2.13 RADIOLOGICAL INCIDENTS and EMERGENCIES      RCT STUDY GUIDE

LEARNING OBJECTIVES:

2.13.01 Identify in general how an RCT should respond to an emergency.
2.13.02 Identify how an RCT should respond to a CAM alarm.
2.13.03 Identify how an RCT should respond to a personnel contamination monitor (PCM) alarm.
2.13.04 Identify how an RCT should respond to off scale or lost dosimetry.
2.13.05 Identify how an RCT should respond to rapidly increasing, unanticipated radiation levels or an area radiation monitor (ARM) alarm.
2.13.06 Identify the RCT responses to a dry or liquid radioactive material spill.
2.13.07 Identify the RCT responses to a fire in a radiological area or involving radioactive material.
2.13.08 Identify the classes of radiological events, incidents, occurrences, and emergencies.
2.13.09 Identify the procedures for documenting radiological incidents.
2.13.10 Identify the structure of the Emergency Response Organization at LANL.
2.13.11 Identify the available offsite incident support groups and explain the assistance that each group can provide.

LANL Standards and Procedures

ESH-1-09-01 Emergency Response Standard
ESH-1-09-02 Responding to Suspect Internal Uptake
ESH-1-09-03 Responding to Acute Exposures
ESH-1-09-04 Responding to Radioactive Material Spills
ESH-1-09-05 Responding to External Personnel Contamination
ESH-1-09-06 Responding to CAM Alarms
ESH-1-09-07 Responding to ARM Alarms
LP 107-01.0 Notification and Reporting of Radiological Incidents
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2.13.01 Identify in general how an RCT should respond to an emergency.

Specialists in emergency response realize that detailed lists of emergency actions are practically useless during an accident because so many unforeseen problems can arise. Instead, they emphasize generalized response procedures.

Three acronyms will be emphasized: SWIMS and RESPOND and HARC.

Stop
Warn
Isolate
Minimize
Secure

Respond
Evacuate
Survey
Plan
Observe
Notify
Document

Get Help
1st Aid
RadCon

Basic Guidelines for Emergency Response

Be prepared. Be familiar with the work area, the types of work in progress, and the location of potentially hazardous materials. Know the emergency plans, and the location of emergency equipment.

If you RESPOND to an emergency:

• Evacuate to an area where known hazards are low (RESPOND).
• Survey to determine the extent of the hazard (RESPOND)
• Remain calm and think through actions to take. Hasty action can make things worse. Plan and Observe (RESPOND). Gather information and take notes.
• Notify the appropriate people, e.g. the Operations Center, the emergency dispatcher (911) and your supervisor (RESPOND)
• Document the radiological conditions. List who was in the area and where they were. Initiate RIR as appropriate. (RESPOND)
Whenever you phone 911, EMR (Emergency Management and Response) is automatically informed. The EMR phone number is on your ES&H Quick Reference Badge. EMR determines what emergency resources are needed and coordinates the response.

Do not publicly discuss the situation. Misinformation about an emergency can cause unnecessary alarm. Remember, you know only part of the story. Refer inquiries to the Public Information group office at 7-7000.

Medical Emergencies

The key points of the response to a medical emergency or serious injury are:

get Help immediately, shout "Help" and send someone to call 911
first Aid, within the limits of your training
Radiological Control is your third priority.

Medical emergencies are discussed in more detail in lesson 2.15.

2.13.02 Identify how an RCT should Respond to a CAM Alarm

A CAM alarm should always be taken seriously as it indicates airborne radioactivity.

RCT’s should insure that the following actions have taken place:

first: Stop work activities and evacuate personnel immediately
Warn others of the hazard
Isolate the area
Minimize exposure to both contamination and radiation
Secure unfiltered ventilation, as appropriate

also Respond
Evacuate
Survey, take nose swipes, check that the evacuation area is safe
Plan; avoid hasty actions that could make the situation worse
Observe; what might have caused the alarm?
Notify your supervisor
Document: make a list of who was in the area, where they were, and what they were doing; could they have caused a release? Initiate RIR.

The first priority is the health and safety of personnel. Collect nose swipes. Personnel must remain in the assembly area until they have been monitored, and the RCT has determined that it is safe to re-enter.

Discuss a plan for re-entry. Refer to ESH-1-09-06 Responding to CAM alarms. Wear a full-face respirator. Observe. Look for unusual conditions. Monitor
exposed surfaces for contamination. Change the filter on the CAM and watch the readings, remotely if possible.
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2.13.03 Identify how an RCT should respond to a PCM alarm.

