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Guidelines for General Employee Training

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GUIDELINES FOR GENERAL EMPLOYEE TRAINING

November 1993
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NATIONAL ACADEMY FOR NUCLEAR TRAINING

Plant Area:
Training

Key Words:
GET, Training, Fitness-for-Duty

The National Academy for Nuclear Training operates under the auspices of the Institute of Nuclear Power Operations (INPO). The Academy provides a framework for a unified, coordinated industry approach to achieving and maintaining effective training and qualification. It also promotes pride and professionalism of nuclear plant personnel. The academy integrates the training efforts of all U. S. nuclear utilities, the activities of the National Nuclear Accrediting Board, and the training-related activities of INPO.

Foreword

Background

These guidelines, used in combination with plant-specific analyses and other position-specific training guidelines, provide the framework for training and qualifying of nuclear power plant personnel. Although these guidelines may not reflect all the mandated training requirements for some positions, they are intended to assist in developing and implementing an effective Plant Access Training (PAT) program, Radiation Worker Training (RWT) program, and Radiological Respiratory Protection Training (RRT). This document replaces INPO 91-011, *Guidelines for General Employee Training*.

Basis

These guidelines are based on existing industry General Employee Training (GET) programs, industry operating experience, and input from the industry including the Council of the National Academy for Nuclear Training and a special working group formed to assist in the development of these guidelines.

Application

Utilities should use these guidelines in conjunction with their position-specific training programs to review and update existing programs. Lesson plans and student training materials have been included to provide a more consistent utility approach to this training. Instructor outlines and student materials allow for adding plant-specific details.

Guideline Revisions

This revision, which represents a significant change from the previous revision, focuses only on the training needed to safely work in a nuclear electric generating station. The following summarizes the major changes:

- The number of learning objectives has been reduced based on a performance-based review conducted by an industry working group.
- The term "Plant Access Training" is now used to more accurately reflect the intent of the initial training program. This training enables an individual to enter and safely work within a nuclear power plant.
- The terms "Category 1 Radiation Worker" and "Category 2 Radiation Worker" have been eliminated. Category 1 Radiation Worker training is now included within Plant Access Training and the Category 2 Radiation Worker training has been retitled "Radiation Worker Training."
- This guideline, including the standardized instructor guides, student handout, and the supporting exam bank will be periodically updated.

- Terminology, radiation limits, and other information have been revised to reflect 10CFR20 revisions.

Guideline Use

Adherence to these guidelines will ensure a base knowledge for all nuclear plant workers. Member utilities should not delete any objectives identified in these guidelines. However, some organizations may want to add learning objectives based upon their unique plant situation.

Those objectives designated with an asterisk (*) will require some site-specific information to be added for completeness. Some generic information, such as department titles, has been used within the instructor guides and student materials that may not be accurate for all plants. This information is contained within brackets ([ ]) and should be reviewed and changed, if necessary, to more accurately reflect site-specific information.

INPO welcomes suggestions for improving these guidelines as member utilities gain experience in their use.

Table of Contents

Section	Page
FOREWORD	i
1. INTRODUCTION	1
Purpose	1
Definitions	1
Goals	1
Qualification Requirements	1
2. STANDARDIZATION OF GENERAL EMPLOYEE TRAINING	3
Introduction	3
Use of Standardized Materials	3
Examination Question Bank	4
3. PLANT ACCESS TRAINING	5
Station Organization	5
Station Administration	5
Nuclear Plant Overview	6
Industrial Safety	6
Individual Responsibilities	6
Health Hazards	7
Industrial Hazards	7
Industrial Safety Policy	8
Fire Protection	8
The Quality Program	8
Quality Assurance	8
Quality Control	9
Reporting Potential Items of Noncompliance	9
Plant Security	9
Emergency Response/Preparedness	10
Radiological Orientation	10
Basic Terminology	10
Background Radiation	11
Biological Effects and Risks	11
Postings	11
Fitness for Duty	11

4. RADIATION WORKER TRAINING 13

Introduction 13
Sources of Radiation 13
Types and Measurement of Radiation 13
Biological Effects 14
Limits and Guidelines 14
ALARA 15
Radiation Dosimetry 15
Contamination 16
Internal Exposure 17
Radiological Work Permit (RWP) 18
Postings 19
Radiological [illegible]rms 19
Radioactive [illegible]ste 20
Rights and [illegible]sponsibilities 20
Practical Exercise 21

5. RADIOLOGICAL RESPIRATORY PROTECTION 23

Radiological Respiratory Protection 23
Respirator Operation 23

6. CONTINUING TRAINING 25

Purpose 25
Continuing Training Topics 25
Conducting Continuing Training 25

APPENDIX A: PLANT ACCESS TRAINI[illegible]G LESSON PLAN
APPENDIX B: FITNESS-FOR-DUTY LESSON PLAN
APPENDIX C: RADIATION WORKER TRAINING LESSON PLAN
APPENDIX D: RADIOLOGICAL RESPIRATOR TRAINING LESSON PLAN
APPENDIX E: STUDENT HANDOUT

Section 1
Introduction

Purpose

Plant Access Training (PAT) enables students to enter a site and, when supplemented by job-specific training, to work safely within a nuclear power plant environment.

Radiation Worker Training (RWT) provides a worker with the knowledge and skills necessary to enter and work safely within a [radiologically restricted area (RRA)].

Definitions

Plant Access Training is the mandatory training for all personnel who require unescorted access to a nuclear facility's protected area but who do not enter the radiologically restricted area (RRA) unless continuously escorted by a qualified basic radiation worker.

Radiation Worker Training contains the radiological training required for unescorted access to the RRA.

Radiological Respirator Training (RRT) contains the training requirements for using respiratory protection equipment to limit internal radiation dose.

Goals

The goal of General Employee Training initial training courses, when combined with job-specific qualifications, is to provide the skills and knowledge necessary to safely carry out assigned tasks.

The goals of continuing training are to correct identified performance weaknesses and provide for a periodic demonstration of competency regarding fundamental subjects important to job safety. Additionally, continuing training should cover plant/industry experience and procedural changes pertinent to all employees.

Both initial and continuing training should address plant performance problems. For example, if workers are repeatedly "tailgating" into vital areas, this topic should be addressed within these training programs until the problem is resolved.

Qualification Requirements

Personnel who require unescorted access to the plant's protected area should be trained according to the objectives contained in Section 3. Personnel required to attend the initial PAT course should be evaluated.

Personnel who enter the RRA should also complete the training in Section 4. RWT students will be evaluated with a written exam and a practical exercise.

Personnel who wear respiratory protection equipment for radiological protection should complete the training in Section 5. Each student will be evaluated with a written and practical exam.

Personnel who have successfully completed PAT, RWT, or RRT at another facility may be granted credit for those courses successfully completed. Credit may also be granted for the RWT practical exercise if successfully performed at another utility.

Section 2
Standardization of General Employee Training

Introduction

These guidelines contain the learning objectives, lesson plans, and student materials necessary to support sections 3, 4, and 5. Exam questions are available for sections 3 and 4. These supporting materials, with some plant-specific modifications, should be used to teach Plant Access Training (PAT), Basic Radiation Worker Training (BRWT), and Radiological Respirator Training (RRT). This will provide a consistent framework for these training programs throughout the industry and will make it easier for each utility to grant credit to individuals having previously completed any or all of these training programs. The adoption of a standardized training program should provide each utility with a high degree of confidence in the content of the training previously received by the worker.

Non-utility students successfully completing any of the training programs defined by these guidelines may be given a standardized training course completion card or other form of documentation if requested by the trainee. This documentation should indicate those courses the student has completed and a reference phone number. This may be used by other utilities to verify student course completion, if desired.

Standardized course credit should be granted only if the course content, as a minimum, includes all the course objectives and lesson plan content recommended by these guidelines.

Use of Standardized Materials

The training materials provided have been standardized to the extent possible. To maintain a consistent core of base knowledge requirements within these training programs across the industry, it is important that none of the learning objectives be omitted from the training course. Suggested lesson plans and a student hand-out are also included in this guideline. The use of these attachments is not mandatory, however, the lesson plan content should be included in the site-specific GET program regardless of instruction format or media.

Some training materials will need to be added to support plant-specific training requirements. Additionally, some learning objectives within these guidelines may require plant-specific information. Information and objectives may be added as required to support individual training programs. The guideline and generic training materials provided use an asterisk (*) to designate the need to add some plant-specific information. Generic material provided that may not be correct for all plants is enclosed in brackets ([ ]). The information within the brackets should be reviewed and, if necessary, revised.

Examination Question Bank

The exam bank available to support these guidelines provides questions covering the PAT and BRWT. This exam bank will be periodically reviewed and revised based on input from member utilities.

As part of the standardized training format, when preparing exams utilities should take at least 60 percent of the generic exam questions from the exam bank. Questions should test students on all categories of learning objectives. These categories are listed in the table of contents.

Section 3
Plant Access Training

Station Organization

Upon completion of this section, students should be able to state the function of station departments.

Students should be able to:

- State the function of the following station departments:
  — operations
  — maintenance
  — [radiological protection]
  — training
  — security
  — [quality]
  — [emergency planning]
  — [safety]

Station Administration

Upon completion of this section, students should be able to comply with company policies when working in the station.

Students should be able to:

- State individual responsibilities regarding the following policies:
  — operating plant equipment
  — working on plant equipment without authorization
  — reporting problems for resolution
  — complying with [radiation protection (RP)] and security rules (oral and written)
  — smoking on company property*
  — reading materials that are not related to the design, operation, or maintenance of the plant*
- State the company policy regarding procedure compliance and use of controlled documents.

- State individual responsibilities regarding station cleanliness and housekeeping.
- Identify steps involved with self-checking (*).
- State conditions that require self-checking.

Nuclear Plant Overview

Upon completion of this section, students should be familiar with the layout of the major plant buildings and how the plant basically operates.

Students should be able to:

- Given a drawing of the site, identify locations of major plant buildings, including:
  — turbine building*
  — reactor building (or equivalent)*
  — security access points*
  — RRA*
  — drug screening reporting site*
  — emergency assembly areas*
  — auxiliary building*

  (Note: Testing is not required on the above objective.)

- Describe the basic process used to produce electricity at a nuclear facility.
- Identify the appropriate communication system to be used for:
  — reporting emergencies*
  — locating an individual in the plant*
  — lengthy discussions*

Industrial Safety

Upon completion of this section, students should be able to comply with basic station industrial safety policies, including identifying and reporting workplace hazards.

Individual Responsibilities

Students should be able to discuss individual industrial safety responsibilities regarding:

- reporting of unsafe working conditions*
- reporting of industrial safety near-misses*
- reporting of work-related injuries/accidents*
- administration of first aid (if qualified)*
- adherence to safety instructions (procedures and permits)

- observation of safety postings, barriers, tags, and signs
- use of personal protective equipment*
- general location of safety equipment such as eyewash stations, first aid kits, and safety showers*

Health Hazards

Students should be able to recognize the following as potential health hazards:

- use of asbestos on some plant components
- electrical equipment
- steam leaks
- confined spaces
- trip and fall hazards
- heat stress
- compressed gases
- moving/rotating equipment
- high noise areas
- falling objects
- eye hazards
- hazardous chemicals

Industrial Hazards

Students should be able to discuss methods for reducing the risk involved with the following industrial hazards:

- chemical products
- electrical equipment
- steam leaks
- confined spaces
- trip and fall hazards
- heat stress
- compressed gases
- moving/rotating equipment
- high noise areas
- asbestos (be able to recognize postings)
- eye hazards

Students should be able to state where information may be obtained explaining the risks, hazards, and handling associated with a chemical or toxic substance.

Industrial Safety Policy

Students should be able to state plant policy regarding the use of the following personal protective equipment:

- hard hats*
- safety glasses*
- hearing protection*
- protective footwear*
- hand protection*

Students should be able to state how the personal protective equipment will be worn.*

Fire Protection

Upon completion of this section students should be able to minimize the potential for causing a fire and properly respond to a fire should one occur.

Students should be able to:

- State individual responsibilities regarding fire barriers such as fire dampers, doors, and seals.
- State actions an individual is required to take upon discovery of a fire.
- State individual responsibilities regarding the control of fire loading (wood, solvents, oil) and the disposal of flammable materials.
- State examples of the types of hot work requiring a permit.
- Recognize and state the response to a station fire alarm.*

The Quality Program

Upon completion of this section, students should be familiar with the purpose of the quality program, how the program is accomplished, and how to report quality-related problems.

Quality Assurance

Students should be able to:

- State the function of the quality assurance [(QA)] program.
- Identify individual responsibilities regarding QA.
- State the authority of QA personnel.
- State the purpose of QA audits and surveillances.

[Quality Control]	Students should be able to: • State the function of the quality control [(QC)] program. • State basic worker responsibilities regarding [QC] hold points. • State the authority of [QC] inspectors. • State company policy on harassment of [QA/QC] personnel.
Reporting Potential Items of Noncompliance	Students should be able to: • Identify potential items of noncompliance. • State how to report items of noncompliance.* • Explain how to report nuclear safety concerns to the Nuclear Regulatory Commission (NRC).
Plant Security	**Upon completion of this section, students should be able to enter and exit the plant and comply with plant security requirements.** Students should be able to: • State the purpose of the station security program. • Identify areas of the station that are controlled by security including the owner-controlled area, protected area, and vital areas. • Recognize the types and purpose of each type of photo identification badge in use at the plant.* • Describe the procedure for entering and exiting the station.* • Describe the procedure for entering and exiting security doors such as those used for vital areas.* • State when security personnel may perform physical searches. • State where and when photo identification badges will be worn and the actions to be taken if lost or found. • Identify materials/items that are prohibited in the protected area.* • Describe escorting responsibilities.

- State the action(s) to be taken upon discovery of an unescorted visitor or an individual without a security badge.
- State individual roles and responsibilities regarding the plant security program.
- Define "tailgating" and explain why it is not allowed.

Emergency Response/ Preparedness

Upon completion of this section, students should be able to respond to an [emergency plan] activation.

