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Editor: Chris DiVitto
INSTRUCTION CONCERNING RISKS FROM OCCUPATIONAL RADIATION EXPOSURE

1. What is meant by ALARA?

ALARA means “as low as is reasonably achievable.” In addition to providing an upper limit on an individual’s permissible radiation dose, the NRC requires that its licensees establish radiation protection programs and use procedures and engineering controls to achieve occupational doses, and doses to the public, as far below the limits as is reasonably achievable. “Reasonably achievable” also means “to the extent practicable.” What is practicable depends on the purpose of the job, the state of technology, the costs for averting doses, and the benefits. Although implementation of the ALARA principle is a required integral part of each licensee’s radiation protection program, it does not mean that each radiation exposure must be kept to an absolute minimum, but rather that “reasonable” efforts must be made to avert dose. In practice, ALARA includes planning tasks involving radiation exposure so as to reduce dose to individual workers and the work group. There are several ways to control radiation doses, e.g., limiting the time in radiation areas, maintaining distance from sources of radiation, and providing shielding of radiation sources to reduce dose. The use of engineering controls, from the design of facilities and equipment to the actual set-up and conduct of work activities, is also an important element of the ALARA concept.

An ALARA analysis should be used in determining whether the use of respiratory protection is advisable. In evaluating whether or not to use respirators, the goal should be to achieve the optimal sum of external and internal doses. For example, the use of respirators can lead to increased work time within radiation areas, which increases external dose. The advantage of using respirators to reduce internal exposure must be evaluated against the increased external exposure and related stresses caused by the use of respirators. Heat stress, reduced visibility, and reduced communication associated with the use of respirators could expose a worker to far greater risks than are associated with the internal dose avoided by use of the respirator. To the extent practical, engineering controls, such as containments and ventilation systems, should be used to reduce workplace airborne radioactive materials.
2. How can we compare the risk of cancer from radiation to other kinds of health risks?

One way to make these comparisons is to compare the average number of days of life expectancy lost because of the effects associated with each particular health risk. Estimates are calculated by looking at a large number of persons, recording the age when death occurs from specific causes, and estimating the average number of days of life lost as a result of these early deaths. The total number of days of life lost is then averaged over the total observed group. Several studies have compared the average days of life lost from exposure to radiation with the number of days lost as a result of being exposed to other health risks. The word “average” is important because an individual who gets cancer loses about 15 years of life expectancy, while his or her coworkers do not suffer any loss. Some representative numbers are presented in Table 1. For categories of NRC-regulated industries with larger doses, the average measurable occupational dose in 1993 was 0.31 rem (0.0031 Sv). A simple calculation based on the article by Cohen and Lee (Ref.10) shows that 0.3 rem (0.003 Sv) per year from age 18 to 65 results in an average loss of 15 days. These estimates indicate that the health risks from occupational radiation exposure are smaller than the risks associated with many other events or activities we encounter and accept in normal day-to-day activities. It is also useful to compare the estimated average number of days of life lost from occupational exposure to radiation with the number of days lost as a result of working in several types of industries. Table 2 shows average days of life expectancy lost as a result of fatal work-related accidents. Table 2 does not include non-accident types of occupational risks such as occupational disease and stress because the data are not available. These comparisons are not ideal because we are comparing the possible effects of chronic exposure to radiation to different kinds of risk such as accidental death, in which death is inevitable if the event occurs. This is the best we can do because good data are not available on chronic exposure to other workplace carcinogens. Also, the estimates of loss of life expectancy for workers from radiation-induced cancer do not take into consideration the competing effect on the life expectancy of the workers from industrial accidents.
Your Annual Dosimetry Badge Summary Report

Alan Watts, Radiation Safety Officer
4/2019

What is this report?
This report summarizes the total occupational radiation dose you received from your work with ionizing radiation at Ohio University in the most recent calendar year.

Why am I receiving it?
State regulations require us to provide individuals monitored for occupational radiation dose an annual summary report of their dose.

What should I do with it?
Read the report and keep the provided copy for yourself. You may be asked for your dose history sometime in the future.

