Georgia Power

POWER GENERATION DEPARTMENT

VOGTLE ELECTRIC GENERATING PLANT

TRAINING LESSON PLAN

TITLE:	RADIATION PROTECTION-CONTAMINATION CONTROL	NUMBER:	GE-LP-006.C
PROGRAM:	GENERAL EMPLOYEE TRAINING	REVISION:	2
AUTHOR:	LEATRICE G. GREEN	DATE:	5/13/86
APPROVED:	Michael J. Kurtzman	DATE:	8/6/86

INSTRUCTOR GUIDELINES:

I. LESSON PRESENTATION - 1 HOUR, 10 MINUTE LECTURE INCLUDING REVIEW; 10 MINUTE FORMATIVE TEST

II. MATERIALS REQUIRED: SLIDES, TRANSPARENCIES, SLIDE PROJECTOR, OVERHEAD PROJECTOR, FRISKER, CLOTH FOR "SMEAR", GLOVE BOX (OPTIONAL)

I. PURPOSE STATEMENT:

TO FAMILIARIZE THE TRAINEE WITH METHODS AND PROCEDURES USED TO CONTROL RADIOACTIVE CONTAMINATION.

II. LIST OF OBJECTIVES:

This lesson is designed to enable the trainee to:

1. Identify statements which correctly characterize radioactive contamination.
2. Identify indicators of the potential presence of contamination.
3. Identify the units used to measure loose surface contamination.
4. Identify activities which, if performed in a contaminated area, could increase airborne contamination.
5. Identify devices and procedures used to control contamination and limit radioactive waste.
6. Distinguish between methods used to control the spread of contamination and those used to limit exposure to radiation.
7. Identify the method normally used to remove external contamination from personnel and equipment.
8. Identify mechanisms by which an individual might become internally contaminated.
9. Identify methods used to detect internal contamination.
10. Identify the consequences of internal contamination as well as ways to reduce the possibility of getting radioactive materials inside the body.
11. Identify the action to be taken if internal contamination is suspected.

REFERENCES:

1. 10CFR19 & 10CFR20
2. USNRC REG. GUIDES 8.13, 8.27, 8.29
3. VEGP 40000 SERIES PROCEDURES
4. "HEALTH PHYSICS FUNDAMENTALS" - GENERAL PHYSICS CORPORATION
5. "RADIATION PROTECTION" - GENERAL PHYSICS CORPORATION
6. "FUNDAMENTALS OF PHYSICAL SCIENCE" - GENERAL PHYSICS CORPORATION
7. "INTRODUCTION HEALTH PHYSICS COURSE" - GENERAL PHYSICS CORPORATION
8. "RADIATION RISKS FOR NUCLEAR WORKERS" - ATOMIC INDUSTRIAL FORUM
9. "BASIC RADIATION PROTECTION SLIDE SERIES" - NUCLEAR SUPPORT SERVICES, INC.
10. "RADIATION SAFETY TECHNICIAN TRAINING COURSE" - H. J. MOE
11. SER 82-13, 82-012

III. LESSON OUTLINE:

NOTES

I. INTRODUCTION

Radioactive contamination is not the same thing as radiation. Contamination and radioactive waste are potentially significant problems that must be dealt with in the nuclear industry. The following information specifies methods of dealing with these problems.

A. Definition and Characteristics

Contamination is radioactive material any place where it is not wanted and where it can get into or onto your body.

Radioactive contamination is radioactive material any place where it is not wanted. Contamination of inanimate objects may be loose or fixed.

AIRBORNE CONTAMINATION WILL BE DISCUSSED LATER.

1. Loose contamination (also called "SMEARABLE" contamination) is radioactive material that loosely adheres to the objects it settles on. Because it is not bound tightly to objects, it can be easily removed or spread to other objects or to people. Loose contamination may occur as a result of leaks (liquid) from valves (note that liquid may subsequently evaporate, leaving a nearly invisible residue of contamination) or from cutting or grinding on contamination materials.

