receive a routine occupational exposure above 100 mrem per year
  - Are permitted unescorted access into radiological areas

Guidance Documents
- 10 CFR 835: Prescribes radiation safety training
- DOE Handbook 1130-98: Specifies radiological worker training objectives and course content
- P121-1.0: Provides LANL occupational radiation protection requirements
## Radiological Areas

<table>
<thead>
<tr>
<th>Posting</th>
<th>Defining Conditions</th>
<th>Minimum Entry Requirements</th>
<th>Exit Requirements</th>
<th>Working Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Controlled Area</strong></td>
<td>Not expected to receive a dose exceeding 100 mrem/yr; contamination unlikely</td>
<td>General Employee Radiological Training</td>
<td>Monitor personnel and equipment as required</td>
<td>Follow job-authorized procedures and protection requirements</td>
</tr>
<tr>
<td><strong>Radiological Buffer Area</strong></td>
<td>Where individuals are likely to receive &gt;100 mrem/yr or potential contamination levels &gt; Table 14-2 of ISD 121-1.0. May be used for areas containing hoods, glove boxes, and rooms with radiation-producing machines</td>
<td>Radiological Worker I and TLD as required by facility</td>
<td>Monitor personnel and equipment as required</td>
<td>Practice ALARA</td>
</tr>
<tr>
<td><strong>Radiation Area</strong></td>
<td>&gt;5 mrem/hr at 30 cm from source up to 100 mrem/hr</td>
<td>Radiological Worker I, TLD, and written authorization to enter and perform work in area</td>
<td>Obey posted requirements</td>
<td>Do not loiter during work delays</td>
</tr>
<tr>
<td><strong>High Radiation Area</strong></td>
<td>&gt;100 mrem/hr at 30 cm from source up to 500 rem/hr at 30 cm from source</td>
<td>Radiological Worker I, TLD, supplemental dosimetry, radiation survey, RWP, and written authorization to enter and perform work in area</td>
<td>none</td>
<td>Follow no eating, drinking, smoking, or chewing policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Read and sign that you understand job radiological conditions and protection requirements written in the RWP and will abide by them</td>
<td>none</td>
<td>Report controls that are not adequate or are not being followed</td>
</tr>
<tr>
<td><strong>Very High Radiation Area</strong></td>
<td>&gt;500 rad/hr at 100 cm from source</td>
<td>No entry allowed during normal operations</td>
<td>none</td>
<td>Obey posted, written, or oral requirements</td>
</tr>
<tr>
<td><strong>Hot Spot</strong></td>
<td>≥5 times area dose rate and &gt;100 mrem/hr or ≥5 times surface contamination level</td>
<td>N/A</td>
<td>N/A</td>
<td>Be aware of changing radiological conditions</td>
</tr>
<tr>
<td><strong>Radioactive Material</strong></td>
<td>Accessible areas where items or containers of radioactive material in quantities of greater than Appendix 16A (ISD 121-1.0) are used, handled, and stored</td>
<td>N/A</td>
<td>N/A</td>
<td>Report any unusual conditions</td>
</tr>
<tr>
<td><strong>Hot Job Exclusion Area</strong></td>
<td>as posted</td>
<td>as posted</td>
<td>as posted</td>
<td></td>
</tr>
</tbody>
</table>

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## Radiological Areas cont...

