Course Title: **Radiological Control Technician**
Module Title: **Radiological Incidents and Emergencies**
Module Number: **2.13**

Objectives:

	2.13.01	Describe the general response and responsibilities of an RCT during any incident.
☞	2.13.02	Identify any emergency equipment and facilities that are available, including the location and contents of emergency equipment kits.
☞	2.13.03	Describe the RCT response to a Continuous Air Monitor (CAM) alarm.
☞	2.13.04	Describe the RCT response to a personnel contamination monitor alarm.
☞	2.13.05	Describe the RCT response to off scale or lost dosimetry.
☞	2.13.06	Describe the RCT response to rapidly increasing, unanticipated radiation levels or an area radiation monitor alarm.
☞	2.13.07	Describe the RCT response to a dry or liquid radioactive material spill.
☞	2.13.08	Describe the RCT response to a fire in a radiological area or involving radioactive materials.
☞	2.13.09	Describe the RCT response to other specific site incidents (as applicable).
☞	2.13.10	Describe the response levels associated with radiological emergencies.
☞	2.13.11	Describe site specific procedures for documenting radiological incidents.
☞	2.13.12	Identify the structure of the emergency response organization at your site.
☞	2.13.13	Identify the available offsite incident support groups and explain the assistance that each group can provide.
☞	2.13.14	Discuss radiological incidents at the plant or other plants, including cause, prevention, and recommended incident response.

References:

1. Title 10 CFR Part 835 (1998), "Occupational Radiation Protection" Subpart N.
2. DOE Order 151.1, "Comprehensive Emergency Management Systems."
3. (Site specific emergency preparedness manuals)

Instructional Aides:

1. Overheads
2. Overhead projector/screen
3. Whiteboard/chalkboard
4. Lessons learned

I. MODULE INTRODUCTION

A. Self Introduction

1. Name
2. Phone number
3. Background
4. Emergency procedure review

B. Motivation

State that most people have an attitude that "it can't happen here" and don't take incident response planning seriously. Explain that incidents do occur, and experience has shown that best response comes from workers who have prepared themselves with a plan for dealing with incidents. Relate to a car skidding on ice. If the driver has thought about corrective actions for skidding, he will be less likely to panic. State that no plan can give an exact solution to every problem, but that a step-by-step approach to responding to any problem can be used.

C. Lessons Overview

1. Radiological incidents
2. Response to incidents
3. Response to emergencies or potential emergencies
4. Radiological emergency planning and organizations

D. Introduce Objectives

Show O.H.: Objectives

II. MODULE OUTLINE

NOTE: This lesson plan should be developed using site specific information and regulatory documents. The following is a recommended format of material.

A. Radiological Incidents and Emergencies

1. Definition

Ask the student to explain the difference between an emergency and incident and define each one. Modify their answer and write the correct definition on the board.

a. Incident

1) Unplanned event involving radiation or radioactive materials (part of an emergency)

2) Response governed by normal procedures

b. Emergencies are classified as either an Alert, Site Area Emergency, or General Emergency, in order of increasing severity, when events occur that represent a specific threat to workers and the public due to the release or potential release of significant quantities of radiological and non-radiological hazardous materials. Classification aids in the rapid communication of critical information and the initiation of appropriate time-urgent emergency response actions.

2. Causes

Ask the student for causes of incidents. List these on the board.

a. Ignorance

b. Forgetfulness

c. Oversight

d. Unforeseen circumstances

e. Communications failures

f. Mechanical failures

g. Human error

h. Natural disasters

3. Examples

Ask the student for examples of potential incidents at the site. List these on the board and relate to causes.

(Insert site specific information here)

Ensure that all of the basic incident types described in the site accident analysis are included in the discussion.

a. Ignorance - Inexperienced operator not knowing correct procedure and opens the wrong valve.
For each general type of incident:

b. Oversight - Misreading an indicator and allowing a valve to be opened.

- Discuss expected radiation levels and/or types and quantities of isotopes released

c. Mechanical Failure - Instrument line ruptures causing spread of contamination.