Surface Contamination is radioactive material on the surface of some items such as floors, walls, equipment, tools, components, articles of clothing and the human body.

1. Smearable/Loose
   - Dust like in nature
   - Can be tracked, smeared, and spread from person to person, or objects.

2. Fixed contamination is radioactive material that has become firmly imbedded in an object. It is difficult to remove and it cannot be spread easily. Fixed contamination might result if loose contamination were painted over or if loose contamination were worked into the porous wooden handle of a tool.

2. Fixed
   - Can be detected by portable survey detector sensitive to type of radiation emitted from the contamination.

   a. It cannot be transferred by normal mechanical pressure such as wiping and/or rubbing. It can be made transferable by mechanical or chemical operations such as grinding, chipping, blasting, welding, and/or chemical decontamination.

Where does contamination come from? Remember the discussion in the fundamentals module - primary source of contamination is activation products circulating in the reactor coolant.

III. LESSON OUTLINE:

NOTES

B. Indicators of Contamination

Remember, contamination is radioactive material in unwanted places. The material may be visible, but not always. The radioactive property of the material is never visible or otherwise detectable by the human senses. Therefore, radioactive contamination cannot be seen. It must be detected by a special instrument. There are, however, certain indicators that radioactive contamination might be present. Examples are:

1. Known airborne radioactivity.
2. Steam or liquid leaks in radiologically controlled areas.
3. Work being performed on contaminated equipment.

Sources of surface contamination: venting, leaks, draining, sampling, and maintenance of primary and aux. systems.

Contamination Sources:
- Leaking valves
- Tank overflow
- Venting, draining a system
- Sampling
- Evaporation of a radioactive liquid

C. Units

The units used to measure fixed and loose surface contamination are "disintegrations per minute per 100 square centimeters" (dpm/100cm^2).

Beta-Gamma greater than or equal 1000 dpm/100 cm^2
Alpha greater than or equal to 50 dpm/100 cm^2

The units used to measure fixed contamination are "dpm/per probe area"

Greater than or equal to 1000 dpm/probe area (Beta-Gamma)
Greater than or equal to 50 dpm/probe area (Alpha)

DEMONSTRATION: PERFORM PHYSICAL DEMONSTRATION OF SMEAR TECHNIQUE. (OPTIONAL)

D. Airborne Radioactive Contamination

Airborne radioactive contamination consists of radioactive materials in the form of gases or particulates that are dissolved or suspended in the surrounding air. Some common causes of airborne contamination are:

1. Welding, cutting or grinding on contaminated equipment.
2. Sweeping in a contaminated area. (Surface contamination agitated by air currents and personnel movement.)
3. Steam leaks.

Airborne contamination is measured in (uCi/cc) microcurie per cubic centimeters of air/water.

III. LESSON OUTLINE:

NOTES

In an area containing airborne radioactivity, the most serious hazard involves the inhalation of radioactive material into the lungs. This material may then be assimilated by the body and retained in some organs of the body. This results in radiation exposure to the lungs and any other organs involved.

E. Contamination Control

A number of devices and procedures have been developed to control the spread of radioactive contamination.

1. Devices

a. Anti-C or Protective clothing - worn by personnel when working inside contaminted areas and when handling contaminated equipment tools and materials.

Although protective clothing is designed primarily to prevent contamination of the skin and to prevent the spread of contamination, they will provide some protection against beta radiation.

Before donning PCs, check each item to ensure it is not damaged.

Removing PCs: Follow undress procedure - be careful not to spread contamination from the clothing into or onto the body.

b. Step-off pads - used to control the spread of contamination from contaminated areas.

Proper use of protective clothing and step-off pads is discussed in a later module.

c. Plastic bags - yellow plastic bags are used to contain tools and equipment that are contaminated and must be removed from a contaminated area.

d. Glove boxes - used to contain contamination in the immediate work area.

e. Tents - containment devices used for performing work which could create an airborne radioactivity problem. An important functional component of this structure is a ventilation system which exhausts potentially contaminated air through a high efficiency particulate air (HEPA) filter.