Students should be able to:

- State the purpose of the [emergency plan].
- State the classifications of station emergencies.
- Recognize the emergency alarms, and state the proper response for each.*
- State the actions required during [emergency plan] implementation.*
- State the purpose of accountability during an emergency.
- [State the location of the employee's assigned assembly area.]*
- Discuss evacuation plans, including identification of evacuation routes.*
- State the company's policy concerning the release of information to the public and news media regarding an emergency.

Radiological Orientation

Upon completion of this section, students should be familiar with the radiological restrictions placed on nonradiation workers and some of the basic risks associated with radiation.

Basic Terminology

Students should be able to:

- Define "radioactive material", "radiation", "contamination", and "dose".

- State the difference among radioactive material, radiation, and contamination.

Background Radiation

Students should be able to:

- Define "background radiation."
- Contrast the average amount of radiation received by radiation workers and members of the general public.
- State the purpose of the thermoluminescent dosimeter (TLD) and whole body contamination monitor.

(Note: The whole-body contamination monitor referred to by this objective is located at the plant exit point.)

Biological Effects and Risks

Students should be able to:

- Identify potential long-term effects from exposure to low levels of radiation.
- Contrast the risk of working in a nuclear facility to the risk in other industries.

Postings

Students should be able to:

- State the colors and symbols used on radiological postings.
- Identify the methods used to identify radiological areas (for example, signs, ropes, tape).
- State the action(s) to be taken if a radiological area or radioactive material is encountered.

Fitness for Duty

Upon completion of this section, students should be aware of the importance of being fit for duty, understand the potential consequences of substance abuse, and work in compliance with the station fitness-for-duty policy.

Students should be able to:

- State the basic fitness-for-duty (FFD) requirements for all nuclear workers.

- Recognize the personal, public health, and safety hazards associated with the abuse of drugs and alcohol.
- State the FFD policy.
- State the methods used to implement the FFD program, including:
  - — chemical testing
  - — searches
  - — training
  - — employee assistance program
- State the purpose of the Employee Assistance Program.
- State the effects prescription drugs, over-the-counter drugs, and diet may have on job performance and test results.
- State the role of the medical review officer in the FFD program.
- State the consequences of nonadherence to the FFD policy.
- State individual rights regarding FFD.

Section 4
Radiation Worker Training

Introduction

Students should be able to use sound radiological practices to minimize dose and should also understand the risks associated with working in radiation fields. Students should also be able to work within a [radiologically restricted area] with minimal risk of becoming contaminated or spreading contamination.

Sources of Radiation

Upon completion of this section, students should be familiar with the sources of radiation.

Students should be able to:

- State the basic structure of an atom including the three primary components.
- Describe how radiation results from the nuclear process.
- List the sources of radiation in the plant including the following:
  - — reactor coolant
  - — activation and corrosion products
  - — plant components
  - — reactor operations

Types and Measurement of Radiation

Upon completion of this section, students should be familiar with the basic types of radiation found in a nuclear plant and some of their characteristics.

Students should be able to:

- State the four types of radiation found in a commercial nuclear power plant.
- Characterize the four types of radiation by the following:
  - — penetrating ability
  - — methods of shielding
  - — exposure hazard (for example, whole body, skin, eyes)
  - — where found

- Define total effective dose equivalent (TEDE).
- Perform conversions from rem to millirem and from millirem to rem.

Biological Effects

At the completion of this section, students should be aware of the risks associated with radiation.

Students should be able to:

- State the effect of radiation on cells.
- Define "chronic radiation exposure" and the associated risks.
- Define "acute radiation exposure" and the associated risks.
- Define "genetic" and "somatic" effects.
- Compare somatic versus genetic effects of radiation exposure.
- Identify the possible effects of radiation on an unborn child due to prenatal exposure.
- Compare the radiosensitivity of different age groups.
- State the purposes of NRC Form-4.

Limits and Guidelines

Upon completion of this section, students should be aware of the federal and plant administrative limits on radiation dose.

Students should be able to:

- State the federal radiation dose limits for total effective dose equivalent (TEDE), skin, extremities, and lens of the eye.
- State the possible consequences if any federal radiation dose limit is exceeded.
- State the plant administrative limits/guidelines for radiation dose.*
- State the actions to be taken if administrative dose limits are being approached.*

- State the federal and plant administrative limit/guideline for an embryo/fetus.*
- State the rights of a declared pregnant female.*
- Recognize the definition of a planned special exposure.

ALARA

Upon completion of this section, students should be able to practice basic methods to minimize radiation exposure.

Students should be able to:

- State the purpose of ALARA (as low as reasonably achievable).
- Describe the plant ALARA program.*
- Explain how time may be used to reduce dose, and state methods to implement this concept.
- Explain how distance may be used to reduce dose, and state methods to implement this concept.
- Explain how shielding may be used to reduce dose, and state some methods that may be used to implement this concept.
- State individual responsibilities regarding temporary shielding.
- Calculate stay time given a dose rate, current exposure, and an exposure limit.

Radiation Dosimetry

Upon completion of this section, students should be able to use dosimetry devices properly to monitor dose as well as to respond to dosimetry problems.

Students should be able to:

- State the purpose of dosimetry.
- List the types of radiation detected by the following devices:
  — thermoluminescent dosimeters (TLDs)
  — self-reading dosimeters (SRDs)
  electronic alarming dosimeters (EADs)

- Identify how to wear dosimetry devices properly including placement and orientation.
- Identify the modes, methods, and frequency for operating and reading self-reading dosimetry.*
- Identify where and when the following dosimetry devices are issued and returned:*
  - — TLDs
  - — SRDs
  - — EADs
- State the action(s) to be taken if dosimetry is lost, off-scale, or alarming.

Contamination

Upon completion of this section, students should be able to minimize the probability of becoming contaminated, spreading contamination to clean areas, or contaminating other workers while working in a contaminated area or working with contaminated equipment.

Students should be able to:

- Identify and compare the following types of contamination:
  - — fixed contamination
  - — loose contamination
  - — discrete (hot) particle contamination
- State the units used to measure contamination.
- Explain why contamination is controlled.
- Describe the sources and indications of contamination including:
  - — spills and leaks
  - — open contaminated systems
  - — maintenance activities
- Discuss the methods used to prevent contamination of personnel and areas including:
  - — work planning and pre-job briefings
  - — the use of protective clothing (PCs)
  - — avoiding potentially contaminated water
  - — avoiding skin contact with contaminated surfaces
  - — use of step-off pads

- restrictions concerning nonroutine surveyed areas (for example, overheads)*
- engineering controls

- State the individual's actions for removing contaminated and non-contaminated materials from the RRA.*

- Explain how to monitor personnel and personal items for contamination including the use of:
  - friskers
  - personnel contamination monitors

- State the actions to be taken upon indication of becoming contaminated.

- State the method for control of contaminated tools, equipment, and materials including:
  - minimizing materials contaminated
  - [hot tool issue]
  - bagging/surveillance requirements*

- State the methods used to designate contaminated areas including postings and step-off pads.

- Regarding discrete/hot particles, be able to state:
  - the hazards
  - methods to identify a discrete particle
  - sources of discrete particles
  - work activities that may result in discrete particle contamination
  - special precautions to be used in an area that may contain discrete particles

- Identify situations that require immediate exit from a contaminated area (for example, torn PCs, wounds, and wet PCs).

Internal Exposure

Upon completion of this section, students should be aware of how contamination can enter the body, how to detect internal contamination, and how internal contamination is eliminated from the body. Students should also be able to take measures that can reduce internal dose.

Students should be able to:

- State four pathways for radioactive material to enter the body:
  - inhalation

— ingestion
— absorption
— open wounds/injuries

- State the methods used to limit the internal deposition of radioactive materials including respiratory protection and engineering controls.

- State the processes by which radioactive material is eliminated from the body (decay and biological).

- Recognize the methods used to determine the amount of radioactive material deposited in the body including whole-body counters and bioassays.

- Define the following:
  — derived air concentration (DAC)
  — annual limit on intake (ALI)
  — committed effective dose equivalent (CEDE)

- State the relationship among DACs, ALIs, CEDE, and TEDE (DAC and mr/hr relationship).

- Discuss plant conditions that may increase the potential for airborne radioactivity such as:
  — brushing or sweeping
  — fan(s) blowing in dusty areas
  — steam leaks
  — sanding or grinding in contaminated areas
  — wet contaminated areas that are drying out

Radiological Work Permit (RWP)

Upon completion of this section, students should be able to interpret and apply information found in an RWP to a task in a radiological area.

Students should be able to:

- State the function of an RWP.

- State the types of RWPs and the function of each.*

- Extract information from an RWP (for example protective clothing, dosimetry, special instructions).*

- State the responsibility for complying with RWP requirements.

- Extract information from a survey map.*

- State the required action(s) to be taken if the work scope or radiological conditions change so that they are not within the scope of an RWP.

Postings

Upon completion of this section, students should be able to recognize and understand the plant radiological postings.

Students should be able to:

- Define and recognize the following radiological areas and postings:
  — [radiologically restricted area]
  — radiation area
  — high radiation area
  — very high radiation area
  — [locked high radiation area]*
  — airborne radioactivity area
  — radioactive material area
  — radioactive materials storage area

- Define and recognize the following radiological postings:
  — hot spot
  — [low-dose zone]
  — hot particle area

- State the potential consequences of violating, moving, or altering a radiological posting.

Radiological Alarms

Upon completion of this section, students should be able to recognize and respond to radiological alarms.

Students should be able to:

- Identify the radiological alarms used in the plant.*

- State the proper response to a given radiological alarm.*

- State the potential consequences of ignoring a radiological alarm.

Radioactive Waste

Upon completion of this section, students should be aware of the importance of and methods for minimizing the generation of radioactive waste.

Students should be able to:

- Define "radioactive waste."
- Contrast the disposal costs of radioactive waste versus nonradioactive waste.
- State the methods for minimizing the generation of radioactive waste.
- Explain why it is important to keep contaminated and noncontaminated waste separate.
- Explain why it is important to keep wet and dry contaminated material separate.
- Explain why it is important to keep contaminated and hazardous waste separate.

Rights and Responsibilities

Upon completion of this section, students should be aware of individual rights and responsibilities regarding working within radiological areas.

Students should be able to state individual rights/responsibilities regarding:

- keeping dose ALARA
- adhering to instructions provided by radiological protection personnel (including stop work authority), written policies and procedures, radiation work permits, and posted warnings and signs
- maintaining awareness of current personal dose
- remaining within federal and plant administrative dose limits and guidelines
- identifying the actions and reporting responsibilities when abnormal radiological conditions and/or violations of radiological requirements are encountered

- the right of the individual and the process to be followed in obtaining personal radiation dose data

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Practical Exercise

Upon completion of this section, students should have demonstrated the ability to wear protective clothing, enter a radiologically contaminated area, remove tools, and exit the radiological area.

Students should be able to:

- Select the correct RWP.*
- Determine protective clothing requirements.*
- Determine dosimetry requirements.*
- Determine respiratory protection requirements.*
- Determine any special conditions defined by the RWP.*
- Determine any special instructions to be followed.*
- Determine the dose rate and contamination levels.*
- Obtain access on the RWP.*
- Don protective clothing including hood, coveralls, glove liners, gloves, shoe liners, and shoe covers.*
- Properly wear dosimetry with protective clothing.*
- Meet the requirements on signs and postings within the radiological area.*
- Read a self-reading dosimeter while wearing protective clothing.*
- Minimize dose and the spread of contamination.*
- Properly remove tools from the contaminated area.*
- Properly remove protective clothing when exiting the contaminated area.*

- Perform required monitoring for contamination.*
- Ensure that the radiation dose is properly recorded when exiting the simulated RRA.*

Section 5
Radiological Respiratory Protection

Radiological Respiratory Protection

Upon completion of this section, students should be familiar with the general requirements for radiological respiratory protection.

Students should be able to:

- State the purpose of the radiological respirator protection program.
- State the qualification requirements that must be met prior to using a respirator.
- State the purpose of a fit test.
- State the factors that can affect the fit of a full-face respirator.
- Describe the procedure for issue and return of respirators.*
- Describe how to perform preoperational checks and don, test, operate, and remove required respiratory protection equipment for each type of respirator the student will be qualified to use.
- State when a negative pressure test is required.

Respirator Operation

Upon completion of this section, students should understand how the respirator operates and any limitations on its use.

Students should be able to:

- Define "respirator protection factor."
- Describe the basic operating principles of an air-purifying respirator.
- Define the general application of an air-purifying respirator, and state the limitations on its use.
- Define the general application of an air-supplying respirator, and state any limitations on its use.

- Perform preoperational checks; don, test, operate, and remove required respiratory protection equipment.

- State the actions to be taken if a respirator malfunctions or physical or psychological distress occurs while wearing a respirator.

Section 6
Continuing Training

Purpose

Continuing training should be provided to address seldom-used skills, observed problems, or anticipated training needs. Infrequently performed tasks should be evaluated to determine if training is needed. Difficulty, importance to plant safety and reliability, worker safety, plant performance trends, and ALARA can be used to determine training needs and required depth of coverage.

Continuing Training Topics

Continuing training may be used to address situations such as:

- degraded human performance
- plant modifications or equipment changes
- in-house and industry operating experience
- special plant operations or maintenance activities

Continuing training learning objectives should also be identified through the use of ongoing training program evaluations. These evaluations should verify the training program is current and relevant. During evaluations of the training program's effectiveness, some training deficiencies may be identified. When such performance deficiencies or training weaknesses are identified, continuing training can be used as a tool to upgrade personnel knowledge and skill.

Conducting Continuing Training

Continuing training should be conducted using a published schedule that minimizes interference with plant operational activities. This training should be mandatory for all personnel granted unescorted access. However, some personnel may be exempted from this training if the information is presented and tested on in another training program (such as in operator requalification training). Consideration should also be given to reducing the amount of required training through alternatives such as:

- students being waived from continuing training by passing a challenge exam
- computer-based training
- reducing the frequency of RWT practical exam for those employees who enter contaminated areas as part of their job and have demonstrated acceptable performance

APPENDIX A

PLANT ACCESS TRAINING
LESSON PLAN
(PAT 93-009)

Station Organization
Lesson Plan

Station Organization

Upon completion of this section, students should be able to state the function of major station departments.

