LEARNING OBJECTIVES:

2. 14.01 List the three factors which determine the actions taken in decontamination of personnel.

2. 14.02 List the preliminary actions and notifications required by the RCT for an individual suspected to be contaminated.

2. 14.03 List the actions to be taken by the RCT when contamination of clothing is confirmed.

2. 14.04 List the actions to be taken by the RCT when skin contamination is confirmed.

2. 14.05 List the steps for using decontamination reagents to decontaminate personnel.

Procedures:
ESH-1-04-04 Hot particle control standard
ESH-1-09-05 Responding to External Personnel Contamination
ESH-1-09-02 Responding to Suspect Internal Intake
LP 107-01.0 Notification and Reporting of Radiological Incidents

INTRODUCTION

In our work environment, one of the major concerns of radiological control is the prevention of personnel contamination. When personnel contamination has been identified, it is the responsibility of the RCTs to control or oversee the decontamination of the individual using the best method available. In this lesson, we are going to address the factors which determine decontamination actions, the responsibilities of the RCTs and the approved methods in decontamination of these personnel.
PERSONNEL CONTAMINATION

The potential for personnel contamination is normally monitored via one of the following methods:

External Contamination
- Hand Held Count Rate Meters
- Personnel Contamination Monitor

Internal Contamination
- Whole Body Counts (in vivo)
- Bioassay Samples (in vitro)

When monitoring for external contamination, count rate meters may be used in one of two ways. Personnel may survey for contamination on their own, or allow radiological control personnel to conduct the survey for them. The majority of external contamination surveys are completed using count rate meters. Another method of surveying for external contamination is using some type of contamination monitoring machine. To conduct a whole body survey, a hand held count rate meter or a personnel contamination monitor that surveys the entire body should be used.

Internal contamination may be monitored in one of two ways. The first method includes whole body counts and specific organ counts (lungs, thyroid, etc.). This type of internal monitoring is called in vivo. The other type of internal contamination monitoring uses some sample from the person to determine the presence of contamination. Methods may include urinalysis, fecal analysis, blood sampling, nasal swipes and others. These methods are called in vitro.

In some cases, the presence of contamination on a worker will be suspected based on the work situation. The following list provides some examples of work situations that may result in personnel contamination.

- Exposure of the worker to known contaminated liquids
- Exposure of the worker to airborne contamination without proper respiratory protection.
- Improper work practices within removable contamination areas such as:
  > Improper removal of protective clothing or devices
  > Improper work practices with contaminated materials
  > Failure to follow radiological control requirements for work being performed
  > Unknowingly working with material discovered to be contaminated.
2.14.01. BASIC FACTORS AFFECTING DECONTAMINATION

Once the RCT determines the worker is contaminated, the actions taken will be controlled by three basic radiological control factors. These factors include:

- Physical condition of the worker (i.e. possible injuries)
- Location of the contamination on the worker
- Activity and type of the nuclide(s) present.

Primary consideration should be given to the physical condition of the worker. The major concern should be whether or not the worker has a serious injury. When a worker sustains a serious injury, the primary concern is the first aid or assistance the worker needs. When a worker sustains an injury, the extent of the injury needs to be determined. Conditions that should be investigated include open/puncture wounds, bruises, sprains, strains and fractures.

Once the physical condition of the worker has been identified, the location of the contamination needs to be determined. Some of the items to pay particular attention to include:

- Is contamination localized on the skin surface
- Is contamination located on or near a body orifice
- Is contamination located near a break in the skin
- Is there a skin condition present in the vicinity of the contamination.

Finally, the amount and type of contamination needs to be determined. This will include a determination of the type of activity (alpha, beta or gamma). If practicable, save some type of sample for laboratory analysis.

2.14.02. SUSPECTED CONTAMINATION

Upon notification that an individual is potentially contaminated, the RCT should obtain necessary instrumentation and proceed to the location of the worker with suspected contamination. An immediate frisk will be performed to locate and quantify the levels of contamination.