Tents - Tradename "Kelly Buildings"

f. Drip trays - used to contain contaminated liquids that may be released from system leaks.

III. LESSON OUTLINE:

NOTES

g. Floor drains - allow contaminated liquids to drain into radioactive waste sump for proper disposal.

Do not dump solvents and oils down floor drains. These agents will shorten the life of radioactive waste treatment equipment, can be harmful to plant operation, and will result in larger amounts of processed waste.

Absolutely nothing should be poured into floor drains. Reason: A wide range of substances will pass thru the demineralizer resins without being removed. These substances could eventually alter the reactor coolant chemistry, causing the reactor to shut down. (Should such a problem occur at Plant Vogtle the cost to correct it could run into several million dollars.) Those having liquids that must be discarded should contact H.P. for guidance. Use of chemical or fluids in the protected area is controlled by procedure VEGP 00262.

h. Respiratory protection equipment devices used by workers in Airborne Radioactivity Areas to control the hazard of inhalation of airborne contamination.

2. Procedures

a. Do not smoke, eat, drink or chew in radiologically controlled areas.

Use wall-mounted map to point out radiologically controlled areas at Plant Vogtle. (upon availability)

b. Properly wear protective clothing and respiratory protection wherever required by signs or H.P.

c. Remove protective clothing and respiratory protection properly to minimize the spread of contamination.

d. Do not unnecessarily touch a contaminated surface or allow clothing, tools, or other equipment to do so.

e. Assume that you are contaminated and properly perform a whole body frisk when leaving a contaminated area in which protective clothing was worn.

III. LESSON OUTLINE:

NOTES

f. All materials must be surveyed as they leave a radiologically controlled area. Contaminated items must be bagged, labeled and stored properly (H.P. will assist).

g. Minimize the spread of a known or suspected radioactive spill. Notify H.P. immediately.

h. Do not step in puddles inside the RCA: Always assume the water is contaminated.

i. Always try to control contamination at its source.

j. Prevent miscellaneous objects (wire, tools, welding rods, etc.) from being left in closed vessels to include steam generators. These objects usually end up as radwaste. It is each worker's responsibility to remove tools, equipment, and trash upon completion of the job.

Contaminated items will be placed in yellow plastic bags. The bags will be folded over and taped to close. Notify H.P. if you observe leaking or standing (puddles) water when you are inside the RCA.

SOER 82-13 82.012

Examples of specific work practices designed to control contamination are listed below. Each should be illustrated using color slides or, where feasible, demonstrated by the instructor in class. (Optional)

1. Proper bagging techniques:

   a. Use tape over sharp objects.
   b. Use absorbant material where liquids are present.
   c. Twist and fold top of bag before taping.

2. Sleeve hoses going into contaminated areas.
3. Secure hoses crossing contaminated area boundaries.
4. Tape handles and wheels of tools and equipment to prevent (not to cover up!) contamination.
5. Use disposable materials (such as plastic sheets) over exposed surfaces of tools and equipment.
6. Use caution not to cross into a clean area when working in contaminated overhead area.

NOTES: 1. Material left in SG could cause tube damage which could spread contamination into the clean side of S.G. 2. Material left inside RCS could become activated.

F. Tools for Use in Contaminated Areas (To be verified upon completion of procedures)

1. Obtain tools from the contaminated tool room. If required tools are unavailable there, they will be issued from the "clean" tool room. (Location of contaminated tool room and clean tool room must be determined.)

2. Perform work using sound contamination control techniques.

III. LESSON OUTLINE:

NOTES

3. Properly bag tools when exiting the contaminated area and have them surveyed at the nearest control point.

4. Return all contaminated tools, regardless of the point of issue, to the decontamination facility. Tools issued from the clean tool room are to be returned to the point of issue if they are not contaminated.

5. If you want tools returned to you after they are decontaminated, be sure to advise the decon personnel and ask them when the tools will be available. Label the bag containing tools with your name and your company's name if decon personnel are unavailable when you return tools. If you are leaving tools issued from the clean tool room at the decontamination facility, a clearance form must be obtained and returned to the clean tool room. Otherwise you will be held responsible for the tools issued.

