(Part 3 of 3)

General Employee Radiological Training

Student's Guide

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Table of Contents

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TERMINAL GOAL:

Upon completion of this training, the participant will be able to DISCUSS (1) the hazards associated with radiological areas and radioactive material, (2) his/her limitations as a trained general employee during access to or work in the controlled areas, and (3) his/her responsibil

EO4 IDENTIFY individual rights and

- There are four basic types of ionizing radiation; alpha particles, beta particles, neutrons and gamma rays.

3. Non-ionizing radiation

   Non-ionizing radiation does not have enough energy to remove an electron from an atom.

   - Types of non-ionizing radiation include: Microwaves, radio waves, visible light, heat, and infrared radiation.

   Non-ionizing radiation is not addressed further in this training.

4. Radioactive Contamination

   Contamination is uncontained radioactive material in an unwanted location.

5. Comparison of radiation and radioactive contamination

   Exposure to radiation does NOT result in contamination of the worker. Only in the case of an individual coming in contact with radioactive contamination would there be a potential for the individual's skin or clothing to become contaminated.

B. Sources of Radiation (EO1)

2. Man-made sources of radiation

Man-made sources of radiation, where the radiation is either produced or enhanced by human activities, contribute to the remainder of the annual average radiation dose (approximately 310 millirem). Man-made sources include the following:

a. Medical uses such as X-rays and nuclear medicine tests or treatments

b. Tobacco products

c. Building materials

3. Comparison of annual radiation doses from selected sources

Examples of the annual radiation dose from selected sources of radiation exposure are as follows:

• Cigarette smoking (1 pack a day)	1300
• Radon	200
• Medical exposures (average)	300
• Terrestrial radiation (rocks and soil)	28
• Cosmic radiation (sun and space)	28
• Round trip US by air	5
• Building materials	7
• World wide fallout	<1

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C. Risks in Perspective (EO2)

Radiation comes from background and man-made sources. We receive approximately 620 millirem/year. This is separate from, and in addition to, occupational exposure received on the job. The potential risks from occupational exposure can be compared to other risks we accept everyday.

1. Occupational dose

The risks associated with occupational doses are very small and considered acceptable when compared to that of other occupational health risks (i.e., being a coal miner or construction worker).

a. Radiation dose limit (EO3)

The DOE whole body radiation dose limit for general employees is 5000 millirem/year.

b. Administrative Control Levels

Sites typically have administrative control levels below the DOE limit. (Insert facility-specific limits). Individuals who complete only this GERT training are not expected to receive more than 100 millirem/yr occupational dose.

c. Average annual radiation dose for various occupations

DOE radiological workers who received measurable radiological doses had an average dose of 63 millirem in 2006. This amount is compared to other occupations.

Occupation	millirem/year
• Airline flight crew member	400-600
• Nuclear power plant worker	300
• Medical personnel	70

2. Potential health effects from exposure to radiation. (EO2)

Biological effects from exposure to radiation may occur in the exposed individual or in the future children of the exposed individual.

a. Exposed individual

There is scientific evidence for health effects (primarily cancer) from radiation doses well above the annual limit for occupational exposure (greater than 10,000 millirem) received under a short duration. The risks associated with occupational doses are very small and considered acceptable when compared to other occupational and non-occupational risks.

b. Future children of the exposed individual

Heritable effects (i.e., genetic changes to the parents sperm and/or eggs that results in an observed effect in their offspring) from ionizing radiation have been found in plants and animals, but have not been observed in human populations. The risk of heritable effects from ionizing radiation is considered to be very small when compared to other naturally-occurring heritable effects and difficult to detect over the natural background rate of birth defects.

3. Prenatal effects (EO2)

A developing embryo/fetus is especially sensitive to ionizing radiation because of its rapidly dividing cells . Radiation is one of many agents that may cause harm to the embryo/fetus (i.e., chemicals, heat, etc.). Significant radiation doses (>10,000 millirem) to the embryo/fetus may increase the chances that the child will develop conditions such as a small head size, lower birth weight, and/or slower mental growth.

The risk of these effects occurring is minimized by having special protective measures for the embryo/fetus of a declared pregnant woman. This is a worker who voluntarily notifies her employer, in writing, that she is pregnant and wishes to invoke the limit for the embryo/fetus of 500 millirem for the period from conception to birth.

It is the recommendation of DOE's Radiological Control Standard that the employer provide the option for

a. Loss of life expectancy due to various causes (Expressed in days)

Health Risk	Estimated Days of Life Expectancy Lost, Average
• Being unmarried male	3500
• Smoking (1 pack/day)	2250
• Being unmarried female	1600
• Being a coal miner	1100
• 15% overweight	777
• Alcohol (US average)	365
• Being a construction worker	227
• Driving a motor vehicle	205
• All industry	60
• Radiation 100 mrem/yr (70 yr)	10
• Coffee (US Average)	6

b. The following activities create a risk of 1 in a million chances of dying
   - Smoking 1.4 cigarettes (lung cancer)
   - Eating 40 tablespoons of peanut butter
   - Eating 100 charcoal broiled steaks
   - Spending 2 days in New York City (air pollution)
   - Driving 40 miles in a car (accident)
   - Flying 2500 miles in a jet (accident)
   - Canoeing for 6 minutes
   - Receiving 2.5 mrem of radiation (cancer)

1) Controlled areas are areas established around radiological areas to manage personnel access to the radiological areas and to provide warning of the existence of radiological hazards in the area.