(A "frisk" is a survey with a portable hand-held instrument. Frisking does not apply for contamination with tritium.)

Assess Conditions

It is advisable that the RCT make a quick assessment of the condition of the individual and the possibility of a contamination spread. If injury is evident, the RCT must immediately notify, or designate someone to notify the RCT supervisor. If the individual is not injured, a preliminary survey will give the RCT a quick indication of the extent and locations of contamination that may be present.
High levels of contamination or hot particles found on the skin or clothing during the preliminary survey should be removed immediately.

While performing the assessment survey, the RCT may question the individual to gain information regarding the event that may have caused the contamination. An RCT may need to ask for additional support when indications show that contamination control has been lost in an area frequented by other workers.

**Nasal Smears:** Nasal smears should be taken when contamination is detected. This is especially important if airborne radioactivity is present, or if contamination is detected on the face. The face is defined as the area within the sealing area of a full face respirator. Positive nasal smears are an indication of possible radionuclide intake. Refer to ESH-1-09-02 "Responding to Suspect Internal Intake".

To take a nasal smear, first ensure that the worker's hands are not contaminated, then instruct the worker to swab the inside of each nostril with a Q-tip. Place both Q-tips in labeled boxes, and send them to HPAL for immediate counting.

**Perform a Thorough Personnel Survey:**

After the quick assessment survey, a second survey should be performed of the entire exposed surface area (protective clothing if worn, personal clothing and/or skin) using the following guidelines:

1. The survey should be performed in an area where the background radiation is low.

2. Verify the instrument is in service (e.g. check the battery, calibration date, and source response). Set it to the proper scale and ensure that the audio output can be heard during the survey.

3. Hold the probe less than 1/2 inch from the surface being surveyed for beta and gamma contamination, and approximately 1/4 inch for alpha contamination.

4. Move the probe slowly over the surface, approximately 2 inches per second.

5. If the count rate increases during the survey, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
2.14.03. **CONFIRMED CLOTHING CONTAMINATION**

Depending on the level and type of contamination found on the clothing there are several options:

1) Decontaminate the clothing using masking tape or some other means of dry contamination removal and return them to the owner.

Wear protective clothing, dosimetry, and respiratory protection, as necessary while performing personnel monitoring and/or decontamination.

If a hot particle is detected, remove the particle or contaminated clothing without delay to limit skin exposure.

Hot particles are small particles that, when located on the surface of the skin, are associated with a shallow dose equivalent > 100 mrem/hr. They are often electrically charged, so they stick to the skin or other objects by electrostatic attraction.

Once removed, measure the dose rate and estimate the size of the area affected by the particle. Retain and store the particle if possible for dose analysis assessment by ESH-12.

2) Decontaminate the clothing by washing in an approved washing machine which is connected to a radioactive waste drain, and return them to the owner. Most facilities at LANL, however, do not have access to an approved washing machine.

3) Alternatively, discard the clothing as radioactive waste and instruct the owner to apply for reimbursement from the laboratory.

2.14.04. **CONFIRMED SKIN CONTAMINATION**

When contamination has been confirmed by monitoring with an appropriate instrument the following steps should be taken:

1) Determine the extent of contamination by doing a whole body frisk.

2) Document contamination levels and locations on the "Contaminated Person Survey" form, ESH-1-09-05.

3) Begin decontamination procedures.
1. Wear protective clothing, dosimetry, and respiratory protection, as necessary while performing personnel monitoring and/or decontamination.

2. Personnel should be decontaminated in previously designated decontamination areas.

3. Cover all minor wounds with a sterile dressing.
   - ESH-2 shall be contacted immediately when there is suspicion of skin damage.

4. Use masking tape, or wash the skin with mild soap and lukewarm water. Pat skin dry with a clean towel.
   - In cases of tritium contamination, use cool water in order to minimize diffusion of tritium.