G. Waste Control

Procedures and work practices designed to reduce the amount of radioactive waste generated.

Radioactive waste - Contaminated trash, contaminated tools, equipment, and materials that can no longer be used.

The amount of material that must be decontaminated or disposed of as radioactive waste can be minimized by observing the following:

1. Do not take tools, equipment or other materials into a radiologically controlled area unnecessarily. Where practical, use plastic bags for other types of containers.

2. Limit the use of water on contaminated surfaces.

3. Use tool, equipment, and staging that are already contaminated.

4. Keep contaminated trash separate from non-contaminated trash.

Problems associated with radwaste generation:

1) Increased shipping and burial costs
2) Stringent regulatory requirements and public concern
3) Increased radwaste generation and limited availability of disposal sites.

III. LESSON OUTLINE:

NOTES

Color coding of drums used for disposal of trash, clothing and equipment is as follows:

Non-contaminated trash	- White	
Contaminated trash	- Yellow	
Contaminated laundry	- Blue (Dark)	(Rubber, Cloth items)
Contaminated respirators	- Gray	
Contaminated hardhats	- Purple	

(Chem-Nuclear, Barnwell, S.C. - possible closing 1992.)

4) Increased radiation exposure from processing unnecessary radwaste.

5. Planning and coordination.

6. Decontamination - aggressive decon program.

7. Use common sense - perform all jobs in a manner that generates as little radwaste as possible.

H. Radioactive Spills

A radioactive spill is any release of radioactive liquid that is not planned. In the event of a radioactive spill, the following steps should be taken:

1. Stop the spill or contain/isolate it if possible.

2. Protect others by warning them of the situation and notify H.P. and the control room immediately.

3. Protect yourself by remaining at the edge of the affected area.

4. Follow instructions given by H.P., your supervisor, or over the P.A. system.

HP Duties:
- Survey & monitor all personnel
- Aid in deconning personnel and the area
- Recommend necessary steps to return area to normal condition.

I. Contamination Control vs. Exposure Control

The methods discussed in this lesson are used to control the spread of radioactive contamination - not radiation exposure. For example, protective clothing will keep personnel from becoming contaminated but it will do nothing to protect against gamma radiation.
It is important to recognize the purpose of a particular protective measure. Remember, time, distance, and shielding are the factors used to control radiation exposure.

Radioactive material is suspended in the water within the primary, auxiliary and rad waste systems.
- It deposits in many places within these systems, such as valves, bottom of tanks, areas of low flow, tortuous areas of flow, process flow filters, demineralizers, reactor coolant pumps, SG tubes, and primary flow inlets and outlets, etc.

Formative test will provide an opportunity to make this distinction.

III. LESSON OUTLINE:

NOTES

J. Decontamination

Decontamination is a procedure used to remove contamination (radioactive material - not radiation) from personnel or equipment. Although several methods are available, the preferred one is to wash the contaminated areas with soap and warm water.

When a system or component is breached (opened) any radioactive material that escapes to the work environment is called contamination.

A decontamination facility for personnel is located in the Control Bldg. (HP Station). Personnel who require decontamination will be escorted by a Health Physics technician.

K. Internal Contamination

1. Mechanisms of Contamination

   a. Inhaling airborne radioactive contamination.
   b. Ingesting (eating) radioactive material.
   c. Through cuts and abrasions in the skin.
   d. Absorption through skin.

2. Detection Methods

   a. Whole-body counts

At Plant Vogtle whole body counts are normally performed when employment begins, annually while employed and upon termination of employment. More frequent counts are made if internal contamination is suspected.

   b. Urinalysis
   c. Nasal/Throat Smears
   d. Fecal Samples

3. Consequences of Internal Contamination

   a. Radiation source close to and surrounded by vulnerable tissue.
   b. Certain radionuclides accumulate in specific tissues.