Response to a personnel contamination monitor alarm (from a PCM, HFM, etc) should include the following:

The individual who sets off the alarm should:
- Remain in the immediate area
- Notify RCT

The RCT should:
- Survey (frisk) to verify and determine the extent of the contamination
- Plan: refer to lesson 2.14 for decontamination procedures
- Observe: remove hot particles immediately and keep them for analysis
- Notify your supervisor if contamination is confirmed.
- Document the incident with an RIR if contamination is confirmed.

Note that "evacuate" is not included in the above list.

For more detail, refer to:
- RadCon manual section 541 (Skin Contamination)
- Appendix 3-C of the Radcon manual
- ESH-1-09-05 "Responding to External Personnel Contamination".

Evaluate the potential for internal intake, and initiate the procedure "Responding to Suspect Internal Intake", ESH-1-09-02, if appropriate.
Always suspect internal intake if there is contamination on the face.

2.13.04 Identify how an RCT should respond to off scale or lost dosimetry.

A person whose dosimeter is off scale should
- place work in a safe condition,
- immediately exit the area, and
- report to the RCT, who should

RESPOND as follows:
- Evacuate the area where the person was working
- Survey; read the dosimeters of other workers who were in the area
- Plan, Observe, and evaluate the situation
- Notify your supervisor, as appropriate
- Document who was in the area and what they were doing, and send the worker's TLD to ESH-4 to be read immediately. If exposures are above the limits, initiate an RIR.

If a dosimeter is lost, complete a Lost Dosimetry Badge Report (Form 1325).
Re-entry of the person should not be made until a review has been conducted, line management has approved re-entry, with the concurrence of ESH-12, and the dosimeter has been recovered or replaced.
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Special procedures must be followed to reconstruct the dose received by the individual (see AR 3-6). Normally, the operating group, with assistance from ESH-1 and the dose assessment staff (ESH-12) will investigate the status of the dosimeter.

Temporary dosimeters may be issued to individuals who have misplaced or forgotten their regularly issued TLD dosimeter.

2.13.05 Identify how an RCT should respond to an Area Radiation Monitor alarm (ARM).

RESPOND to an Area Radiation Monitor (ARM) alarm as follows:

- Respond
- Evacuate the area
- Survey to determine the extent of the hazard; make sure the evacuation area is safe; read the dosimeters of those who were in the area;
- Plan; avoid hasty actions; keep your own dose ALARA;
- Observe; what might have caused the alarm?
- Notify your supervisor; notify ESH-2 immediately of doses > 5 rem
- Document who was in the area and what they were doing; could they have caused the problem? If exposure is above limits, initiate an RIR.

Personnel should remain in the assembly area until the RCT allows re-entry. Be cautious. Plan to keep your own dose ALARA.

If you are entering a High Radiation Area, you should:
- prepare an RWP
- performance test a suitable instrument
- leave it turned on
- hold it in front of you as you enter
- use supplementary and alarming dosimetry

Nuclear Accident Dosimeters NAD

Facilities that have sufficient quantities of fissile material to potentially constitute a critical mass, as well as all facilities where a nuclear criticality accident is credible, shall have nuclear accident dosimeters, e.g. the personnel nuclear accident dosimeter, PNAD or PND, discussed in lesson 2.04. The critical mass is the mass of material that will support a self-sustaining chain reaction; under some conditions this can be as small as 0.5 kg (one pound) of plutonium or uranium.

These dosimeters shall:

- determine neutron dose (rad)
- determine neutron energy spectrum, so as to calculate the dose equivalent (rem)
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- measure fission gamma radiation in the presence of neutrons
- provide a neutron dose range from 10 rads to ~ 10,000 rads, and
- provide a gamma dose equivalent range from 10 rems to ~ 10,000 rems.
The Radiation Protection Measurements Section of ESH-4 provide fixed Nuclear Criticality Packets (nuclear accident dosimeter units that meet the above requirements). Refer to RCT lesson 2.10 objective 11.

Refer to ESH 1-09-07 Responding to ARM alarm and ESH 1-09-03 Response to Acute Exposure.

2.13.06 Identify the RCT responses to a radioactive spill

Response to a spill of radioactive material should include the following actions:

- Stop and secure the operation causing the spill if possible
- Warn others in the area
- Isolate and contain the spill area if possible
- Minimize individual exposure and contamination
- Secure unfiltered ventilation, as appropriate, to minimize airborne contamination

- Respond:
  - Evacuate the area;
  - Survey to determine the extent of the hazard; take nose swipes;
  - Plan; avoid hasty actions that could make things worse;
  - Observe; find out what radionuclides are in the spilled material;
  - Notify your supervisor;
  - Document who was in the area and where they were. Initiate an RIR.