- Discuss on site consequences
- Discuss off site consequences
- Ask the student for examples of how human error or violating procedures could result in the consequences of the incident being greater than presented in the site accident analysis.

4. Non-radiological risks

Explain that immediate threats to life and health, such as fire, may require disregarding normal procedures, but that ALARA can always be applied if not following normal procedures.

B. General Response to Emergencies

Objective 2.13.01

1. Although radiological control personnel respond to an emergency using basic guidelines, an area or site may have specific procedures which have priority over these guidelines.

2. Radiological control personnel must be familiar with the emergency procedures applicable to each site and the types of equipment to which they are assigned. The basic guidelines can then be used in conjunction with the specific procedures. In addition, the order or necessity of some actions may change depending on whether one is the first responder, one of many responders, or a backup person.

3. The basic emergency response guidelines are:

   a. Define and assess the problem. Typically personnel at the scene are a good source of information, however remote instrumentation and other resources should not be overlooked. Depending on the nature of the incident, do not delay or over analyze the situation. Assess only what is needed for action.

   b. Attempt to stop the cause of the emergency. No undue risks should be taken.

   c. Notify site management and safety.

Whether or not to activate a site emergency response program (such as dialing 911) is determined by the nature of the incident. Activation usually automatically fulfills this requirement. When a situation is confusing, not fully understood, or may not be controllable; over reacting is better than under reacting.

d. Warn personnel in the area of the emergency. This keeps unnecessary personnel away from the event site, minimizing their exposure.

e. Isolate the area. Install barriers as quickly as possible to establish an exclusion area. The exclusion area may be very large initially. In determining the size of the exclusion area, consider internal and external exposure rates, potential for criticality, possible spread of radioactive contamination or other hazardous materials, weather conditions, non-radiological hazards, and security (site security may assist in establishing boundaries). Outside the exclusion area normal operations may continue. Even if there is no radiological risk, an RCT may help others provide access control.

f. Minimize personnel exposure. During initial response remember to use ALARA concepts, as practical. Plan supplementary operations as necessary to assure personnel exposure is minimized. All planned exposures above the occupational limits (5 rem) is voluntary. The following guidelines for control of emergency exposures are

   1) Up to 10 rem for protecting major property and where lower dose limit is not practicable

   2) Up to 25 rem for lifesaving or protection of large populations where lower dose limit is not practicable

   3) Above 25 rem for lifesaving or protection of large populations. Only on a voluntary basis to personnel fully aware of the risks involved

g. Secure ventilation. Close entrances, windows, and the supply ventilation systems as necessary. Unless one is certain that ventilation is contributing to the incident, this may involve no more than just ensuring that conditions are correct for normal designed ventilation.

h. Perform surveys. Radiological control personnel are trained to perform emergency surveys. Types of surveys will vary with the nature of the emergency.

Performing good surveys may require significant time but must be done before recovery can be initiated.

i. Initiate the recovery. This includes clean-up operations, decontamination and moving the exclusion area barricade inward.

C. Facilities and Equipment — Objective 2.13.02

1. Facilities

RCTs should have a thorough knowledge and understanding of processes and hazards of their assigned facility. This should include a knowledge of the *Site Emergency Response Plan*. These plans usually contain information concerning evacuation routes, staging areas, handling of contaminated personnel, and information concerning off-site support organizations.

2. Equipment

Typically, facilities maintain "emergency kits/cabinets" which contain supplies used in responding to emergencies. These kits/cabinets usually contain smears, gloves, bags, supplies for posting, dosimetry, respiratory equipment, and a copy of facility emergency procedures.

(Insert site specific information here)

RCTs should always know the resources and equipment available to them in the area where they are working. For each site or area, discuss the location, security and habitability provisions, equipment and communications available.

D. Response to Continuous Air Monitor (Cam) Alarm — Objective 2.13.03

Airborne radioactivity may be caused by a breach in a system, or resuspension of particulate radioactivity due to work evolutions such a welding, grinding, or other heavy work.