Show learning objectives for station organization.

Operations

The operations department operates the plant by performing activities such as:

- operating plant equipment
- placing protective tags
- approving most types of plant work
- controlling reactor power

Maintenance

The maintenance department keeps the plant in good operating condition. It performs activities such as:

- repairing plant equipment such as:
  - instruments
  - pumps
  - valves
  - security equipment
  - motors

- performing preventive maintenance on equipment

Radiological Protection

The radiological protection (RP) department assists workers in minimizing personnel radiological exposure and the spread of radioactive contamination. It performs activities such as:

- [escorting personnel into high radiation areas]

- monitoring various areas of the plant for radiation levels

- controlling access and work in radiation, airborne contamination, and contaminated areas

- preparing radiation work permits
- controlling access to and from the RRA

Training

The training department assists with training and supports the line organization in qualifying personnel to perform the tasks necessary in their job. Training performs activities such as:

- working with the plant departments in setting up training programs for plant personnel
- presenting training courses
- maintaining training and qualification records

Security

The security department protects the plant from nuclear sabotage. Security performs activities such as:

- controlling access to and from the protected area
- controlling the issue of all badges for site access
- controlling security doors within the plant

Quality

The quality program spot checks the quality level in the plant to ensure it meets certain standards and codes. Quality performs activities such as:

- monitoring plant activities to ensure they are done correctly
- performing program reviews to confirm they are being done according to plant procedures
- inspecting safety-related parts and supplies to verify they meet all requirements

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Emergency Planning

The [emergency planning] department ensures adequate plans and trained personnel are available to protect the health and safety of the general population in case of a plant emergency.

[Safety] The function of the [safety department] is to provide oversight of the industrial safety program. They perform activities such as:

- checking air quality
- evaluating industrial accidents
- evaluating heat stress concerns

Ask if there are any questions regarding station organization.

Station Administration Lesson Plan

Station Administration

Upon completion of this section, students should be able to comply with company policies when working in the station.

Show the learning objectives for station administration.

Individual Responsibilities

Each individual must comply with company policies such as:

- operating plant equipment only when qualified, and authorized by the control room, or specifically by procedure
- getting all work on plant equipment authorized prior to starting
- reporting problems observed in the plant regarding plant equipment, programs, or methods using the problem reporting programs that are discussed later in this training
- smoking only in authorized areas such as (*)
- reading of only technical materials(*)

Procedure Compliance

All work in the plant is to be performed in accordance with an approved work document. Approved documents include procedures, maintenance work packages, plant modification packages, radiation work permits, and others. If a task cannot be performed in accordance with the approved document:

- Stop the work.
- Place the job in a safe condition.
- Contact your supervisor.
- Resolve the problem.

Individuals are responsible for:

- verifying only the latest approved revision of the document (procedure, drawing, manual, etc.) is being used to perform the work
- reviewing the document prior to performing the task

- verifying all necessary tools and parts are available

Housekeeping

Each individual is expected to keep his/her own workspace as neat as possible and to clean up after completing a job in the plant. The goal should be to leave an area cleaner than it was found. If a housekeeping problem is discovered that cannot be resolved, contact your supervisor or call (*).

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*Self-Checking**

Self-checking is a mental process that is used anytime a task is about to be performed that could have adverse consequences if done incorrectly. Self-checking ensures the correct action is being taken on the correct component. The steps involved with this process are as follows:

- **Stop** Plan and prepare.
- **Think** Think about what you are about to perform and what you are supposed to be performing.
- **Act** Perform the action.
- **Review** Verify the response was correct for the action taken.

This process is easy to remember by using the first letter in each step to form the word STAR.

Some examples of where self-checking is important are when:

- manipulating a valve or component
- connecting test equipment
- opening panel doors
- entering [radiologically restricted areas]

[NOTE: The STAR method of teaching self-checking may be replaced with a more site-specific method.]

Ask if there are any questions regarding station administration.

Nuclear Power Plant Overview Lesson Plan

Nuclear Power Plant Overview

Upon completion of this section, students should be familiar with the layout of the major plant buildings and how the plant basically operates.

Reference learning objectives in student handout.

Provide students with a site layout drawing, or show overhead/slide.

Site Layout (*)

Using the site layout drawing, show the location of the following plant buildings/points of interest:

- turbine building*
- reactor building (or equivalent)*
- security access points*
- [radiologically restricted area] (RRA) and access points*
- drug screening reporting location*
- auxiliary building*

Generation of Electricity

A nuclear power plant converts nuclear energy into electrical energy (electricity). To understand this process, students need to look at how nuclear energy is converted to thermal energy, thermal to mechanical, mechanical to electrical.

Overview

Nuclear energy is energy released from the fission process. When a uranium atom fissions, or splits, energy is released in the form of heat. The heat is used to heat water and produce steam (thermal energy). The steam causes the main turbine to spin, producing mechanical energy. The turbine is connected to the generator and causes the generator to spin, producing the electricity the company supplies to customers.

Nuclear Energy

Fission occurs when a neutron strikes the nucleus of a uranium atom. The atom will usually split into two smaller atoms and release about two free neutrons, which continue the chain reaction.

To control the chain reaction, the control room operator in a pressurized water reactor (PWR) uses control rods and boron to absorb some of the neutrons and prevent them from fissioning other uranium atoms. In a boiling water reactor

(BWR) the operator uses control rods and the amount of water flowing through the reactor core to control this process.

When fission occurs, heat is released, which is used to heat the water in the reactor vessel. In a PWR, this water, called primary water, is prevented from boiling by keeping the primary at a high pressure. The pressurized water is then circulated inside tubes that are submersed in a second water system (secondary system). The secondary system is at a lower pressure; therefore, it will boil in the steam generator and produce steam. The steam is used to turn the main turbine, which turns the generator, producing electricity.

In a BWR, the water actually boils in the reactor core, and the resulting steam is piped directly to the turbine.

Steam Cycle

Once the steam passes through the turbine, it exhausts into the main condenser where it is condensed back into water. (There are many tubes inside the condenser with cooling water flow for condensing the steam.) The water from the condenser is pumped through some filters and heaters and eventually returns to the steam generator or reactor, depending on the plant type, where the process starts again.

Communications

As with any large industrial complex, there are several types of communication systems. In general, the following guides should be used:

- For emergencies, call (*).
- For locating an individual in the plant, use (*).
- For discussions that may be lengthy, use (*).

Ask if there are any questions regarding the power plant overview.

Industrial Safety
Lesson Plan

Industrial Safety

Upon completion of this section, students should be able to comply with basic station industrial safety policies, including identifying and reporting workplace hazards.

Show the learning objectives for industrial safety.

Individual Responsibilities

Industrial safety is comprised of many elements, perhaps the most important of these is the individual. Plant management expects each individual to take responsibility for his/her own safety and to help keep others safe. Any questions regarding plant policy should be directed to the individual's supervisor. The following policies are designed to assist in personnel safety:

Reporting Problems

- Report any condition that does not appear to be safe. (Examples of this could include a missing handrail, a ladder with a defect, or an exposed electrical conductor on a typewriter.) If not sure about how to report an industrial safety problem, discuss it with your supervisor or call [safety].

- In plant work activities, you may be involved in a "near miss" event. In other words, someone could have been hurt but was lucky instead. It is important to follow up on these near-misses so that the causes are eliminated. If you are involved in a near-miss, report it to (*).

- If an individual needs immediate medical attention, give any life-saving aid that you are qualified to perform, and then call [the control room or] (*) as soon as possible.

  A [medical] team of personnel trained in first aid will respond to your call. When the [medical] team arrives, offer assistance and then stand aside.

- [Report all on-the-job injuries to supervision, regardless of how minor the injury may seem. This will document the injury occurred on the job in case it develops into something more serious.]

Compliance with Safety Postings and Permits

- Several types of postings warn workers of hazards such as energized equipment, confined spaces, flammable material, and others. Management expects all personnel to read and follow industrial safety postings.

- Station management expects employees to use all permits required for a task. Examples of activities requiring a permit include welding, propping open a fire door, and entering a confined space. If a permit is required, it must be obtained before starting the task.

Safety Tags

Several types of tags are used in the plant. Tags are used for everything from tracking discrepancies to protecting someone's life. Respect these tags. Do not remove any tag unless authorized to do so. Always read and adhere to instructions on a tag.

One particular tag is extremely important. The [DANGER] tag is [red] and is used to protect lives and equipment. Do not disturb or operate any component with a [DANGER] tag attached to it. Should a [DANGER] tag be found not attached to a component, immediately notify the control room.

Show students what a [DANGER] tag looks like.

Personal Protective Equipment

Protective equipment is required in some plant areas. The following requirements must be met:

- Hard hats must be worn anytime you are (*).

- [Safety glasses must be worn anytime hard hats are required or in any area that is posted for safety glasses.] Safety glasses must meet American National Standards Institute (ANSI) and company standards. If uncertain whether glasses meet safety standards, check with supervision.

- [Substantial footwear must be worn in any area where hard hats are required. Shoes must have leather uppers.]

- Hearing protection must be worn when in a posted high-noise area. Ear plugs or ear muffs issued in the plant may be worn as hearing protection. The effects of hearing loss may not be immediately noticeable; for that reason some employees may be required to take an audiometric (hearing) test.

- Gloves must be worn when involved in any work activity that could result in a hand or finger injury. If working with rough material such as wood, rusty metal, metal with unfinished edges, or with equipment that may generate sparks or flying particles (grinder), gloves should be worn to protect the hands.

- Safety equipment includes eyewash stations, first-aid kits, and safety showers. These safety devices are located throughout the plant such as (*).

  To operate the safety shower, [step into the shower and pull the safety chain]. Stay in the shower for [20] minutes. To operate the eyewash station, put your face near the fountain and depress the hand lever.

Industrial Safety Hazards

Working in any industrial complex can increase the risk of injury if industrial safety hazards are not recognized and avoided. The following topics are some of the hazards and personnel protection equipment/actions that employees should recognize.

Asbestos

Asbestos may be used in some parts of the plant such as in gaskets, lagging, and insulation. The asbestos that remains is labeled with an ["ASBESTOS"] label. If required to work on a component suspected of containing asbestos and you have not had asbestos training, notify your supervisor.

Electrical Hazards

Various types of electrical equipment are used in the plant. This equipment can be AC or DC at voltages ranging from a few volts to thousands of volts. If assigned to work on or around any exposed electrical conductors or equipment that uses electricity, ensure it is removed from service and safety tagged prior to starting work. Working on energized equipment is allowed only with special authorization from plant management.

Work areas and equipment should be inspected for hazards before beginning work. Examples of electrical hazards include:

- open electrical panels
- frayed cords/cables
- water on or near electrical equipment
- missing or broken ground plugs

Consideration should also be given to hidden electrical hazards prior to performing activities such as drilling, nailing, or spraying water on an object. Never touch an individual who is in contact with a live circuit.

Discuss a plant or industry event involving an electrical shock or fatality.

Steam Leaks

Steam is used in a variety of applications at various pressures in the plant. Occasionally steam leaks develop. This steam is normally at an elevated pressure and temperature. When working in the plant, stay away from steam leaks. Steam can create serious burns. If a steam leak is discovered, report it to the control room. Steam leaks may be identified by:

- visible vapor coming from a valve or pipe
- whistling noise
- increased area temperatures
- moisture on walls, ceiling, or adjacent equipment

Some of the efforts used to prctect personnel are preventive maintenance, tours by operations personnel, and temporary signs and barriers.

Confined Spaces

The plant has many large tanks, pits, and other areas that can pose a health threat if entered without the proper safety precautions. A confined space is any space in the plant that:

- Is not intended for continuous human occupancy.
- Has a limited means of getting in and out.
- Is subject to the accumulation of an actual or potentially hazardous atmosphere or potential for engulfment.

Give some examples of confined spaces in the plant.

Discuss an industry event involving a confined space such as INPO SER 35-88, "Inadequate Work Control, Work Practices, and Rescue Preparations Contribute to Fatality"

Do not enter a confined space unless you have met the requirements of the entry permit and have completed confined space training.

Heat Stress

Some plant areas can get extremely warm, particularly in the summer. The length of time on a job may be restricted due to heat stress concerns. If you are working in an area that is hot and begin to feel lightheaded or overheated, let a coworker know and relocate to a cooler area. Other measures include:

- drinking fluids
- installing temporary or permanent ventilation
- monitoring temperature and humidity
- using cooling devices such as fans or ice vests

- establishing temporary air conditioning in the area

Heat stress can also result from strenuous work at normal temperatures.

Trip and Fall Hazards

The plant has potential hazards that could cause an individual to trip or fall. A few examples are:

- piping, conduits, ropes, and cables
- work on elevated equipment
- unsecured ladders
- scaffolding

For potential falls of more than [10] feet, [a safety line, harness, and safety person is required]. Use of some safety equipment may require special training, and you should check with your supervisor before using specialized equipment. Some other protective measures include:

- postings
- fall protection equipment
- temporary platforms for elevated work

Always be alert to what is in front of or below you.

Compressed Gases

Another potential hazard is the use and storage of compressed gases.

Give some examples of compressed gases in the plant.

- When working near compressed gas in the plant, stay clear of relief and blowoff valves.

- If using compressed air for pneumatic tools or cleaning, be sure the hoses are in good repair and do not direct compressed air at any part of the body.

- If using portable compressed gases, ensure that the storage bottle is securely stored and tied off in an upright position.

- Compressed gas bottles must be moved by either using a cart designed for compressed gas bottles or by rolling them using the bottom of the bottle as a rolling point.

- Do not store compressed gas bottles exposed to the weather or direct sunlight.

- Do not store compressed gas bottles exposed to the weather or direct sunlight.
- Always ensure the cap is on the bottle when it is not in use.