2) This training will permit you unescorted entry into the controlled area.

b. Radioactive Material Area

1) This is an area within a controlled area where radioactive material in excess of specified quantities is located.

2) This training alone typically will not permit you unescorted access to these areas.

c. Radiological Areas

1) There are radiological areas established within the controlled area.

"Radiation Area, High Radiation Area, and Very High Radiation Area," identify areas where the hazard is exposure to ionizing radiation and the different areas designate increasing levels of hazard (increasing levels of dose rates).

"Contamination Area" and "High Contamination Area" identify areas where the hazard is from accessible loose radioactive

contamination. Protective clothing is used to prevent contamination of personnel.

"Airborne Radioactivity Area" indicates the potential for radioactive contamination in the air. Protective clothing and respiratory protection may be used to protect personnel from getting contamination on their skin or inhaling the contamination."

2) This training typically will NOT permit you to enter these areas. Personnel trained at the GERT level are typically not permitted to enter these areas unless escorted and/or trained.

d. Radiological Buffer Area

1) A radiological buffer area may be established within the controlled area to provide a secondary boundary for minimizing exposures to radiation or contamination.

2) This training typically does NOT qualify you to enter the radiological buffer area unless you are continuously escorted. (Insert facility-specific requirements.)

E. ALARA Program (EO4)

1. ALARA Concept

The DOE and this Site are firmly committed to having a Radiological Control Program of the highest quality. Therefore, maintaining

occupational dose from radiation and radioactive materials As Low As Reasonably Achievable (ALARA) is an integral part of all site activities. The purpose of the ALARA program is to control radiation doses in consideration of the overall benefit of the activity causing the dose.

There are a few basic practices used to maintain exposure to radiation ALARA.

a. Time-Reduce the amount of time spent near a source of radiation.

b. Distance-Stay as far away from the source as possible.

c. Shielding-Shielding is placed between workers and the source.

d. Source elimination or reduction: Eliminate the source, if possible (e.g., flushing the pipeline) or substitute with non-radioactive substance.

e. Radioactive contamination is controlled using engineered ventilation, containments, decontamination, and lastly, personnel protective equipment to minimize the potential for inhalation, ingestion, or absorption of radioactive material.

F. Emergency Procedures (EO5)

In the unlikely event that a radiological incident occurs, it is important for each employee to know the emergency procedures.

1. Abnormal Conditions

If you discover radioactive material that is not where it belongs, (e.g., discarded in a clean trash receptacle, outside of radiological areas, or loose outside or in a building corridor), you should take the following actions:

1) Do not touch or handle the material.

2) Warn other personnel not to approach the area.

3) Guard the area, moving a safe distance, (see following ALARA Section) and have someone immediately notify Radiological Control personnel.

4) Await Radiological Control personnel.

These actions are taken to minimize exposure to radiation and potential contamination of y

All employees have an impact on maintaining exposures to radiation and radioactive material ALARA. Work planning is a key component of the ALARA program to ensure each of the controls listed below is applied as appropriate to the work being performed. Some of the employee responsibilities are listed.

1. Obey all signs/postings.

2. Comply with all radiological and safety rules.

3. Do not enter any radiological area unless escorted. If visiting a radiological area with an escort:

    a. obey the instructions of your escort.

    b. obtain and properly wear dosimeters as instructed by procedure, procedure,

6. Comply with emergency procedures for your work area.

7. Keep exposures to radiation and radioactive materials ALARA and know the Administrative Control

Such a report shall be transmitted at a time not later than the transmittal to the Department.

III. SUMMARY

It is important to understand what radiation and radioactive materials are and to recognize the postings associated with radiological work. All employees are responsible to comply with the safety rules and to access only areas they are authorized to enter. Through an enhanced awareness of this topic, each employee may contribute to safe practices in the workplace.

References :

1. DOE Radiological Control Standard, [DOE-STD 1098-99, Ch. 1]
2. "Guide to Good Practice in Radiation Protection Training," ORAU 88/H-99
3. US NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" June 1999
4. US NRC Regulatory Guide 8.29, "Instruction Concerning Risks from

CONCLUDING MATERIAL

Review Activities:

DOE	Ops Offices
NA	AL
HS	CH
EM	ID
SC	NV
NE	OR
LM	RL
	SR

Area/Site Offices	National Laboratories
Amarillo	BNL
Ashtabula	LANL
Carlsbad	LLNL
Columbus	PNNL
Fernald	Sandia
Kansas City	FNL
Kirtland	SRNL
Los Alamos	
Miamisburg	
Pinellas	
West Valley	
Y-12	

Preparing Activity:

DOE HS-11

Project Number:

TRNG-0057