Indications that an airborne contamination event is occurring include CAM alarms, air samples exceeding limits, and increasing radiation levels.

1. Initial Response

    a) Stop operations that may be causing airborne radioactivity

    b) Warn others to evacuate

    c) Secure unfiltered ventilation

    d) Contact line or facility management for support

2. Supplementary Actions (re-entry)

    a) Upon re-entry, don respiratory equipment and protective clothing based on conditions of the event.

    b) Evaluate the affected area by taking an air sample, measuring radiation levels, and checking for CAM malfunction.

    c) Obtain additional air samples as necessary to determine boundaries and maintain access control.

    d) Identify isotope(s) to help determine problem source and protective measures.

    e) Consider additional ventilation to minimize personnel exposure and reduce the need for respiratory equipment (HEPA).

    f) Measure and control surface contamination to minimize the spread of contamination.

    g) Survey exhaust systems, ventilation filters, and ducts. Have decontamination performed as necessary to minimize contamination spread.

    h) Evaluate the potential for internal exposure and contact facility dosimetrist for proper internal dosimetry protocol.

i) Personnel should be interviewed for information on any off-normal event which could have caused the alarm.

j) Take air samples, once operations resume, to verify that the cause of airborne activity has been corrected.

(Insert site specific information here)

Explain the basis for and significance of the alarm setpoints for CAMs at your site

E. Response to Personnel Contamination Monitor Alarm

Objective 2.13.04

1. Initial Response

a. Instruct affected worker to remain in area (standfast)

b. Report to the scene with at least portable instruments for direct surveys and smear media.

c. Perform whole body surveys (frisk) for the appropriate type of radiation (alpha and/or beta-gamma). The RCT should be careful not to contaminate self and instrumentation.

d. Take actions to minimize cross-contamination, such as covering or placing a glove over a contaminated hand.

2. Supplemental Actions

a. Survey affected area to characterize the extent of contamination.

b. Suspect an up-take if contamination is verified and survey facial area for contamination, taking nasal smears or nose blows. If positive, contact RCT supervision and refer to your facility specific procedures.

c. If contaminated, follow-up actions include saving any radioactive material pertaining to the contamination event, as this may help characterize the event at a later time.

d. Refer to facility specific procedures if contamination persists.

e. Document all surveys and estimate skin dose on proper forms. Do not unduly delay any decontamination efforts by taking too long in documenting contamination for skin dose estimates. Remember that dose is being incurred all the time that the skin is contaminated. Think ALARA especially in the case of high energy beta emitters.

f. Report all confirmed skin contaminations to RCT supervision and refer to your facility specific procedures if transporting to a medical facility.

g. Gather appropriate information for follow-up surveys.

3. Follow-up actions shall be in accordance with the site procedure. These typically include:

a. Removal of contaminated clothing or decontamination of minor skin contamination. Decontaminate skin using mild non-abrasive soap and tepid water or decon toweletts. Continue decon as long as significant reduction in activity is occurring after each decon. Do not irritate the skin.

b. Verification that personnel monitoring equipment is working properly. Equipment should not be returned to service until all problems are resolved. Alarms can be caused by a variety of equipment failures or by "nuisance" non-work related situations such as environmental radon resulting from local conditions.

(Insert site specific information here)

NOTE: Alarms and alarm set points should not be tampered with. If alarm cannot be silenced by the acknowledge button, take out of service.

F. Response to Off-scale or Lost Dosimetry

Objective 2.13.05

1. For Off-scale self reading dosimeters, typical actions include:

   a. Assure that the worker is placed in as safe an area as possible (low dose area) and that the work has been left in a safe condition where possible.

   b. Alert others working in the area (for off-scale response).

   c. Evaluate the situation. All dose indicated by the dosimeter is assumed to have been received by the individual until it can be clearly demonstrated otherwise.

   d. Gather data for dose estimate. Data typically includes work area dose rates, work activities, worker position, co-worker dose readings, and travel path conditions. For High exposures, the official permanent dosimetry (TLD or film badge) should be retrieved for processing.