Moving/Rotating Equipment

Moving/rotating plant equipment may pose a hazard. Some examples include:

- unguarded equipment (shafts, motor-operated valves)
- lathes and machine tools
- cranes

When working near rotating equipment, do not wear loose clothing, such as ties, or jewelry that could get caught and cause an injury. Heed postings and alarms, and do not tamper with guards or shrouds.

High Noise

As discussed earlier, there are high-noise areas in the plant. In addition to the posted areas, areas where it is difficult to hear or talk should also be considered high-noise areas. Ear protection is required in high-noise areas. The company provides ear plugs and ear muffs for use in the plant.

Falling Objects

Scaffold toe boards, tool lanyards, and proper housekeeping are used to minimize potential hazards from falling objects. Look for work in progress in overhead areas, and stay clear. Wear a hard hat, approved shoes, and safety glasses.

When working in elevated spaces, be aware of the hazard that can be created for those below.

Eye Hazards

Eye hazards also exist in the plant including debris from grinding, dirt, and dust blown by ventilation fans. The company makes safety glasses and other eye protection available to all employees. Safety glasses are required to be worn (*). Contact lenses may be worn (*).

Hazardous Chemicals

Many types of chemicals are used in the plant in a variety of applications. Examples of these chemicals include cleaners, acids, petroleums, and caustics. Methods to recognize chemical hazards include:

- liquid spills
- labeled or unlabeled containers
- unusual vapors or odors

- posted chemical storage areas

Don't use unidentified chemicals, and don't mix chemicals.

Each individual has the right and responsibility to know potential chemical hazards. The Material Safety Data Sheet (MSDS) defines chemical hazards and explains:

- physical hazards
- protective clothing needed
- storage requirements
- spill and leak procedures
- respiratory protection needed

Prior to using any chemical, the user should be aware of potential hazards. The MSDS is located (*).

When using a chemical, be careful not to deface the label on the container and be sure to follow the label's instructions.

Some plant areas have large quantities of dangerous chemicals such as acid storage tanks. These areas may have special entry requirements. To enter a posted chemical area, contact your supervisor if uncertain of the entry requirements.

Protection methods include training, labeling, chemical control program, and protective equipment.

Hazardous Waste Operations

Hazardous waste operations regulates the health and safety of employees responding to any emergency involving hazardous substances.

- If a hazardous chemical emergency occurs, notify the [control room] immediately.

- Hazardous chemicals must be properly disposed of according to the Resource Conservation and Recovery Act (RCRA). This includes wastes such as solvents, fuels, lubricants, and outdated chemicals. To dispose of these wastes (*)

Industrial Safety Policy

Basic personal protective equipment is required in many plant areas. When to wear this equipment has already been covered, but it is just as important to know how to wear and use personal protective equipment.

Hard hats should be worn with the sides parallel to the ground and the bill in front. The hat should not have any holes or cracks and should not have any conductive material on the outside. The suspension on the inside of the hard hat should be periodically checked for fraying and tears.

Eye protection should provide protection from flying particles/debris and be shatterproof. Safety glasses [with side shields], safety goggles, or face shields are required to meet these requirements.

Eye protection is required to meet ANSI and company requirements and should be inspected periodically for scratches and cracks that may obscure vision or lessen protection. Additionally, workers should keep eye protection clean to prevent obscured vision.

Shoes in good condition should not have any of the following:

- crushed toe guard
- cracked, split, or cut outer covering
- cracks or holes in the soles
- slick heels or soles

Shoes should fit comfortably to ensure proper support and protection.

Fire Protection Lesson Plan

Fire Protection

Upon completion of this section students should be able to minimize the potential for causing a fire and properly respond to a fire should one occur.

Fire Barriers

Fire barriers are required by federal law and have been built into the plant to prevent the spread of a fire. These barriers come in several forms such as doors, dampers, and seals.

When in the plant and a fire door is opened, make sure the fire door is firmly reclosed and latched before leaving. Any problems with a fire door should be reported to the [control room].

Other types of fire barriers pass through the walls, floors, and ceiling. Before beginning a task that will disturb a sealed wall or floor penetration, contact [supervision] prior to beginning the task.

Discovery of a Fire

If a fire is discovered, take the following actions:

- Notify the control room using the plant page, radio, or telephone at extension (*).
- [Inform the control room of the location and what is burning. Make sure the control room acknowledges the report.]
- [Stand by in a safe location and warn others until the fire brigade arrives.]
- Do not attempt to fight the fire [unless it is small and clearly within your capability].

Hot Work

Any work activity that has the potential of starting a fire, such as welding or grinding metal (sparks), must be approved before work is started. This type of work requires that a permit and, potentially, other special requirements be met before the work is started. If involved in a task that could create a fire hazard and approval has not been obtained, contact supervision for guidance.

Fire Loading

The plant is required to meet many types of codes and regulations regarding fire suppression and fire prevention. These regulations require that any flammable material, such as lubricants and oils, be stored in special fire cabinets. There are also limits on the amount of flammable materials that can be stored in any area. Whenever using combustible material on a job, limit the amount to just what is needed to get the work done or to the amount allowed in the area, whichever is less.

When the job is done, return any unused combustible material to its proper storage area. If in a safety-related area, return the material to its storage area by the [end of the shift] unless approval has been given to temporarily store it elsewhere.

[Use of wood that is not fire retardant is not permitted on site without authorization. Fire-retardant wood is usually distinctively marked, most often with a color coating such as blue or green. Contact supervision if wood is discovered that does not appear to be fire retardant.]

Fire Alarm

In case of a fire, the station will sound the fire alarm.

Play a recording of the fire alarm.

The fire brigade responds to all fires. All other personnel are expected to cooperate with the responding personnel, evacuate the area, and follow any instructions on the plant announcing system. Do not use any elevator in the same building as the fire. Some areas of the plant contain fire suppression systems such as halon or carbon dioxide. Should you be in an area when one of these systems activates, leave immediately. These systems can result in suffocation.

Ask if there are any questions regarding the fire protection program.

The Quality Program Lesson Plan

The Quality Program

Upon completion of this section, students should be familiar with the purpose of the quality program, how the program is accomplished, and how to report quality-related problems.

Quality Assurance Function

The quality assurance (QA) program provides adequate confidence that systems, components, and structures will perform satisfactorily while in service. This includes reviewing:

- written documentation to ensure activities are being performed according to plant procedures
- programs to ensure they are meeting the intent of the applicable requirements
- procedures to ensure they are meeting quality requirements
- management involvement to ensure managers are aware of plant quality performance in the areas of their responsibility

QA reinforces or strengthens quality measures on equipment and activities that can affect the safe and reliable operation of a nuclear power plant.

QA Audits and Surveillances

QA personnel verify quality and its documentation. They provide an independent check of completed work through a paperwork review.

A comprehensive system of QA audits is used to verify compliance with all aspects of the QA program and to evaluate the effectiveness of the program being audited.

Surveillance describes the act of observing activities, hardware, and/or reviewing documentation to verify conformance with specified requirements and to evaluate their adequacy and effectiveness.

Worker Responsibilities

Individuals in various line organizations are responsible for the quality of the work performed, including documentation. Pride of craftsmanship and the desire to accept nothing less than a quality product should be the goals of each worker and supervisor. Each individual is responsible for performing a job in a quality manner and doing every job right the first time.

QA Authority

A quality program is required by federal law; therefore, any threat, assault, or interference with an inspector or auditor while performing his/her job is a federal offense punishable by a fine and/or imprisonment.

QA personnel also have the authority to stop work. If requested to stop work, stabilize the job and then stop work.

[Quality Control]

[Quality control (QC)] is responsible for checking, testing, and verifying that pre-established characteristics have been met. A [QC] inspector may observe an entire job or may only monitor a specific step in a job.

[QC] inspections verify conformance with the documented instructions, procedures, and drawings used to accomplish an activity. A [QC] inspector may perform examinations, measurements, tests of materials or products, and work observations.

Procedures are established for the control of materials, parts, and components that do not conform to specified requirements to prevent their inadvertent use or installation. Nonconforming parts may be identified:

- by station personnel during plant work activities
- during the receipt acceptance inspection process
- when documented in an NRC IE Notice or Bulletin

If a part is discovered that isn't right, stop work, contact supervision, and make sure it is right before continuing.

[QC] Hold Points

When in the plant performing a task, there may be a ["QC Hold" or "QC Witness"] point in the document you are using. If a ["QC Hold" or "QC Witness"] point is encountered in a procedure or work package, the individual is required to contact [QC] so that an inspector can monitor performance of that step(s). Willful violation of a [QC] hold point is a serious action and is subject to discipline up to termination of employment.

QC Authority

Like the QA auditor, [QC] inspectors are protected by federal law and have the authority to stop work.

Reporting of Items of Nonconformance

During a worker's day-to-day activities, something may be found that does not appear to be correct. Some examples are:

- an incorrect part installed on a safety system
- a safety-related valve out of position
- use of an outdated procedure on a safety-related task
- a fire barrier left out of position

Plant management encourages workers to report these potential problems so that they may be evaluated and corrected. Should a potential item of noncompliance be discovered, the following avenues of resolution are available:

- Discuss it with supervision. This is the easiest and most convenient way to get a problem resolved.

- Document it with (*).

- Discuss the problem with quality management

- (*)

If the problem is not resolved, workers have the right to contact the NRC.

NRC Form-3

Posted at various places in the plant are copies of NRC Form-3 that show the NRC regions and telephone numbers. Each worker has the right to contact the NRC at any time and request an inspection if a violation of any regulation has occurred, or if there are unsafe radiological conditions or practices at the plant.

If an inspection is requested, the NRC will:

- Keep the requester's identity anonymous.

- Protect the individual from being discharged by the company for filing the complaint.

- Notify the individual in writing if the complaint is rejected because no reasonable grounds exist.

Interfacing With the NRC

Plant management expects all employees to be truthful with all NRC requests for information. Employees should conduct themselves with openness and a cooperative spirit when providing information to the NRC. The following will not be tolerated:

- recognizing a violation of procedural requirements and not taking corrective action
- falsifying records
- willfully providing, or causing someone else to provide, the NRC with inaccurate or incomplete information
- willfully withholding safety-significant information from supervisory personnel
- submitting false information to gain unescorted access to a nuclear station

Willful misconduct by any employee or contractor will not be tolerated and may result in disciplinary action, fines, and/or imprisonment.

Ask if there are any questions regarding the QA/QC program.

Plant Security Lesson Plan

Plant Security

Upon completion of this section, students should be able to enter and exit the plant and comply with plant security requirements.

Show the learning objectives for plant security.

Purpose

The station security program:

- Protects against radiological sabotage.
- Protects against theft of special nuclear material.
- Protects company assets.

Security Areas

The three general security areas are:

- The area outside the fence that immediately surrounds the plant is called the owner-controlled area. Access to this area is generally restricted to those entering on official business.

- The area within the fence around the plant is called the protected area. Access to this area requires a badge issued by security. Individuals and hand-carried items within the protected area are also subject to search.

- Areas within the protected area that house equipment important for nuclear safety are designated as vital areas. Access to a vital area is allowed only if an individual has been authorized to be in that area.

Any activity that will breach the integrity of a protected or vital area must be approved by security in advance of performing the work. If an opening in a security boundary (doors, equipment hatches, penetration of floor, ceiling, or wall) is discovered, notify security immediately.

Access Badges

There are two general types of access badges in use on site:

- Visitor badges are worn by individuals entering the protected area on a temporary basis. An individual wearing a visitor badge requires an escort at all times. The appearance of the badge is (*).

- Unescorted access badges require successful completion of this training and other requirements. The appearance of the badge(s) is (*).

Show students what the badges look like.

Wearing a Badge

All security badges must be displayed facing out, on the upperfront portion of the body on the outer garment while in the protected area. When removing the outer garment, ensure that the security badge is transferred to the new outer garment.

Lost Badges

Anyone losing a badge should check the immediate area. If unable to locate the badge, notify security and wait for a security officer to arrive.

Anyone finding an access badge should notify security immediately.

Prohibited Items

The following items are not allowed on company property:

- explosives
- weapons of any kind
- incendiary devices
- alcoholic beverages
- unauthorized drugs
- repellent sprays such as Mace
- ammunition

Search Policy

All employees on company property are subject to search at any time. The following rules apply:

- [All searches are by implied or expressed consent. Signs are posted near the entrance to the station explaining that employees are subject to search. Passing these signs upon entry is implied consent.]

- Consent may be withdrawn at any time. If an employee refuses to be searched, the employee will be escorted off company property, and access may be permanently revoked.

- Random searches may be conducted at any time at the discretion of security personnel.

- Personal vehicles may be searched at any time while on company property.

Entering the Protected Area

The following procedure must be used to enter the protected area for badged employees:

- (*) [Enter site specific information.]

Exiting the Protected Area

The following procedure must be used to exit the protected area for badged employees:

- (*) [Enter site specific information.]

Entering and Exiting Vital Areas

Personnel requiring unescorted entry to a vital area must have specific authorization for that area. If not sure of an authorization status for an area, contact security before attempting to enter.

- (*) [Enter site-specific information on entering and exiting a vital area.]

Security Violations

Tailgating occurs when one worker follows another worker into or out of a vital area without properly using the card reader.

Tailgating is prohibited because it bypasses the security controls put in place to ensure only authorized personnel are allowed into a vital area, and it prevents an accurate accounting of personnel during an emergency.

Other common security violations include:

- holding a vital door open too long—If the door is to be held open for a period of time, contact security first.
- improper closing of doors—Always ensure the door closes completely after passing through, particularly if there is a pressure difference on the two sides of the door.
- [Unauthorized or multiple attempts to enter a security area will cause an alarm to sound. If access is not granted on the first attempt, call security personnel and follow their instructions.]
- tampering with locks and other security equipment, such as video cameras and other detection equipment

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Escorting Visitors

Prior to entering the protected area, ensure the visitor is properly wearing the visitor badge. Observe the following rules:

- Keep the visitor in sight at all times. Visitors may enter the bathroom or locker room unescorted provided there is only one entrance/exit and the entrance/exit is continuously observed by the escort.
- Visitors are not allowed to enter the [radiologically restricted area] unless authorized by management.
- Ensure the visitor follows all applicable policies and procedures.
- The maximum number of visitors that one individual may escort within the protected area is [10].
- The maximum number of visitors that one individual may escort within a vital area is [five].
- When the visit is over, return the visitor to the security exit point. Do not leave the visitor until he/she has left the protected area.
- When using an access requiring a key card, follow this procedure: (*)

Transferring Visitor Responsibility

Visitors are escorted at all times when within the protected area. However, at times escort must be transferred to another individual. Before transferring escort responsibility, first ensure the new escort is qualified and will accept the escort responsibility. [Additionally you must (*).]