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<th>Working Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination Area</td>
<td>Levels (dpm/100 cm²) that are greater than (or likely to exceed) Table 14-2 values but do not exceed 100 x Table 14-2 values (ISD 121-1.0)</td>
<td>Radiological Worker II, TLD, anti-Cs, and authorization by way of work control documents as required and appropriate internal dosimetry programs</td>
<td>Exit only at step-off pad(s). Remove anti-Cs carefully. Monitor personnel via a whole body frisk. Monitor personal items and equipment.</td>
<td>Follow all of the requirements for working in radiological areas. Avoid unnecessary contact with contaminated surfaces.</td>
</tr>
<tr>
<td>High Contamination Area</td>
<td>Levels (dpm/100 cm²) that are greater than (or likely to exceed) 100 x Table 14-2 values (ISD 121-1.0)</td>
<td>Radiological Worker II, TLD, anti-Cs, RWP, and authorization by way of work control documents as required and appropriate internal dosimetry programs Read and sign that you understand the job, radiological conditions, and protection requirements as written in the RWP and will abide by them</td>
<td></td>
<td>Avoid stirring up contamination. Secure hoses and cables. Wrap or sleeve materials, equipment, and hoses.</td>
</tr>
<tr>
<td>Airborne Radioactivity Area</td>
<td>Concentrations (µCi/cm³) above backgrounds that are greater than the derived air concentration (DAC) values or that would result in an individual’s being exposed to greater than 12 DAC-hours in a week</td>
<td>Radiological Worker II, TLD, anti-Cs, RWP, respirator, and authorization by way of work control documents as required and appropriate internal dosimetry programs</td>
<td></td>
<td>Bag contaminated tools. Avoid touching exposed skin. Exit area immediately if wound occurs or if anti-Cs tear.</td>
</tr>
<tr>
<td>Soil Contamination Area</td>
<td>Contaminated soil not releasable in accordance with DOE Order 5400.5</td>
<td>Radiological Worker II, facility/ job-specific requirements</td>
<td>Facility/job-specific requirements may apply.</td>
<td></td>
</tr>
<tr>
<td>Fixed Contamination</td>
<td>No removable contamination and total contamination levels that are greater than Table 14-2 values (ISD 121-1.0)</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
Key Learning Concepts in Rad Worker Training

- Radiological Fundamentals
- Biological Effects
- Dosimetry
- ALARA
- Contamination Control
- Radiological Emergencies
- Postings and Controls
Rad Worker Course Requirements
(Badge access required course)

- 8-hour lecture
- The Radiological Worker exam is a 50-question, multiple-choice test that must be retaken every 24 months
- The Radiological Worker Hands-on Simulation Practical Exam
  - Demonstration of exercising ALARA in radiological areas, donning, doffing, and monitoring
- The passing score for each exam is 80%.
How do educators enhance the learning experience using instructional technology?
Four Levels of Interactive Multimedia Instruction

Level 1 (PASSIVE)
- Video and audio lectures and presentations
- Watch simulation sessions

Level 2 (LIMITED PARTICIPATION)
- Training modules with basic open and closed-ended assessments
- Blogs, wikis, journaling, discussion board activities

Level 3 (COMPLEX PARTICIPATION)
- Vignette players with dynamic assessments (branching or adaptive)

Level 4 (REAL-TIME PARTICIPATION)
- Massive multiplayer role-based gaming in a simulated world
Multimedia

Is the combination and representation of text and media including video, audio, and still imagery – Mayer, 2001

Multimedia Principle – Assertion that people learn more deeply from words and pictures, then from words alone
Three Cognitive Science Principles of Learning

1. The human information processing system includes dual channels for visualizing pictorial/auditory, and verbal processing

2. Each channel has a limited capacity for processing

3. Active learning entails carrying out a coordinated set of cognitive functions and processes during learning
Five Stages of Skill Acquisition

- **Novice**
  - Strict adherence to rules
  - Little situation assessment

- **Competent**
  - Conscious, deliberate planning
  - Routinized procedures

- **Proficient**
  - Recognized anomalies in normal patterns
  - Course of action selection evolves with changes in situational factors

- **Expert**
  - Intuitive grasp of situations based on tacit, experiential knowledge
  - Intuitive recognition of appropriate decisions and actions

- **Advanced Beginner**
  - Limited situational perception
  - Situational attributes treated separately and given equal importance

- **Novice**
  - Strict adherence to rules
  - Little situation assessment
Three Dimensions of Immersion
(Zimmerman, Burns, Sestokas, 2007)

**Spatial Immersion** *(Response to Setting)*
- The “hook”
- Relates to learners’ past memories
- Helps develop an intimate relationship to the setting