2. For lost dosimetry, typical actions include:

   a. Individual(s) must leave the area if dosimetry is required.

   b. Contact RCT supervision for reissue of dosimetry.

3. Supplemental action

   a. Notify workers supervision

   b. Restrict additional entries until a dose assessment can be completed

   c. Consider suspending further work on the RWP until issues are resolved

   (Insert site specific information here)

G. Response to Rapidly Increasing, Unanticipated Radiation Levels or an Area Radiation Monitor Alarm.

Objective 2.13.06

1. Initial Response

a. Evacuate personnel as quickly as possible to a safe area (low dose area).

b. Measure radiation levels in affected area.

c. Notify line/facility management. Whether or not to activate a site emergency response program (such as dialing 911) is determined by the nature of the incident. Activation usually automatically fulfills this requirement. When a situation is confusing, not fully understood, or may not be controllable; over reacting is better than under reacting.

d. Evaluate the situation. The best contact is people at the scene.

e. Verify postings and boundaries are adequate.

2. Supplemental Actions

a. Verify personnel staging area dose rates are acceptable and check individual exposures. Notify RCT supervision of results.

b. Re-occupy area upon approval of line/facility management.

c. Document all surveys using appropriate forms.

(Insert site specific information here)

H. Response to Dry or Liquid Radioactive Spill of Known Material and Origin Requiring SWIMS

Objective 2.13.07

1. <u>STOP</u> the spill.

a. Take appropriate precautions, dependent on situation, all are different.

b. Correct immediately, if possible without undue risks. ALARA should be practiced at all times. If a major spill can be averted with minimal risk, then some action may be warranted; otherwise, try to contain the spill as it presents itself.

2. WARN other personnel.

   a. Let people in the affected area know what is going on.

   b. If situation warrants, evacuate the area.

   c. Notify your supervisor, site management, and emergency response network if appropriate. As before, whether or not to activate a site emergency response program (such as dialing 911) is determined by the nature of the incident. Activation usually automatically fulfills this requirement. When a situation is confusing, not fully understood, or may not be controllable; over reacting is better than under reacting.

3. ISOLATE the area. Use banners or whatever materials available to isolate the area. Recruit whatever personnel are at hand to assist.

   - Establish boundaries and post the area for exposure and contamination control.

4. MINIMIZE exposure. Use all protective gear available. Do not risk uptakes by not using respiratory protection or anti- contamination clothing.

   a. To yourself as well as others.

   b. Practice ALARA principles.

5. SECURE Ventilation

   - Control HVAC (heating, ventilation, air conditioning).

Unless one is certain that ventilation is contributing to the incident, this may involve no more than just ensuring that conditions are correct for normal designed ventilation.

6. Supplemental actions

   a. Survey as necessary including air sampling.

Major spills may very likely involve many people and require Radiation Work

b. Decontaminate as necessary.

c. Verify boundaries.

d. Complete all documentation surveys and logs.

(Insert site specific information here)

Permits and ALARA reviews of activities. Do not try to clean up a major spill by yourself, just keep it contained and isolated until the entire clean up operation is formulated.

7. If you cannot contain the spill or are unaware of the spill's nature, use WIN

   a. Warn others

   b. Isolate the area

   c. Notify

I. Response to a Fire in a Radiological Area or Involving Radioactive Materials

Objective 2.13.08

Typically Radiological Control will supply support to the Fire Department and will be represented at the Command Post. Additional actions could include the following.