Actions for an Unescorted Visitor

Should a visitor be discovered without an escort, take the following actions:

- [Escort the person to security, and] inform a security officer of the problem.
- If the individual refuses to follow instructions, contact security and explain the problem. Do not attempt to physically force the visitor to comply with instructions.

Ask if there are any questions regarding security.

[Emergency Plan]
Lesson Plan

Emergency Response/ Preparedness

Upon completion of this section, students should be able to respond to an [emergency plan] activation.

Purpose and Types of Emergencies

The [emergency plan] protects the public, employees, and plant if an emergency occurs at the station.

These are the four classifications of emergencies, listed in order of severity, covered by the [emergency plan]:

- [Notification of] Unusual Event (NUE)
- Alert
- Site [Area] Emergency
- General Emergency

An emergency will be declared based on plant conditions and will be escalated, deescalated, or terminated as plant conditions change.

Employee Response

The response required for each of the emergencies is to listen and respond to plant alarms and announcements. The alarm sounds like...

Play a recording of the site area emergency alarms.

If there is a need to assemble or evacuate, [the evacuation alarm will sound] and an announcement will be made. Listen to the announcement and:

Play a recording of the site evacuation alarm if different than the emergency alarm.(*)

- Place any equipment and/or work in progress in a safe condition.
- Escort all visitors to [security].
- If in the [radiologically restricted area], exit using normal procedures, unless otherwise directed.

During an emergency, all personnel must be accounted for to ensure their well-being and location are known.

If an evacuation becomes necessary, all employees who are not a part of the emergency response organization will:

- [Take the shortest route to the designated exit].
- [Leave all security badges at the exit.]
- Proceed as directed using appropriate transportation. [Provide site information on the location of the assembly/evacuation area(s). *]
- (*)

A spokesperson is designated by the company to release information to the public and media. If anyone asks for information refer him/her to the company spokesperson.

Ask if there are any questions regarding the [emergency plan].

Radiological Orientation Lesson Plan

Radiological Orientation

Upon completion of this section, students should be familiar with the radiological restrictions placed on nonradiation workers and some of the basic risks associated with radiation.

Basic Terminology

- Radioactive material is any material that emits radiation as it decays.
- Contamination is defined as "radioactive material where it is not wanted."
- Dose is defined as "the amount of radiation absorbed by the body or a particular organ."
- [illegible] is energy that is emitted from unstable atoms.

Background Radiation

Background radiation is low-level radiation from natural or man-made sources.

Some examples of background radiation sources are:

- [illegible]mic radiation including the sun
- radon gas
- fallout from weapons testing
- radioactive materials in the earth's crust such as granite and coal

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Health Effects

Exposure at high levels has been shown to increase the risk of cancer. Scientists believe it is prudent to assume there may be a slight increase in the risk of cancer due to exposure to low levels of radiation.

Exposure is minimized in nuclear facilities. The average person receives about 200 mr per year due to natural and man-made background radiation. The average nuclear worker may receive an additional 300 mr per year.

Radiation Monitoring Devices

Two types of radiation monitors may be used by workers not entering any [radiologically restricted area]s in the plant. They are as follows:

- The thermoluminescent dosimeter (TLD) measures the amount of radiation an individual receives in the plant. The TLD is used for the permanent dose records of employees. It should normally be worn on the front of the body, about chest high.

- The whole-body contamination monitor is used to detect personnel contamination. Everyone passes through an automatic contamination monitor when leaving the protected area.

Biological Risk

Radiation exposure is maintained as low as possible in the plant. But even long-term low levels of radiation may expose an individual to some health risks. The average exposure to radiation workers in the United States is 300 mr per year. The legal limit is 100 mr per year for the general public, including nonradiation workers. Depending on location, background radiation alone may result in a dose of about 200 mr per year.

Postings

Some plant areas are posted as radiological areas. Entering these areas requires additional training. These areas are posted with signs that include the following characteristics:

- The background of the sign is yellow.
- The sign will have a tri-foil radiation symbol on it.
- The lettering and radiation symbol are magenta or black.

Show students an example of a radiological posting/sign.

Types of Postings

While signs are used extensively for posting radiological areas, other types of postings, such as ropes and tape, can also be used. These are distinguished by the color combination of yellow and magenta. Ropes will normally have a sign hanging from them providing more information.

Required Actions

Should a radiological posting be encountered, do not enter the area or work on the equipment. The following are examples of activities that are not allowed unless you are a qualified radiation worker:

- removing a manway cover with a radiological posting attached
- working on a pipe that has yellow and magenta tape on it
- entering a radiologically posted area to pick up trash

Ask the students if there are any questions on radiation or radiological postings.

APPENDIX B

FITNESS-FOR-DUTY
LESSON PLAN
(FFD 93-009)

Fitness-for-Duty Lesson Plan

Fitness-for-Duty

Upon completion of this section, students should be aware of the importance of being fit for duty, understand the potential consequences of substance abuse, and work in compliance with the station fitness-for-duty policy.

Introduction

An individual is fit for duty when he/she is neither mentally nor physically impaired from any cause that could adversely affect safe, competent job performance. These impairments could be the result of:

- physical illness
- mental illness
- improper diet
- substance abuse
- fatigue

Federal Law

Federal law requires that each utility licensed to operate a nuclear facility:

- Provide reasonable assurance that station personnel are reliable and trustworthy and are neither under the influence of any substance (legal or illegal) nor mentally impaired from any cause that may adversely affect their ability to safely and competently perform their duties.

- Establish a fitness-for-duty (FFD) program to create an environment free of drugs, alcohol, and their effects, and provide employees with assistance for fitness-for-duty-related problems.

Negative Impact of Substance Abuse

Substance abusers have the following impact on business and the public:

- They have four times as many accidents.
- They file five times as many worker compensation claims.
- They use about three times as many sick benefits.
- They are absent about twice as often.
- They make about twice as many mistakes.
- They cause 50 percent of all vehicular accident deaths.
- They cause 500,000 serious injuries in vehicular accidents each year.

Company Policy

It is the policy of this company that all employees:

- Report to work fit for duty unimpaired by alcohol or drugs.
- Abstain from alcohol for at least [five] hours preceding regularly scheduled work and long enough to ensure blood alcohol content (BAC) is less than [0.04] percent.
- Notify their supervisor of any problems such as mental stress, fatigue, or illness that may affect their fitness for duty.
- Seek assistance for any problems that may affect their ability to safely and competently perform their duties.
- [Report the use of legitimate prescription or over-the-counter drugs that could impact their ability to performance.]
- Prevent and report actions that threaten the company or coworkers.
- Report any previous denial of unescorted access, positive chemical test, or involuntary participation in a substance abuse treatment program.
- Cooperate fully with the chemical testing program.
- Do not use, sell, or possess illegal substances on or off company property.

Implementation of FFD

The primary tools used to implement FFD are:

- drug/chemical testing
- employee assistance program

Each of these is discussed in more detail below.

Chemical Testing

The chemical testing program provides a means to detect and deter substance abuse in the workplace.

There are four test categories in chemical testing:

- Preaccess/prebadging is conducted within 60 days prior to:
  - granting of unescorted access
  - assignment to any emergency operations facility or technical support center

- Random testing may be conducted:
  - at various unannounced times of the day, night, weekend, and holidays
  - at a rate at least equal to 100 percent of the work force authorized unescorted access

- For-cause testing will be conducted:
  - as soon as possible following any observed behavior if there is reasonable suspicion that the person was under the influence of drugs or alcohol
  - after on-duty accidents [or potential accidents] involving failure [or suspected failure] of an individual's performance if reason to believe the person was under the influence of drugs or alcohol
  - after receiving credible information that an individual is abusing drugs or alcohol

- Follow-up testing will be performed:
  - for any employee, if reinstated, after testing positive for drugs or alcohol to verify continued abstention from the use of substances

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Testing Notification

[The supervisor or point of contact will be notified when an individual is to report for drug testing. The supervisor, or point of contact, will notify the individual of the scheduled test time.] The collection site is located (*).

When an individual has been notified of a scheduled random drug test, the individual must report at the scheduled time and may only miss the test if [not on site and if not expected to return that day or there is an emergency]. An individual may not request time off once notified of a scheduled test.

Call-Ins

Individuals may be called in as needed for unscheduled work. Employee are responsible for informing their supervisor if they have consumed alcohol within the past [five] hours or are not fit for duty for any other reason.

Substances Tested For

Employees will be tested for the following substances:

- alcohol
- marijuana
- cocaine
- opiates
- phencyclidine
- amphetamines

Urinalysis will be used for all substances except alcohol. A breath alcohol content test will be used for alcohol, and a confirmatory breath alcohol content test will be used if the test result is [0.04] percent or greater.

If an individual's breath alcohol content test is positive, he/she may request a blood test.

Employees should be aware that prescription and over-the-counter medication can impact chemical test results. [This is one of the reasons that it is important to inform your supervisor if taking medication.] All drugs must be in a properly labeled container. Nonprescription drugs must be in the original container.

Employee Assistance Program

The company has an Employee Assistance Program (EAP) to provide:

- short-term counseling
- referral services
- treatment monitoring

Only company employees are eligible for the EAP. Employees may request assistance from the EAP (self-referral) or be referred by their supervisor or the company medical staff.

If the EAP staff determines that an individual's condition constitutes a hazard to the individual or to others, 10CFR26 requires notification of company management even if the employee was self-referred.

Effects of Drugs

Drugs can have a significant impact on job performance. Those individuals using drugs or other chemicals can have:

- impaired judgment
- impaired vision
- changes in reflexes
- reduced analytical ability

The prescribed use of drugs and chemicals may have an impact on any testing for chemicals. This also includes commonly purchased over-the-counter drugs such as aspirin and cold medicine. For this reason, it is important that you list all drugs you have taken prior to the test.

Medical Review Officer

The medical review officer (MRO) is responsible for:

- [overall administration of the chemical testing program]
- reviewing all positive chemical test results
- [recommending individuals to the employee assistance program]
- (*)

Consequences for Violations

All site workers who violate the fitness-for-duty policy [can be suspended, have their unescorted access denied], and will be referred to the employee assistance program.

Rights and Responsibilities

Upon completion of this section, students should be familiar with individual rights and responsibilities regarding fitness for duty.

Individual Rights and Responsibilities

Individuals who test positive shall have the right to appeal the test results and any sanctions taken against them.

Appeals for a confirmed positive test:

- Apply to permanent employees [and contractors].
- Must be in writing.
- (*)

Individuals have the right to privacy at the collection site unless there is reason to believe that the individual will tamper, alter, or substitute a specimen.

Personal information collected for the fitness-for-duty program will be protected and will not be disclosed except as required by the appropriate procedure.

Individuals are responsible for:

- keeping their supervisor informed of any medication or other substances that could affect job performance

- talking with your supervisor if you notice unusual behavior or suspect substance abuse by any of your coworkers. This could result in injuries or reduced plant performance.

APPENDIX C

RADIATION WORKER TRAINING LESSON PLAN (RWT 93-009)

Sources of Radiation Lesson Plan

Sources of Radiation

Upon completion of this section, students should be familiar with sources of radiation.

Show the Sources of Radiation learning objectives.

Atomic Structure

All matter is composed of atoms. Atoms, in turn, are composed of three primary components:

Show a basic graphic of an atom

- Protons—These particles are in the nucleus of the atom and have a positive electrical charge. They also determine material type.
- Neutrons—These particles are also in the nucleus of the atom and are electrically neutral.
- Electrons—These particles form a cloud around the nucleus of an atom. They have very little mass and a negative electrical charge.

When an atom has too much energy, it becomes unstable and emits packets of energy or particles from the electron cloud or nucleus. It may require several emissions before becoming stable. These emissions are called radiation. Often the reactor creates unstable atoms by forcing a stable atom to accept a neutron or energy particle.

Radiation may interact with other atoms, causing a loss of electrons. This is called ionization and can change the properties of the atom.

Energy in the form of radiation may also be created when a larger atom is fissioned into two or more smaller atoms.

Sources of Radiation

There are several potential sources of radiation in the plant:

- reactor coolant
- fission and activated corrosion products (for example, cobalt and iron) that have been through the reactor and have been deposited on plant components

- reactor fuel
- reactor operations (neutron radiation, Nitrogen-16)
- plant components (filters, piping, valves)

Types and Measurement of Radiation

Upon completion of this section, students should be familiar with the basic types of radiation found in a nuclear plant and some of their characteristics.

Show the types and measurement of radiation learning objectives.

Types of Radiation

There are four basic types of ionizing radiation:

- alpha
  - Is the least penetrating particle.
  - Source is reactor fuel and radon gas.
  - Stopped by a piece of paper or a dead layer of skin.
  - Shielded by clothing.
  - Primarily is an internal hazard.
- beta
  - Has more penetrating power than alpha.
  - Source is fluid within piping.
  - Shielded by a thin layer of aluminum or plastic.
  - Is a hazard for the skin and eye lens.
- neutron
  - Has high penetrating ability.
  - Source is the reactor core at power.
  - Shielded by water or concrete.
  - Gives a whole-body dose.
- gamma
  - Has high penetrating ability.
  - Sources are fluids and corrosion products within primary piping, including steam in a BWR.
  - Shielded by dense materials such as lead and steel.
  - Gives a whole body dose.
  - Is the primary concern in the plant.

TEDE

Dose rate is the amount of radiation dose in a specified period of time. It is usually expressed as mr/hr.

The Total Effective Dose Equivalent, or TEDE as it is commonly called, is an individual's total dose and is determined by adding the external dose to the internal dose. The TEDE is expressed in terms of rem or mr. The rem is a unit used to relate radiation dose to biological effects. Millirem is one thousandth of a rem.