In the case of a liquid spill, be aware of the potential for airborne radioactive material from the residue, which may be a fine powder after the liquid has dried.

Think about possible internal intake. Take nose swipes. Refer to ESH-1-09-02 Responding to Internal Intake.

Refer to ESH-1-09-04 Responding to Radioactive Material Spills.

2.13.07 Identify the RCT response to a fire in a radiological area

Controlling exposure to radiological materials during a fire is complex. Multiple hazards may exist and alternative methods for controlling exposure to emergency response personnel may have to be taken. The Incident Commander, in consultation with the RCT and other technical advisors, will evaluate the situation and direct actions.

In the event of a fire, personnel safety is the number one consideration. Personnel should be evacuated to a position upwind of the fire. You may use a
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fire extinguisher to fight a small fire, if you have been trained, and you can reasonably expect to extinguish the fire.
RCT’s should report to the HazMat or Incident Command area and be ready to indicate what resources are available, what hazards are present, what entry precautions are needed for emergency personnel (protective clothing, respirators, etc.) and what decontamination procedures might need to be initiated upon exiting the area. Since each facility has its own Building Emergency Plan that should be followed during an emergency, each individual worker should be familiar with the plan and have emergency numbers listed on their ES&H Quick Reference Badge.

During a fire, be aware that

- water is a moderator for fissile materials, and could result in criticality;
- collapse of structures could move fissile materials to form a critical mass;
- smoke can interfere with monitoring equipment, e.g. tritium monitors;
- plutonium and uranium are pyrophoric; fires involving these materials are class D fires, requiring special fire extinguishers;
- plutonium and uranium react strongly with water to form plutonium oxide.

Discussion: an argumentative employee insists that after plutonium has burned, it is less radioactive than normal plutonium. To support his argument, he points out that LANL is proposing to incinerate radioactive waste. His argument is wrong, but why?

2.13.08 Identify the classes of radiological events, incidents, occurrences, and emergencies.

Classes of radiological events are defined in DOE Orders 5500.2B and 5000.3B. In order of increasing severity they are as follows.

**Event**
anything that happens, like a loss of power, equipment failure, etc.

**Incident**
An event that exceeds the criteria defined in objective 9 of this lesson.

**Off-normal Occurrence**
A serious incident, as determined by the facility manager and ESH-7.
e.g. unlabelled radioactive material in a Controlled Area
Written notification to DOE must be submitted within one working day.

**Unusual Occurrence**
More serious occurrence, as determined by facility manager and ESH-7
e.g. significant radioactive material released off-site
DOE must be notified within 2 hours after ESH-7 has the information
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**Operational Emergency**

A very serious occurrence that reduces the safety of a facility.
DOE must be notified within 15 minutes after ESH-7 has the information.
County, tribal, and state authorities are also notified.

An emergency can involve an Alert, a Site Area Emergency, or a General Emergency, as follows.

**Alert**

- reduction of the level of safety of a facility
- release of hazardous materials expected to be small

**Site Area Emergency**

- Major failure of safety systems necessary for protection of workers and public.
- Onsite release of hazardous materials likely.
- Offsite release of hazardous materials expected to be small.

**General Emergency**

- Catastrophic reduction of facility safety systems.
- Offsite releases of hazardous materials expected to exceed Protective Action Guide levels.

Emergency Action Levels (EALs) are defined as the specific criteria used to recognize and categorize Operational Emergency events and are summarized in LANL's Emergency Action Levels (refer to Handout).

**Emergency Rescue and Recovery** operations should be carried out according to the following guidelines:

- When protecting major property where lower dose limits are not practical, the wholebody dose limit is 10 rem.

- When providing lifesaving recovery or protection of large populations, the wholebody dose limit is 25 rem.

- When providing lifesaving recovery or protection of large populations where lower limits are not practical, greater than 25 rem is allowed, only on a voluntary basis to personnel fully aware of the risks involved.
2.13.09 Identify LANL’s specific procedures for documenting radiological incidents.

Definitions

A Radiological Incident is any unexpected event resulting from the use of radiation-producing materials or equipment that meets the criteria specified on the Radiological Incident Report (RIR) form, and summarized in the reporting levels table of LANL procedure LP107.01.0 (page 7). These are simplified as follows.