What information is important for me to look at?
Your occupational radiation dose from external sources of radiation is summarized on the right side of the form under “Doses (in rem).” The most important values for you to look at are:

- **Deep Dose Equivalent (DDE):** the external radiation dose at a tissue depth of 1 cm to the *whole body* (Box 11B)
- **Lens (Eye) Dose Equivalent (LDE):** the external radiation dose to the *lens of the eye* at a tissue depth of 0.3 cm (Box 12)
- **Shallow Dose Equivalent (SDE):** the radiation dose at a tissue depth of 0.007 cm applicable to exposure of the *skin of the whole body or the skin of an extremity* (Box 13, and if you wear a ring badge, Box 14)

Committed Effective Dose Equivalent values in Boxes 15 and 16 may or may not apply to you. Bioassay (urine) sample results would normally be recorded here but this recording service has not been purchased. If you ever were to receive a positive CEDE or CDE, Radiation Safety will follow up with you immediately. If you have a reading of “ND,” that means “Not Detectable,” or less than 1 millirem.

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What do my numbers mean?

State and federal occupation radiation dose limits are set at levels below which there are believed to be negligible health risks to workers. Limits for different body parts are set to different levels because organs in the body differ in their sensitivity to radiation. You can compare your readings to the limits in the table below.

<table>
<thead>
<tr>
<th>Type</th>
<th>Annual Regulatory Limit</th>
</tr>
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<tbody>
<tr>
<td>Whole Body (DDE)</td>
<td>5,000 millirem</td>
</tr>
<tr>
<td>Lens of eye (LDE)</td>
<td>15,000 millirem</td>
</tr>
<tr>
<td>Skin and Extremities (SDE)</td>
<td>50,000 millirem</td>
</tr>
<tr>
<td>Fetal Dose</td>
<td>500 millirem during the entire pregnancy</td>
</tr>
<tr>
<td>Lifetime cumulative dose</td>
<td>Not regulated</td>
</tr>
</tbody>
</table>

You can also compare your dose to that from other radiation sources in everyday life.

<table>
<thead>
<tr>
<th>Type of Exposure for 1 year</th>
<th>Estimated Dose¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural background radiation</td>
<td>311 mrem</td>
</tr>
<tr>
<td>Inhalation of naturally occurring rad and thoron gas</td>
<td>228 mrem</td>
</tr>
<tr>
<td>Exposure on earth from space radiation</td>
<td>33 mrem</td>
</tr>
<tr>
<td>Living in a brick, concrete, or stone home</td>
<td>21 mrem</td>
</tr>
<tr>
<td>Consumer products</td>
<td>13 mrem</td>
</tr>
</tbody>
</table>


Radiation risk

The main risk from low doses of radiation, such as those from occupational dose, is believed to be a very small increased likelihood of developing cancer, although this increased risk has not been proven by scientific studies. Because of the uncertainty, it is always best to use **ALARA** (As Low As Reasonably Achievable) techniques to reduce your occupational radiation dose:

- **Minimize the time** you are near a radiation source (X-ray or radioactive materials)
- **Maximize your distance** from the source of radiation (step back, use tongs)
- **Use available shielding** (lead apron, leaded acrylic shield, syringe shield)

Questions? Contact the Radiation Safety Officer: 740-593-4176
Contact the Radiation Safety Technician: 740-597-2950

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1869 Mendeleev introduces periodic system of elements.

1895 Roentgen discovers basic properties of x-rays.

1896 Becquerel announces discovery of radioactivity.

1898 Curie discovers polonium and radium and coins term “radioactivity.”

1915 British Roentgen Society resolves to protect people from over-exposure to x-rays.

1922 American organizations adopt British protection rules.

1920s Organizations form to address radiation protection.

1930s Scientists begin to understand fission and radioactive decay.

1940s The first nuclear reactors and atomic weapons are developed.

1959 The Federal Radiation Council is established.

1970 Congress creates the Environmental Protection Agency.

Stay tuned for a continuation of the risk information in the next newsletter!

Who you gonna call?

Radiation Safety Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUPD</td>
<td>593-1911</td>
<td></td>
</tr>
<tr>
<td>Alan Watts</td>
<td>593-4176</td>
<td>740-517-5075</td>
</tr>
<tr>
<td>Ricardo Gaytan</td>
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<td>956-740-5900</td>
</tr>
<tr>
<td>David Schleter</td>
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<td>740-591-0557</td>
</tr>
<tr>
<td>David Ingram</td>
<td>593-1705</td>
<td>740-707-5362</td>
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