Converting rem and mr

Since TEDE can be expressed in terms of rem or mr, it is important to know how to convert from one to the other.

- To convert a rem to mr, multiply the number of rem by 1,000.

Ask students to work the following examples and ask students for answers.

Examples: A worker has a lifetime dose of 3.2 rem. What is the lifetime dose in mr?

(3.2 rem)(1,000)=3,200 mr

While performing a job inside a steam generator, a worker receives a TEDE of 1.6 rem. What is the dose received by the worker in mr?

(1.6 rem)(1,000)=1,600 mr

- To convert mr to rem, divide the mr by 1,000.

Examples: A worker has received 1,750 mr TEDE this year. What is the dose in rem?

1,750 mr/1,000=1.75 rem

A welder is welding a pipe near a radiation source and receives 800 mr. What is the dose received in rem?

800 mr/1,000=.8 rem

Biological Effects

Upon completion of this section, students should be aware of the risks associated with radiation.

Show the learning objectives for biological effects

Effects on Cells

When a cell is exposed to ionizing radiation, one of four things may happen:

- nothing
- cell damage
- cell death
- cell mutation

In general, rapidly reproducing cells and organs are more likely to be affected by exposure to radiation. For this reason, a infant is much more sensitive to radiation than an adult, and blood-forming cells are more sensitive than bone cells.

Additionally, the effects of radiation on the body vary with:

- area or organ of the body exposed to radiation
- type of radiation exposure
- length of exposure

Chronic Exposure

Exposure received over a long period of time is called chronic exposure. To be safe, we assume that there is a health risk associated with chronic exposure and therefore limits the exposure to workers in the plant. For example, chronic exposure due to background radiation is 200 mr/yr for the general public.

Acute Exposure

Exposure received in a short period of time, usually less than 24 hours, is called acute exposure. Assuming no medical treatment, the risk of health effects is as follows:

- less than 25 rem — No observable effects
- 25 to 100 rem — Slight blood changes, no other observable effect
- 100 to 200 rem — Vomiting may occur within three hours of exposure. Moderate blood changes are possible. Except for the blood-forming system, recovery will occur in essentially all cases within a few weeks.
- 200 to 600 rem — Vomiting for most people occurs within three hours. Loss of hair after two weeks, severe blood changes, hemorrhaging, and infection. Death may occur. The recovery period is one month to one year.

- Over 600 rem — Vomiting occurs within one hour. Other effects include severe blood changes, hemorrhage, infection, and hair loss. Probability of death is 80 percent (for 600 rem) within two months. Survivors convalesce over a long period of time.

(Source: S. Glasstone, Sourcebook on Atomic Energy)

Somatic and Genetic Effects

Two classes of effects may occur due to exposure to radiation:

- Somatic effects occur in the individual that received the radiation exposure. These are broken into two groups:
  - — Prompt effects appear shortly after the exposure (immediately to a few months later).
  - — Delayed effects appear months or years after the dose.
- Genetic effects appear in the future children of the individual exposed to radiation. Studies have shown that the risk of genetic effects is very small.

Effects on the Unborn Child

Genetic effects may occur due to radiation exposure during the embryonic stage to the fetus. Examples of these effects include death, structural abnormalities, abnormal growth, and mental retardation.

Due to an unborn child's increased sensitivity to radiation (because the embryo/fetus is rapidly developing), stricter limits are established for pregnant employees. These limits will be covered later.

Effects of Age

As we discussed earlier, radiation has a greater effect on cells that have a higher rate of reproduction. As a person ages, cell reproduction slows. Therefore, the effects ionizing radiation have on the body lessen as an individual grows older.

Dose History

Before a plant worker is allowed to receive more radiation than a member of the general public, all previous occupational doses of radiation must be recorded on NRC Form-4 [or the plant's equivalent dose history form]. An individual normally will not be allowed to work as a radiation worker until one of these forms is completed and on file. This form is also used by the plant to document all doses.

Limits and Guidelines **Upon completion of this section, students should be aware of the federal and plant administrative limits on radiation.**

Show learning objectives for limits and guidelines

Federal Limits Several limits are placed on how much radiation a worker can receive. The NRC sets these limits low enough to prevent prompt effects, to minimize delayed effects, and to ensure that risks due to radiation exposure are comparable with the risks in other industries.

The federal limits are:

- 5 rem TEDE per year
- 50 rem per year to the skin of the whole body
- 50 rem per year to the extremities (elbows, lower arms, wrists, hands, knees, lower legs, ankles, and feet)
- 15 rem per year to the lens of the eye
- 500 mr for an entire term of pregnancy—This limit only applies to a pregnant worker who declares her pregnancy.
- 50 rem to any internal organ (for example, thyroid)

Exceeding the Limits Exceeding any of these federal limits is a serious violation of plant and federal policy. Potential consequences of exceeding any federal limit include:

- increased health risk
- possible disciplinary action for willful violations
- NRC fines
- other NRC action against the plant and/or the individual

Administrative Guides The plant has established administrative guides to ensure that no employees exceed
federal radiation limits. These are:

- The TEDE guide is (*) mr per year.
- The guide for skin is (*).

- The guide for extremities is (*).
- The guide for the lens of the eye is (*).
- Other guides (*).

Approaching the Administrative Guides

If an administrative guide is being approached, [the worker's supervisor will be notified to] take appropriate actions to either extend the limits or to limit the exposure.

Embryo/Fetus Exposure Limit

Federal rules and guides concerning embryo/fetus exposure provide for the following:

- Radiation dose will be limited to 500 mr during the term of pregnancy. However, this is voluntary and if chosen requires a pregnant worker to write a statement to [plant management] stating her desire to limit radiation exposure. Dose should be minimized and spread as evenly as possible throughout the pregnancy. This is regulated by 10CFR20.1208.

- [It is also the right of the pregnant worker not to limit exposure during her pregnancy. It is the individual worker's choice.]

- A pregnant worker may also change her status at any time during the pregnancy.

To achieve this limit, the company will review alternate work assignments for declared pregnant worker to reduce or eliminate radiation dose. Work assignments will be made to minimize, or where possible, eliminate dose.

Planned Special Exposure

A planned special exposure is an infrequent exposure to radiation separate from, and in addition to, the federal dose limits. This type of exposure has several requirements associated with it and can be used only in an exceptional situation where alternatives that might avoid the higher exposure are unavailable or impractical.

ALARA

Upon completion of this section, students should be able to practice basic methods to minimize radiological exposure.

Show the ALARA learning objectives.

Purpose

The nuclear industry adheres to the conservative assumption that there is a risk associated with any exposure to radiation. Minimization of this risk is the basis for the ALARA concept. ALARA stands for "as low as reasonably achievable". Plant management and workers share the goal of keeping dose ALARA.

ALARA Program

The ALARA program is designed to minimize dose.
Important components include:

- pre-job reviews
- job planning including worker experience
- training using mock-ups
- use of radiological practices for dose reduction such as temporary shielding
- engineering controls

The individual is the most important element in the effort to minimize dose.

Time, Distance and Shielding

Discuss the following three basic principles that can reduce dose—time, distance, and shielding:

- Since dose is the amount of radiation exposure received, the less time spent in a radiation field, the less dose received. This concept could be used in a variety of ways. For example, if a worker used a wrench to disassemble a valve in 20 minutes and another worker did the same job in 12 minutes using a ratchet, the second worker would receive less dose.
- The farther away from a source of radiation, the less dose received. In a practical application, waiting for a tool in a low-dose area/zone will result in less dose than standing next to a source.
- As discussed earlier, radiation can be reduced by shielding. If a valve is emitting a large amount of radiation, the amount of dose could be reduced by placing shielding between the individual and the valve. Examples of shielding include walls, equipment, and temporary shielding.

Temporary Shielding

Since shielding to reduces dose, temporary shielding may be installed. The following are guides to use with temporary shielding:

- ALARA does not apply just to the individual but to the plant as a whole. If shielding will reduce an individual's dose by 30 mr, but will cause other workers to receive 50 mr during the installation of the shielding, there will be a net increase of 20 mr for the station.

- Temporary shielding, usually in the form of blankets containing lead, may not be installed, removed, or moved without the permission of the [RP] department. Temporary shielding is heavy. It may stress a component beyond its design. If it is moved or removed, it may significantly change the dose rate. Consequently, it would change the dose received.

Calculating Stay Time

The amount of time permitted in a radiation area, or stay time, depends on:

- the amount of dose received up to this time
- the dose rate
- the allowed dose

Work the following problem on the board.

Example: Assume an employee has received 200 mr of dose this year and the administrative limit is 1,000 mr. The employee is assigned to work in an area with a dose rate of 20 mr per hour. How long could you work on this job before exceeding the limit?

First determine the amount of dose the employee may still receive. Since 1,000 mr is permitted, and 200 mr has been received to date, the employee can receive 800 additional mr.

(1,000-200=800)

A total of 800 mr remains, and the dose rate is 20 mr per hour. Divide the amount allowed by the rate, or 800/20=40 hours. Forty hours is the stay time.

Provide the students with another example to work on.

Radiation Dosimetry

Upon completion of this section, the student should be able to use dosimetry devices properly to monitor dose and to respond to dosimetry problems.

Show the learning objectives for radiation dosimetry.

Purpose and Sensitivity

Dosimetry measures the amount of external dose received by the worker. There are two basic types of dosimetry issued:

- The TLD provides the permanent occupational dose record. It measures gamma, [neutron], and beta radiation. Special dosimetry TLDs may be issued for certain situations such as finger and toe rings or multiple whole-body TLDs.

- The other type of dosimetry is the self-reading dosimeter (SRD). The SRD provides a worker with an immediate indication of dose received. It only measures gamma radiation. Types of SRDs include pocket ion chambers (PICs), pocket dosimeters (PDs), and electronic alarming dosimeters (EADs). The EAD is an electronic SRD. EADs have alarm capability if dose or dose rate is too high. They are sensitive to gamma, and some newer models and sensitive to beta.

Normally dosimetry should be worn on the front part of the body between the waist and shoulders. The TLD and SRD/EAD should be worn close together. Individuals may be required to wear dosimetry in other locations as directed by [RP]. The TLD must be worn with the beta window facing out.

Show the students the TLD beta window.

Use of Dosimetry

- The SRD is read by looking through the barrel part while pointing it at a light. The scale should be horizontal. The SRD should not be subjected to shock or high humidity because they could affect accuracy.

- SRDs should be read immediately upon issue, every 15 to 20 minutes when in a radiation zone, and upon exit. An SRD should be read more often when in higher dose rate areas or where dose rates could change quickly.

- The TLD can only be read through the use of a special TLD reader.

- The electronic type of SRD has a digital display that may be read by looking at the display. Most electronic dosimeters operate in one [of two] modes:
  - — The dose mode provides a readout of estimated dose in units of [rem].

— [There is a button on the EAD to switch modes.]

— [The dose rate mode provides a readout of the estimated dose rate in units of [rem/hr]. The dose rate mode should never be used as a dose rate meter.]

Demonstrate how to read an SRD.

- Electronic dosimeters will alarm if a preset dose [or dose rate] is exceeded. However, it is still important to track your on-the-job dose and use the alarms as a backup. Should the alarm activate, report to [RP].

Show and demonstrate the electronic dosimeter student will use.*

Getting and Returning Dosimetry

(*)

Actions for Abnormal Conditions

When working in a [radiologically restricted area], several conditions could require action:

- If dosimetry is damaged or lost, employees should immediately place their jobs in a safe condition, leave the [RRA], and report to [RP].

- If a dosimeter is off-scale high, or alarming, immediately inform coworkers, leave the area, and notify [RP].

- If a dosimeter does not appear to be working correctly, leave the area and return the dosimeter to [RP].

Contamination

Upon completion of this section, students should be able to minimize the probability of becoming contaminated, spreading contamination to clean areas, or contaminating other workers while working in a contaminated area or working with contaminated equipment.

Show the contamination learning objectives.

Types of Contamination

(Review the definition of contamination.) Three basic types of contamination are of concern:

- Fixed contamination is surface contamination that has become embedded in an object and cannot be removed using normal cleaning methods. Fixed contamination can become airborne or spread through activities such as grinding or welding. Fixed contamination can become loose contamination by leaching.
- Loose contamination is contamination that is loosely adhered to an object or surface. Two problems associated with loose contamination are that it may be transferred to another area or personnel and it can become airborne if disturbed.
- Discrete, or hot, particles are very small radioactive particles that may be too small to be seen. These particles can be highly radioactive and can cause a dose of several rem to a very small localized area of the skin. If ingested, it can give a large dose to an internal organ.

Contamination Units, Sources, and Indications

Because contamination is radioactive, it is measured by the level of activity. The more contamination there is, the higher the activity level will be. The units for contamination are counts per minute (cpm) or disintegrations per minute (dpm) per unit of area. This is typically dpm/100cm^2.

Potential sources of contamination include:

- spills and leaks from a system carrying reactor water
- open contaminated systems
- grinding of a pipe with fixed contamination
- disassembly of a plant component with internal contamination

Therefore, when working in an area or on a system that is potentially contaminated be sensitive toward indications of contamination.

Ask students what may be indicative of contamination.

The following are examples of potential indications of contamination:

- Reactor water is leaking from a pump or valve.
- A pipe is being removed from a potentially contaminated system.
- Maintenance is being performed on a potentially contaminated component.
- Water is on the floor near or under a contaminated system.
- A rise in frisker counts or frisker alarm.

Methods to Prevent Spread of Contamination

It is important not to spread contamination. If contamination were not controlled, it could eventually be spread to homes, cars, and office areas. This would result in unmonitored radiation dose, an increase in radioactive waste, decreased productivity, and exposure to the public.