- **ARM alarm**, or external exposure of personnel that is unexpected
- **CAM alarm** (true or false) or unexpected airborne radioactivity
- **internal intake** (e.g. nose swipes, facial, or wound counts)
- **Personnel contamination** on skin or personal clothing
- **Unlabelled radioactive material** outside a Buffer Area

How much contamination is too much? If you can detect it, fill out an RIR. You may write an RIR, for any reason you and your supervisor think is justified. Let the facility manager and ESH-7 decide how serious it is.

A Radiological Occurrence is a serious incident, to be reported to DOE in accordance with DOE Order 5000.3B. The RCT's responsibility is to fill out the RIR. The facility manager and ESH-7 take it from there, and decide whether an incident is also an occurrence.

Notification checklist: this is an initial notification to make sure that appropriate Laboratory organizations are aware that an incident has occurred. The goal is that these notifications take place within two hours. The notifications are documented on the Notification Checklist form, which will usually contain preliminary information and measurements.

RIR. The Radiological Incident Report (RIR) form will usually contain final results and measurements. The goal is to have the RIR completed within two weeks.
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2.13.10 Identify the structure of the Emergency Response Organization at LANL.

In an emergency, your first action should be to instruct someone to telephone 911. The Emergency Management and Response (EM&R) office is automatically informed of all emergency calls at LANL.

Your second phone call should be to your supervisor. EM&R and your supervisor can deal with the other notifications, such as ESH-2 for medical emergencies, ESH-4 for wound counts, ESH-12 for internal dose assessment.

The EM&R office has overall responsibility for coping with any emergency at the Laboratory. The phone number, 7-6211, is on your ES&H quick reference badge.

Initial direction and control of the Emergency Response is provided by the duty Emergency Manager, a senior member of the Emergency Management and Response Office staff. The Emergency Manager makes appropriate notifications, activates the Emergency Response Organization, and proceeds to the scene. The Emergency Manager has full authority to assume Incident Command with full responsibility for all actions at the scene.

**Emergency Response Organization Structure**

The Emergency Response Organization includes the following:

- **Emergency Management and Response Office** personnel.
- **Laboratory specialized teams** (Hazardous Materials Response, Crisis Negotiations, Hazardous Devices).
- **Facility-specific emergency response teams**, e.g. Plutonium Facility (TA-55) and Sigma Complex Emergency Response teams.
- **Protective Force**, including the **Rapid Response Team**.
- **Los Alamos Fire Department** including ambulance and rescue.
- **Laboratory Spill Coordinators**.

The LANL Emergency Management Plan is reviewed annually and updated when significant changes are required.
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2.13.11 Identify the available offsite incident support groups and explain the assistance that each group can provide.

The Los Alamos County Fire Department responds to 911 calls. The Fire Department includes ambulance and rescue crews and paramedics. Note that if you only activate a fire alarm, a fire truck will respond, but an ambulance will not respond immediately unless you also call 911.

Fire Department personnel have TLDs and SCBAs, and receive training that is equivalent to RadWorker, but need guidance from an RCT in a radiological emergency. In an emergency, you should allow them unrestricted access into radiological areas, but guide them, advise them, and frisk them for contamination as time allows.

Local support may also be requested from Los Alamos Medical Center, and the Los Alamos Police Department.

At the request of the Incident Commander or the Crisis Manager the following state agencies may be called by the DOE Los Alamos Area Office Manager: New Mexico State Police, Emergency Planning and Coordination Bureau, Environment Department, Emergency Medical Service Bureau, New Mexico Highway Department, and the New Mexico Department of Health.

In addition, there are DOE National Emergency Response Resources that LANL can call upon in the event of an emergency.

**Note:** Any off-site activity by an RCT is politically sensitive. In a recent incident, a contaminated employee who had left the site was followed to a local barber’s shop. The other customers were concerned, and DOE was not pleased! If there is any hint of a potential incident off-site, contact:

- your supervisor,
- EM&R (see the phone number on your quick reference badge).
- Also, ensure that somebody contacts DOE AL (Albuquerque)

**Summary**

Due to the continuing concerns of many people with low radiation exposure, RCT’s should understand the perception of personnel concerning radiation risks. RCT’s should understand radiation, its risks, and their role in minimizing exposure. It is not sufficient to rely solely on regulatory limits for defining acceptable work practices and work environments. Whenever possible, RCTs should encourage workers to ask questions concerning their work in dealing with radiological materials and their safety.