Airborne gaseous activity is generally not as dangerous as airborne particulate activity because most of the inhaled gas is expelled from the lungs during exhalation. (Iodine is the most abundant radioactive gas found in nuclear power plants that is soluble in body fluids. Most others are insoluble noble gases.)

III. LESSON OUTLINE:

NOTES

Thus, exposure to gaseous radioactivity is similar to exposure to an external radioactive source - when one leaves the airborne area the radioactive source is left behind.

4. Prevention

   a. Keep hands and other potentially contaminated objects away from face.
   b. Report the presence of open wounds or sores to H.P. prior to entering contaminated areas. Notify H.P. immediately if a wound occurs in a contaminated area.
   c. Do not smoke, eat, drink, or chew in radiologically controlled areas.

Point out the importance of washing and monitoring prior to eating, etc., following work in a contaminated area.

5. If internal contamination is suspected, notify Health Physics immediately.

Facial contamination is an indicator of possible internal contamination. A nasal smear showing activity is an even stronger indicator. In both cases, a whole-body count should be performed. Through proper medical intervention, the dose due to an uptake of radionuclides can often be greatly reduced. Isotopic dilution, metabolism stimulation, and chelation therapy are three basic techniques that have proven effective. However, in treating cases of internal contamination, time is of the essence. Generally speaking, most of the activity for materials such as iodine that will be retained by the body is fixed in place within one or two hours following the intake.

SUMMARY

Review objectives using examples to illustrate how each might be tested.

Administer formative test following objectives review, allowing a maximum of 10 minutes for completion. Review test, giving particular attention to any problem areas identified. Allow trainees to keep test papers as study aids but try to be aware of who is having difficulty.

TEST 6 - CONTAMINATION CONTROL
TIME ALLOWED - 15 MINUTES

NAME _____
SSN _____

1. Below are several statements about radioactive contamination. Circle the letter preceding each one that is true.

   a. It is a source of radiation
   b. It can be fixed or loose
   c. It is easily seen
   d. It is radioactive material where it is not wanted
   e. It is a type of radiation

2. List two possible causes of radioactive contamination.

   a. _____

   b. _____

3. Each of the following devices or procedures is designed to control either radioactive contamination or radiation exposure. Write the word "contamination" or "exposure" in the blank preceding each item to indicate what it is designed to control.

   a. _____ shielding
   b. _____ protective clothing
   c. _____ respirators
   d. _____ friskers
   e. _____ step-off pads
   f. _____ drip trays

Write the word "True" or "False" in the blank preceding each of the following statements.

4. _____ Fixed contamination is nothing to worry about since it is not easily spread.

5. _____ Loose surface contamination may cause airborne contamination.

6. _____ Airborne contamination is rather mysterious because no one is sure what causes it.

7. _____ Any trash generated at Plant Vogtle must be placed in yellow plastic bags.

8. _____ When you leave a radiologically controlled area where protective clothing was worn, a whole body frisk must be performed.

9. _____ If a liquid spill is observed, you should leave the area immediately because the liquid might be radioactive.

10. _____ When you enter a contaminated area to perform a job, you should take all your tools with you to be sure you have what you need.

11. _____ If your shoes become contaminated and they cannot be decontaminated, they will not be returned to you.

Circle the letter preceding the correct answer.

12. The method normally used to remove external contamination from personnel is _____.

    a. Wash with a sodium hydroxide solution
    b. Surgically remove contaminated tissue
    c. Wash with soap and warm water
    d. Soak for several hours in a mild solution of vinegar and water

13. The units used to measure loose surface contamination are _____ ___.

    a. spd per square centimeter
    b. dpm/100 cm^2
    c. Roentgens
    d. Millirems per hour

14. Radioactive material can enter the body through the _____.

    a. Mouth
    b. Nose
    c. Skin
    d. All of the above

15. If you think you might be internally contaminated you should _____.

    a. Try to induce vomiting immediately
    b. Relax and enjoy yourself because there is nothing you can do about it
    c. Tell no one until you are sure
    d. Contact Health Physics immediately