There are several methods that are effective in preventing the spread of contamination. These include:

- Planning a job and use of pre-job briefings
- Using protective clothing when working in a contamination area
- Avoiding water that is around or under a contaminated system
- Avoiding skin contact with a contaminated area
- The use of step-off pads and warning signs
- Restrictions on entering areas that are not routinely monitored for contamination
- Restricting entrance to contamination areas
- Use of engineering controls such temporary ventilation with filters and special enclosures
- Protective clothing (PC) is used to prevent personal contamination, but generally does not protect against dose. The correct use of PCs is important if they are to be effective.

Removing Material From the RRA

No material, including brooms, notebooks, tools, hard hats, parts, flashlights, and others, is to be removed from a radiological area without being checked for contamination.

Removing an article or material from a radiological area requires the following:

- (*)

Personal Contamination Monitoring

Most plant workers use two primary methods for personal contamination monitoring:

- The frisker is a device that detects contamination. It has a meter and a hand-held probe that is slowly passed over the area of interest while watching the meter. To use the frisker, perform the following:

Illustrate the following using a meter or by showing slides/overheads.

  - [Check the daily source check and calibration date to ensure they are current.]
  - [Check that the meter is on the X1 scale.]
  - Check the background radiation. [The meter should not be reading over [200 cpm] if on the X1 scale. If it is, move to another frisker or call RP.]
  - Frisk the hands first. Pass the hands over the probe at a distance of about one-quarter to one-half inch at a speed of two inches per second while observing the meter.
  - Pick up the probe and move it over the body (or surface) at about two inches per second. It should take two to five minutes to frisk the entire body.
  - If there is an increase in indicated counts hold the probe stationary and if there is an increase of [100] cpm or more, there may be contamination present. If this occurs, stay where you are and contact [RP].

- The second type of monitor is the whole-body contamination monitor. To use the monitor:
  - Enter the monitor.
  - (*)
  - If the monitor alarms, [try again]. If it alarms a second time, stay where you are, minimize touching anything, and contact [RP].

Control of Contaminated Materials

When working on contaminated systems, employees may contaminate some tools, equipment, or materials. Company policy is to minimize the contamination of these articles. Some of the methods that help in this effort are:

- Minimize the amount of material taken into a contaminated area (CA). Do not take packing material or unnecessary tools into the CA, and minimize the amount of trash generated.

- When getting tools for use in a CA, get the tools needed from the [hot tool] issue point. These tools have previously been used in a contaminated area and may have fixed contamination.

- If a contaminated article is to be taken out of a contaminated area, it should be [labeled and bagged in a yellow poly bag].

Contamination Area Postings

Signs warning of known contaminated areas are used in the plant. These areas are:

- Contamination Area - This is an area that has greater than [1,000 dpm/ 100 cm^2 of beta plus gamma or 100 dpm/100 cm^2 of alpha contamination]. Entering this area, requires RWP authorization. The RWP will specify entry requirements.

- High Contamination Area - This is an area that has greater than [100,000 dpm/100 cm^2 of beta plus gamma or 2,000 dpm/100 cm^2 alpha]. Entering this area requires authorization by RWP and meeting the requirements in the RWP.

An area designated as a contamination or high contamination area will be posted. The area is typically roped off with yellow and magenta rope with signs hanging from the rope with the area designation. There is an entrance and exit to the area with a step-off pad. This entrance and exit are the only authorized ways in and out of the area.

Think of the ropes as walls. Do not enter the area or reach over the ropes unless authorized by [RP].

Failure to adhere to these requirements can result in the spread of contamination, personnel contaminations, and potentially, disciplinary action.

Discrete Particles

As mentioned earlier, discrete particles are very small but can give a high dose. If a discrete particle, sometimes called a hot particle, gets on the skin, the legal dose limit can be exceeded in a short time. Additionally, if the particle is ingested, it can yield a high internal dose.

Provide an industry example of a discrete (hot) particle event.

There are several ways to identify a discrete particle:

- When frisking, a hot particle can cause the meter to rapidly rise to a much higher count rate. The frisker will respond only if it is close enough to the discrete particle.

- The personnel contamination monitor is effective in finding discrete particles.
- An alarming WBCM monitor when leaving the site is not the preferred method of detecting a discrete particle; however, industry experience shows that it is often capable of detecting discrete particles.

As discussed earlier, discrete particles originate in the nuclear fuel or from corrosion products. Therefore, work that involves systems connected to the reactor or systems with activated corrosion products may contain discrete particles.

Some precautions that should be used in areas that may contain discrete particles are:

- careful review of the RWP survey map for discrete particle contamination areas
- use of PCs as required by the RWP
- careful monitoring for discrete particles when exiting the area

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Conditions Requiring Exiting a Contaminated Area (CA)

Some situations require exiting a CA immediately. If any of the following occur, immediately leave the CA:

- cut or torn PCs
- cuts, abrasion, or any other type of open wound
- PCs become wet from a leak or spill
- an unusual SRD condition such as being upscale or off-scale
- directed to leave by [RP]
- lost or damaged dosimetry

Show students internal exposure learning objectives.

Internal Exposure

Upon completion of this section, students should be aware of how contamination can enter the body, how to detect internal contamination, and how internal contamination is eliminated from the body. Students should also be able to take measures that can reduce internal dose.

Methods of Internal Deposition

Radioactive material enters the body through:

- Inhalation - breathing.
- Ingestion - eating, drinking, or chewing.
- Absorption - absorbing it through the skin.
- Open wounds - through an open wound or sore.

Limiting Internal Deposition

Methods that may be used to minimize internal dose include:

- not eating, drinking, smoking, or chewing within the RRA
- engineering controls including controls such as temporary ventilation with filters, isolating potentially radioactive steam leaks, or shifting ventilation flowpaths
- as a last resort, the use of respirators and other protective equipment— Since these devices often reduce work efficiency, they increase time in a CA and often increase dose
- time keeping and monitoring

Elimination of Internal Depositions

Two primary processes that will reduce radioactive material from the body:

- Biological processes naturally occur that will eliminate most types of internal deposition.
- Radioactive decay will also occur. This decay process will eventually reduce radioactivity. Decay time is entirely dependent on the type of material.

Measuring Internal Activity

The body must be measured for activity before assigning internal dose. Two primary methods used to measure the level of internal radioactivity are:

- Whole-Body Count—Required prior to initially entering the RRA and periodically thereafter. The whole-body count measures the level of radioactivity within the body.
- Bioassays such as urine and sweat may also be used to determine internal activity levels. The bioassay is an evaluation of a sample taken from the body.

CEDE, DAC, and ALI

The mouth and nose are the most common pathways for the intake of radioactive material. Federal law regulates the amount of internal dose. The following defines three often-used NRC acronyms.

- A Committed Effective Dose Equivalent (CEDE) is the amount of assigned internal dose that relates organ dose to the whole-body dose.
- An Annual Limit on Intake (ALI) is the amount of airborne radioactive material necessary to receive a CEDE of 5 rem effective dose equivalent or 50 rem to any organ. Each individual is limited to one ALI per year.
- A Derived Air Concentration (DAC) is the concentration of radioactive material in air that would result in a volume (and equivalent dose) of one ALI if breathed for 2,000 hours.

Relating DAC, CEDE, ALI, and TEDE

TEDE is equal to the external dose plus the internal dose (CEDE). Since 5 rem is equivalent to 1 ALI, which is also equivalent to 2,000 DAC hours, 1 DAC hour is equal to 2.5 mr (5,000 mr/2,000 hours=2.5 mr per DAC hour).

Discuss problems such as the following with the class.

- A worker is assigned the task of repairing a door in a radiological area. The area has a dose rate of 24 mr/hr and also has some airborne radioactivity. From experience with this door, the worker knows it will take 2 hours and 20 minutes to make the repair with a respirator or 2 hours without a respirator. If the job is done without a respirator, he will receive 2 DAC hours internal exposure.
- If the worker wears a respirator what will the total dose be?

  Answer: The total dose will be 56 mr.
  (24 mr/hr)(2.33 hrs) = 56 mr

- If the worker does not wear a respirator, what will the total exposure be?

  Answer: The total dose will be 53 mr.
  (24 mr/hr)(2 hour) + (2 DAC hours)(2.5 mr/DAC hour) = 53 mr

- Which worker received less dose?

  Answer: The worker not wearing the respirator.

Increasing Airborne Radioactivity

Many types of activities within the RRA can increase the amount of airborne radioactivity. Some of these include:

- brushing or sweeping
- fans blowing in dusty areas
- steam leaks
- sanding, grinding, or welding on a contaminated pipe
- a wet contaminated area that is drying out

Be alert to these types of conditions that can increase TEDE.

Radiation Work Permit

Upon completion of this section, students should be able to interpret and apply information found in an RWP to a task in a radiological area.

Show the RWP learning objectives.

Function of an RWP

A radiation work permit contains details concerning a radiological area. An RWP has three major functions:

- An RWP authorizes entry into a radiologically controlled area.

- An RWP details the radiological requirements necessary for the work being performed including dosimetry, protective clothing, and precautions.

- An RWP provides information concerning radiological conditions in the work area.

The types of RWPs in use are (*)

Extracting Information from an RWP

An RWP contains information such as clothing requirements, dosimetry requirements, and special requirements. Signing on to an RWP means that an employee understands and will comply with the instructions. Discuss any questions with [RP].

Provide the students an example RWP.

- (Discuss site-specific contents of an RWP.)*

RWP Compliance

Plant managers and supervisors expect full compliance with all RWP requirements. Failure to comply with the requirements established by an RWP may result in a radiological event or problem. This could result in unnecessary exposure, the plant being fined, or other regulatory action, as well as possible disciplinary action.

Survey Maps

The survey map generally shows a drawing of the area covered by an RWP and includes information on dose rates, contamination levels, and other radiological concerns.

Provide students an example of a survey map.

- Located on the survey map is, for example, the [RWP number,] date of the survey, area of the plant surveyed, [and the purpose of the survey].
- On the survey map is a drawing of the area surveyed and radiological information such as dose rates, contamination levels, and radiological postings.
- Symbols and/or designators are used to identify the different types of information:
  — Radiological postings are shown by (*).
  — A smear location is shown by (*).
  — A dose rate is shown by (*).
  — (Add site-specific details.)*

A Change in Conditions

Radiological conditions can change with reactor power level, equipment status changes, movement of shielding, and other reasons.

- If radiological conditions are different than expected, or if the conditions change unexpectedly, inform others that may be in the area, exit the area, and contact [RP].

- If, while working on a task in the RRA, the job scope changes such as having to completely disassemble a component instead of just part of it, contact [RP] before proceeding.

Radiological Postings

Upon completion of this section, students should be able to recognize and understand the plant radiological postings.

Show the postings learning objectives.

Types of Postings

There are different types of radiological areas. Radiation and contamination areas are only two examples. The following are common types of postings; entry requirements are defined by the associated RWP:

Provide students an example of each radiological postings discussed below.

- [Radiologically Restricted Area] (RRA)—This is an area with access limited for the purpose of protecting individuals from radiation exposure and radioactive contamination. [It's generally posted.]
- Radiation Area—This is an area with a dose rate greater than [5] mr per hour.
- High Radiation Area—This is an area with [>100] mr per hour.
- Very High Radiation Area—This posting has the words GRAVE DANGER and identifies an area that has greater than [500 Rad] per hour.
- [Locked High Radiation Area]—This is an area with [>1,000] mr per hour dose rate. It is kept locked to prevent inadvertent exposure.
- Airborne Radioactivity Area—This is an area containing airborne radioactivity that exceeds [1 DAC or 12 DAC hours per week].
- Radioactive Materials (Storage) Area—This is an area that has radioactive materials stored in it.
- Hot Spot—This is a localized source that is [five] times the general background and at least [100] mr per hour.
- [Low Dose Zone]—This is an area that has less dose than the general area.

- Discrete (Hot) Particle Area—This is an area established to control the spread of discrete hot particles.

Movement of Postings

The violation, movement, or removal of any radiological posting or boundaries will not be tolerated. This can result in a radiological hazard, increased dose to personnel, regulatory violations, and other actions. Disciplinary action can result from tampering with any radiological posting.

Radiological Alarms

Upon completion of this section, students should be able recognize and respond to radiological alarms.

Show the radiological alarms learning objectives.

Radiological Alarms and Responses

The following typical radiological alarms are used in the plant. Students must know the alarms and responses:

Show facsimiles of the local alarms where appropriate, and play a recording of each alarm.

[• continuous air monitor alarm—This alarm indicates that the air being sampled has exceeded a preset level of radioactivity. If this alarm is activated, it will (*). Employees should leave the area immediately and notify the control room.]

- area radiation monitor alarm—This alarm indicates that the radiation level in an area has exceeded a preset value. If this alarm is activated it will (*). If employees encounter this alarm, leave the area [and report it to the control room].

[• process radiation monitor—This alarm indicates that a system or containment process radiation level has exceeded its alarm setpoint. If setpoint is exceeded, the PRM will (*). If you should discover the PRM in an alarming state, exit the area and inform the control room.]

- (*)

Ignoring Alarms

Radiological alarms can be an indication of a serious problem. Improper response or ignoring a radiological alarm can increase radiation dose and, consequently, health risk.

Anyone who purposely ignores a radiological alarm will be subject to disciplinary action.

Radioactive Waste

Upon completion of this section, students should be aware of the importance of and methods for minimizing the generation of radioactive waste.

Show the radioactive waste learning objectives.

Definition

Radioactive waste is radioactive material that must be disposed of. Examples are:

- used PCs that are no longer serviceable
- used tape, gloves, and plastic bags from a CA
- contaminated packing material leaving the RRA

Waste Cost and Reduction

Depending on the geographical location, radioactive waste can cost [$2,500] or more per barrel of low-level radioactive waste (LLRW). This compares to about [$8] per barrel of clean trash. Reducing LLRW improves our economic position and lowers disposal costs.

Some effective methods of reducing LLRW are:

- Use cloth bags, protective clothing, and tool bags whenever possible. These can be recycled.
- Take only needed items and quantities into the RRA.
- Never mix wet and dry wastes in the RRA.
- Segregate contaminated and noncontaminated trash and properly dispose of each.
- Tape clothing only when required by the RWP.
- Many other practical ways exist to reduce radwaste. Use good judgment and common sense.