1. Assist in evacuation of personnel.

2. Perform air samples, radiation, and contamination surveys.

3. Establish radiological boundaries.

(Insert site specific information here)

J. Response to Other Site Specific Incidents

Objective 2.13.09

(Insert site specific information here)

K. Response Levels

Objective 2.13.10

1. ALERT. An Alert shall be declared when events are predicted, are in progress, or have occurred that result in actual or potential substantial degradation in:

   a) Level of control over hazardous materials

b) Safety or security of a nuclear weapon, component, or test device that would not pose an immediate threat to workers or the public

c) Safety or security of a facility or process that could, with further degradation, produce a Site Area Emergency or General Emergency

2. Site Area Emergency. A Site Area Emergency shall be declared when events are predicted, in progress, or have occurred that result in actual or potential situations that could include one or more of the following:

a) Major failure of functions necessary for the protection of workers or the public

b) Threat to the integrity of a nuclear weapon, component, or test device that may adversely impact the health safety of workers in the immediate area, but not the public

c) Major degradation in level of safety or security of a facility or process that could, with further degradation, produce a General Emergency

3. General Emergency. A General Emergency shall be declared when events are predicted, in progress, or have occurred that result in actual or likely situations that could result in one or more of the following:

a) Catastrophic reduction of facility safety or security systems with potential for the release of large quantities of hazardous materials to the environment

b) Catastrophic failures in safety or security systems threatening the integrity of a nuclear weapon, component, or test device that may adversely impact the health and safety of workers and the public

(Insert site specific information here)

L. Documentation of Radiological Incidents and Event Categorizations

Objective 2.13.11

(Insert site specific information here)

Event Categorizations

1. Emergency: An event having significant offsite consequences or resulting in activation of the site emergency plan (i.e., activation of an Emergency Control Center).

2. Unusual Occurrence: A non-emergency that has significant impact or potential impact on health and safety, the environment, security or operations.

3. Off-Normal: Other events or conditions that adversely affect health and safety, the environment, security or site operations or which indicate that degradation in protection or performance has occurred.

M. Emergency Response Organization

Objective 2.13.12

(Insert site specific information here)

Emergency organization and responsibilities may include:

1. Site specific teams
2. Crisis Manager
3. Crisis Management Team
4. Operational Assistance Team
5. Emergency Response Team
6. First Line Initial Response Team

Discuss reporting and authority relationships, persons normally assigned to each team, and where they are located. Emphasize the responsibilities of RCT when assigned to applicable teams.

N. Offsite Support Groups

Objective 2.13.13

(Insert site specific information here)

For each offsite support group, discuss the training and qualifications, number of personnel, and equipment resources available.

1. Purpose is to overcome the limitations of the lack of training and insufficient equipment/personnel.

Explain that local offsite response groups may have different dose guidelines that they have to follow. Emphasize that the most restrictive guideline must be followed for these personnel.

2. May include:

   a. Firefighting

   b. Medical

   c. Law enforcement

   d. Radiological Assistance Program (RAP) Team

O. Site Specific Lessons Learned

(Insert site specific information here)

Objective 2.13.14

Ensure that all of the basic incident types at the site are included in the discussion. For each of the following incidents, refer the students to the applicable site procedures listed and discuss each step. Emphasize the rationale for the actions instead of just listing them. Include each of the following under the discussion of each incident type as applicable:

- Additional ways in which each could be discovered, such

as routine surveys or observation of unusual conditions.
- Who is in charge of response
- Radiation Control responsibilities
- Immediate actions
- Corrective actions
- Recovery
- Documentation

Read the accident reports and analysis and then:

- Discuss the radiation levels and/or types and quantities of isotopes released.
- Discuss on site consequences.
- Discuss off site consequences.

III. SUMMARY

Conduct summary by asking questions which will show that the student objectives have been met. Modify answers for completeness, correctness and clarity. Use the student objectives to formulate your questions. Base your selection of questions on the areas that the students have demonstrated some weakness or misconceptions.

A. Review major points

1. Radiological incidents
2. Response to incidents
3. Response to emergencies or potential emergencies
4. Radiological emergencies Planning and organizations

B. Review learning objectives

IV. EVALUATION

Evaluation should consist of a written examination comprised of multiple choice, fill-in the blank, matching and/or short answer questions. 80% should be the minimum passing criteria for examinations.