   *Caution: Moisture on the skin may prevent detection of alpha contamination. Ensure the skin is dry before monitoring.*

5. Do not pursue decontamination to the point of skin irritation or abrasion.

6. Care shall be taken to ensure that all waste generated during the decontamination process is properly disposed of.

   *Note: If mild soap is not effective, then pumice or powdered soap may be used on selected parts of the person’s body, such as the hands and feet.*

**General Body Decontamination** - Have the individual shower in a decon shower stall, using warm (not hot) water. Have individual pat dry. Resurvey.

**Hair and Scalp Decontamination** - Have the person sit facing away from a decon sink, and tilt the head backward over the sink. Shampoo the hair for approximately two minutes, and rinse carefully. Dry the hair with a towel and survey. The process may be repeated two more times as necessary, using a clean towel each time.

In extreme cases it may be necessary to remove hair either by cutting or shaving. This requires permission from the affected person.
Facial Decontamination - Use only soap and lukewarm water

Eye Decontamination - Flush the eyes at an eyewash station or connect a piece of hose to a sink faucet. Flush with clean water, eyelids open, while the individual rolls the eyeball to dislodge the contamination.
Mouth Decontamination - Advise the individual not to eat, drink, chew, or smoke until decontamination has been completed. If the mouth is generally contaminated, have the individual swish tepid water in the mouth while keeping the head forward. For localized contamination, remove with cotton swab or gauze dipped in water, and rinse carefully.

More complete decontamination instructions can be found in ESH-1-09-05, "Response to External Personnel Contamination".

DOCUMENTATION

1. Complete a "Contaminated Person Survey" form (ESH-1-09-05).
2. Complete a "HPAL Analysis Request Form", as necessary, for nasal swipes.
3. Complete a Radiation Incident Report, see procedure LP107-10.0

2.14.05. DECONTAMINATION REAGENTS

Step 1: Wash the contaminated area with soap and water.

There may be a need for stronger decontamination agents than soap and water. Contact ESH-2 for further assistance in determining what chemical agents would be appropriate.

An RCT may be asked to assist ESH-2 with some of the procedures below if further decontamination is necessary.

Laundry Detergent or Clorox Bleach

These two techniques have similar results. ESH-2 may use either technique, depending on the facility and type of contamination present.

Laundry Detergent - Mix detergent with tepid water in a container and stir until a soapy solution is formed. Apply detergent solution, wait two minutes, rinse with water.

Clorox Solution - (5% sodium hypochlorite). Clorox may cause eye burns and skin irritation. If no reddening or irritation is noted, wait up to two minutes before removing the bleach by rinsing with water.

EDTA Solution

This solution may be prepared by dissolving one third of a teaspoon or ten grams of EDTA chemical salt in 100 mL of tepid water. Add one teaspoon of detergent to the solution to provide sudsing or lifting action to help in the removal of the contamination. EDTA works as an external chelating agent and may cause skin and eye irritation.

Apply the solution and if no reddening or irritation is noted, you may wait up to two minutes before removing by rinsing with water.
Potassium Permanganate and Sodium Bisulfite

Potassium Permanganate is used in conjunction with Sodium Bisulfite, and the solutions should not be prepared until immediately before use.

Potassium Permanganate (KMnO₄) Solution. Dissolve one capsule or one gram of Potassium Permanganate crystals in one ounce of tepid water. This solution may cause irritation to the skin, eyes, and mucous membrane. Apply the solution and allow it to dry thoroughly. Remove with Sodium Bisulfite solution. This solution may be repeated only once.

Sodium Bisulfite Solution. Dissolve one capsule or approximately one gram of sodium bisulfite in one ounce of tepid water. This solution may cause irritation of the eyes, nose, throat, and skin. Apply the solution to the dried Potassium Permanganate, gently rub until the discoloration has been removed, and rinse with water.

SUMMARY

In this lesson we have covered the basic principles of personnel decontamination. Our main subjects are the actions taken in the event of potential personnel contamination, notifications required, proper methods for identification and location of contamination, proper action to be taken once contamination has been confirmed and the approved methods for decontamination of personnel.