**Temporal Immersion** *(Response to Plot)*
- Past events cast shadows on the future, restrict the range of what can happen next
- Creates suspense that increases as the range of possibilities decreases
- This is when learners reach a state of temporal immersion

**Emotional Immersion** *(Response to Character)*
- Response occurs as learners form attachments to the characters within the simulation
IMI LEVEL 1: Passive Participation

Includes knowledge-based or familiarization, lessons provided in a linear format (one idea after another)

• primarily used for introducing an idea or concept

• learner has little or no control over the sequence and timed events of the lesson material

• minimal interactivity is provided by selective screen icons, and inserted into the lesson through typical input / output peripherals, and programming protocols
IMI LEVEL 1: Passive Example

Click on the picture to execute the interactive exercise

You are in the room with Louis Slotin, Al Graves, Dwight Young and other colleagues. Drag & drop the approximate distance on each person that was standing from the radioactive source.

Distance from the Source
- 50 cm
- 100 cm
- 140 cm
- 210 cm
- 400 cm

SUBMIT
Students watch a brief 60 second opening video courtesy of the Atomic Heritage Foundation. This can be shown the main instructor’s screen at the front of the room. This video provides initial context for the Slotin incident.
Assessing the ALARA principle of distance
You are in the room with Louis Slotin, Al Graves, Dwight Young and other colleagues. Drag & drop the approximate distance on each person that was standing from the radioactive source.

Correct
That's right! You approximated the correct distances from the radioactive source.

Continue
Assigning radiation dosage based on distance from the source
What dose (roentgen equivalent man = rem) did Louis Slotin, Al Graves, Dwight Young and other colleagues receive from the radioactive source? Drag & drop the approximate dosage on each person.

Correct
That's right! You applied the correct radioactive dosages to the right individuals.

Continue

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Conversion from rems to mrem

Occupational Medicine needs you to quickly convert Slotin's radiation dosage from rem to mrem. Hurry, time is of the essence.

Convert Slotin's dosage to mrem

2100 rem
equals

mrem

SUBMIT
Conversion from mrems to rems

Occupational Medicine needs you to quickly convert Graves’ radiation dosage from mrem to rems. Hurry, time is of the essence.

Convert Graves’ dosage to rem

360,000 mrem equals

 SUBMIT

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Selecting the proper shielding

Louis Slotin received a fatal 2100 rem dose of neutron radiation. Select the shielding that could have saved his life.
Assessing radiation sickness based on dose

Using the effects of whole-body radiation dose table on page 20, who in the room received radiation sickness. Select the corresponding individuals and then click the submit button.

Select the people who received radiation sickness?

SUBMIT
Using the effects of whole-body radiation dose table on page 20, who in the room received radiation sickness. Select the corresponding individuals and then click the submit button.

Correct

That's right! You selected the correct individuals. Raemer Schreiber & Theodore Pearlman did not receive radiation sickness because their radiation dose was at 75 rems.
Results / Review Pane

Results

Your Score: 83.33% (50 points)
Passing Score: 80% (48 points)

Result:
✓ Congratulations, you passed.

Review Exercise
IMI LEVEL 2: Limited Participation

Involves the recall of more information than Level 1, and allows the learner more control over the lesson’s content through screen icons and other peripherals such as light pens or touch screens.

- Simple synthetic task environments or simulations may also be presented to the learner.
- Custom feedback can be given to the learner in a single mode (feedback window).
**IMI LEVEL 3: Complex Participation**

Involves the collection and recall of more complex information that requires an increased level of interaction.

- Involves applying information to solving a problem(s) or producing a result

- Prompts are reduced and the learner encounters information for decisions to be assessed / executed

- Custom feedback is given through multiple modes (chaff)
IMI LEVEL 4: Real-time Participation

Involves in depth recall of a larger amount of information with little prompting from live participants

• Learners demonstrate that they can perform specific tasks and make errors which are compounded in a live team environment

• Task prompts often do not occur in this level
Contact

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