Keeping Wastes Separate

Keep the wet waste separate from dry LLRW waste. If liquid and dry radwaste are mixed, further processing is required. Mixing of chemicals with either dry or liquid radwaste creates mixed waste. This is even more difficult to dispose of due to the additional restrictions that apply.

Rights and Responsibilities

Upon completion of this section, students should be aware of individual rights and responsibilities regarding working within radiological areas.

Show the rights and responsibilities learning objectives.

Individual rights and responsibilities are as follows:

- maintaining dose ALARA
- complying with the governing RWP
- complying with instructions from [RP] personnel, including stop work authority
- staying aware of personal dose
- complying with federal and administrative limits
- informing plant management whenever a radiological violation occurs and/or abnormal conditions are encountered
- A worker right includes reviewing personal radiation dose records. To obtain this record, contact [RP].

Practical Exercise

Upon completion of this section, students should have demonstrated the ability to wear protective clothing, enter a radiologically contaminated area, remove tools, and exit the contaminated area.

Selecting and Extracting Information From an RWP

The following information is needed to work within the limits of an RWP:

Provide the students an example RWP or show an RWP on the board.

- Select the correct RWP by (*).

- Review the RWP to determine the protective clothing requirements. They are found by (*).
- The dosimetry requirements are determined by (*).
- Determine if respiratory protection is required by (*).
- If any special conditions are defined by the RWP, they can be determined by (*).
- If any special instructions are to be followed, they are (*).
- Dose rates and contamination levels can be determined by (*).
- Obtain access on the RWP by (*).

Don Protective Clothing

[Note: The order of donning protective clothing may vary from the following sequence depending on site-specific requirements.]

- [Remove personal outer clothing. Only underclothing or modesty garments, socks, and shoes should be worn under PCs.]
- Don shoe liners.
- Don cotton glove liners.
- Don coveralls.
- [Place the TLD and SRD in the pocket provided on the upper chest area of the coveralls, unless directed otherwise.]
- Don rubber overshoes over the shoe covers.
- Don rubber gloves over the cotton liners [and tape].
- Don respirator, if required.
- Don the hood [and hard hat] and then close the hood.

Removal of Protective Clothing

[Note: The following generic sequence may vary depending on site-specific requirements.]

PCs are removed in the following sequence:

Demonstrate the following for the class. Explain that students will be required to perform this as a practical demonstration.

- Approach the step-off pad.
- [If wearing a hard hat, remove it.]
- Remove any outer tape.
- Remove the rubber shoes. Place the rubber shoes into the proper container.
- Remove rubber gloves and place in the proper container.
- Remove the hood, and place in the proper container.
- Remove respirator, if used.
- [Remove dosimetry and place in a clean area.]
- Remove coveralls by loosening and turning inside out as they are removed. Place them in the proper container.
- Remove shoe liners, placing the clean foot on the step-off pad after the liner is removed. Place the liner in the proper container.
- Remove the cotton liners, turning them inside out as they are being removed.
- [Retrieve dosimetry, proceed to frisker, and frisk out.]
- [Explain tool removal process.]*

Exiting the RRA (Exiting the RRA and signing out is site specific.)*

APPENDIX D

RADIOLOGICAL RESPIRATOR TRAINING LESSON PLAN (RRP 93-009)

Radiological Respirator Protection
Lesson Plan

Notes

All students in this course should have already completed Plant Access Training and Radiation Worker Training. Students will be required to demonstrate competency in inspecting, donning, and removing a respirator either as part of the fit test or in a separately evaluated demonstration.

Radiological Respiratory Protection

At the completion of this section, students should be familiar with the general requirements for radiological respiratory protection.

Program Purpose

The respiratory protection program limits the intake of radioactive materials. This program is required by federal law.

Qualification Requirements

To qualify as a respirator user, an individual must successfully complete:

- a medical certification
- this training
- a fit test
- a current whole-body count

Fit Tests

Part of this qualification requires performance of a fit test. This test ensures a good seal between the face and the respirator mask. There are several factors that can affect the seal, such as:

- facial hair
- unusual facial features such as large scars or prominent bone structure
- corrective lenses (glasses)

A fit test should be reperformed [once per year] or if there have been changes that could affect the mask fit caused by situations such as:

- significant changes in body weight
- new facial scars
- facial, oral, or dental surgery
- damage to the ear drum
- any other condition that has resulted in a change to the facial structure

Negative Pressure Test

One other type of test that must be performed prior to each use of a respirator is the negative pressure test. To perform this test:

- Cover all air inlets to the mask.
- Inhale as much as possible with the mask on.
- Hold your breath [for 10-15 seconds].
- The mask should stay collapsed toward the face.

If leakage is detected, the following steps should be taken:

- Tighten one or more straps.
- Re-adjust the mask.
- Make sure the exhalation valve wasn't pulled into the mask.
- Retry the negative pressure test.

If the mask will not pass this test, return the mask to the point of issue and get another.

Respirator Issue and Inspection

When you need a respirator, report to [RP]. They will verify that you are qualified prior to issuance and that you are clean shaven. If everything is in order, they will issue you the respirator. Once you get the respirator:

Demonstrate the following process.

- Verify the respirator has been inspected by [observing the inspection tag].
- Look the respirator over for general condition.
- Check the lens for cracks and clarity.
- Check the respirator for missing or broken parts.
- Ensure the proper filter is attached.
- Hold the respirator up to your face and get a good seal. Breath in and out several times ensuring proper operation.
- Perform a negative pressure test.

If any problems are discovered, return the mask, describe the problem, and get another mask.

Respirator Donning and Removal

To don a respirator:

- Place the chin in the chin cup.
- Move hair and protective clothing out of the seal area.

Demonstrate this process for the students.

- Put the mask against the face, and pull the straps over the head.
- Tighten the straps equally, snug but not too tight, lower neck straps first then slide straps and front forehead strap last.
- Perform a negative pressure test before entering the hazard area.

If the mask does not pass the test, return it to the respirator issue point.

Respirator Return

When exiting the radiological area where the respirator was in use, [remove the mask and place it in the respirator receptacle].

Respirator Operation

Upon completion of this section, students should understand how the respirator operates and any limitations on its use.

Protection Factor

The degree of protection provided by a respirator is called the protection factor. The actual protection factor is found by dividing the outside concentration of a contaminant by the concentration of the same contaminant inside the mask. Each type of mask is assigned its own protection factor.

Example: The outside concentration of a contaminant is 25,000 parts per million and the protection factor is 50. What is the inside containment concentration?

The inside containment concentration is 500 ppm.
(25,000/50 = 500).

The protection factor of 50 tells us that the respirator is giving us 50 times the protection as compared to wearing no respirator at all.

Air-Supplied Respirators

The air-supplied respirator is a respirator that is supplied with fresh air through a hose from an air system. The quality of the air used for breathing is checked periodically. The respirator operates in a continuous flow mode, which results in a positive pressure. This means that any leakage will be into the atmosphere.

Advantages of air-supplied respirators include:

- [A hood can be worn by personnel who cannot wear tight-fitting face pieces due to facial abnormalities or eye glasses.]
- Positive pressure greatly reduces in-leakage concerns.
- Increased protection factor compared to a negative pressure respirator.

Disadvantages include:

- Mobility is restricted due to air hose length. The maximum length is [300] feet.
- Air hose can become kinked, damaged, or tangled.
- Wearer is dependent upon an external source of air; therefore, air-supplied respirators will not be used in atmospheres that are immediately dangerous to life and health (IDLH).
- Work time and personnel dose can be increased.

The hood provides a protection factor of [1,000.] The air-supplying respirator, with a full-face mask, has a protection factor of [2,000].

Air-Purifying Respirator

The air-purifying respirator is most commonly used. This respirator has a cartridge that filters the air containing airborne contaminants. This type of respirator cannot be used in IDLH atmospheres.

Show the class an air-purifying respirator.

Air flows in through the filter and is exhaled through exhaust valves located in the mask. The air-purifying mask operates in a negative pressure mode, which means that any leakage will be into the mask.

Advantages include:

- It's lightweight.
- Mobility is not restricted.

Disadvantages include:

- Work time and associated dose can be increased.
- Can become plugged and cause difficulty in breathing.
- Cannot be used in IDLH environments.
- In-leakage can occur if face piece-to-face seal is broken or cartridge gaskets are damaged.
- Provide limited hazard protection.

The protection factor is 50 for a full-face respirator.

Respirator Problems

All respirators are periodically inspected; however; there is always a chance of failure or other problems. Symptoms include:

- procedural or communications failure
- unusual odor/taste
- leakage
- irritation
- difficulty in breathing
- inhalation of extremely hot air
- any feeling of nausea or dizziness
- physical/psychological distress (for example, claustrophobia)

If any of the above symptoms occur or if respirator relief is required, leave the area immediately, remove the respirator if necessary, and return to a safe area. If respirator failure or sickness happens suddenly, remove the respirator immediately, return to a safe area as quickly as possible, and report the event to [RP].

APPENDIX E

STUDENT HANDOUT

Station Organization

Station Organization

Upon completion of this section, you should be able to state the function of station departments.

To do this, you should be able to:

- State the function of the following station departments:
  - — operations
  - — maintenance
  - — [radiological protection]
  - — training
  - — security
  - — [quality]
  - — [emergency planning]
  - — [safety]

Operations

The operations department is responsible for the "hands-on" control of the plant. The operators are involved in many plant activities. The department performs activities such as:

- operating plant equipment
- placing safety tags
- approving most types of plant work
- controlling reactor power

They also staff the main control room and respond first to most problems in the plant.

Maintenance

The function of the maintenance department is to maintain the plant in good operating condition. It performs all types of maintenance activities such as:

- repairing plant equipment such as:
  - — instruments
  - — pumps
  - — valves
  - — security equipment
  - — motors

- performing preventive maintenance on equipment

Radiological Protection

The function of the radiological protection department (RP) is to minimize personnel radiological exposure and the spread of radioactive contamination. It performs activities such as:

[• escorting personnel into high-radiation areas]
- monitoring various areas of the plant for radiation levels
- monitoring plant surfaces for contamination
- preparing radiation work permits
- controlling access to and from the RRA

Training

The function of the training department is to assist the plant in training and qualifying personnel to perform their jobs. Training performs activities such as:

- working with plant departments in setting up training programs for plant personnel
- presenting training courses
- maintaining training and qualification records

Security

The function of the security department is to protect the plant from nuclear sabotage. It performs activities such as:

- controlling access to and from the protected area
- controlling the issue of all badges for site access
- controlling security doors within the plant

Quality

The function of the Quality Program is to maintain the quality level in the plant as high as possible. It perform activities such as:

- monitoring some plant activities to ensure they are done correctly
- performing program reviews to ensure they are being done according to plant procedures
- inspecting safety-related parts and supplies to ensure they meet all requirements

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Emergency Planning	In case of a plant emergency, it is important and is federally required to have adequate plans and enough trained personnel to deal with the situation. The purpose of [Emergency Planning] is to ensure that both of these requirements are met.
[Safety]	The function of the [safety department] is to provide oversight of the industrial safety program. They may become involved with activities such as checking air quality, evaluating industrial accidents, and evaluating heat stress concerns.

STATION ADMINISTRATION

Station Administration

Upon completion of this section, you should be able to comply with company policies when working in the station.

To do this, you should be able to:

- State your responsibilities regarding the following policies:
  - — operating plant equipment
  - — working on plant equipment without authorization
  - — reporting problems for resolution
  - — complying with [RP] and security rules (oral and written)
  - — smoking on company property*
  - — reading materials that are not related to the design, operation, or maintenance of the plant*
- State the company policy regarding procedure compliance and use of controlled documents.
- State your responsibilities regarding station cleanliness and housekeeping.
- Identify steps involved with self-checking (*).
- State conditions that require self-checking.

Individual Responsibilities

As in any industrial organization, several general rules must be followed when working in the plant. Some of these are as follows:

- Operating plant equipment only if the person is qualified to operate it and is authorized by the control room or by procedure.
- Working on equipment must be approved prior to starting the job.
- Problems in the plant must be reported using the problem-reporting programs. Equipment problems should be reported using the [work request]. This will be covered in more detail later in the course.
- Smoking is allowed only in designated areas. The areas are (*).
- [The only reading material allowed in the station is that which is directly related to the operation, maintenance, or design of the plant.]

Procedure Compliance

Procedures ensure that a job is performed consistently, in a quality manner, and in a logical sequence. If the job you are performing requires a procedure, compliance with the procedure is mandatory; you must follow the procedure [exactly as it is written] or get the procedure changed.

- Should you ever feel that a job can't be performed the way the procedure is written, perform the following actions:
  - — Stop the job.
  - — Place the job in a safe condition.
  - — Contact your supervisor.
  - — Resolve the problem.

It is always your responsibility to:

- Make sure the procedures and drawings that you are using are the current revision.

- Always review the procedure before beginning the job. If the procedure is not correct, talk to your supervisor or get a form to have the procedure revised. Above all, make sure the procedure is correct before you begin the job.

- The review of the procedure and job should include a walkdown of the job site whenever possible. You should be aware of any safety-related equipment in the area and how your work could affect the equipment around you. Accidental bumping or hitting of some equipment can cause unexpected occurrences. Some equipment has caused plants to trip off line because one instrument had been bumped.

Housekeeping

You are expected to keep your own workspace as neat as possible and to clean up after yourself when a job is finished in the plant. Your goal should be to leave an area cleaner than you found it. If a housekeeping problem is discovered that you can't take care of, contact your supervisor.

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*Self-Checking**

Self-checking helps ensure you are on the correct component or in the correct area before you take an action or start to work. The steps for this process are as follows:

- <u>S</u>top — Plan and prepare.

- <u>T</u>hink — Think about what you are about to perform and about what you are supposed to be performing.

- Act — Perform the action.
- Review — Verify the response was correct for the action taken.

This process is easy to remember by using the first letter in each step to form the word STAR.

[Note: The STAR method of teaching self-checking may be replaced with a site-specific method.]

A few examples of where to apply self-checking could include manipulating plant components, connecting test equipment, opening panel doors, and welding.

Nuclear Power Plant Overview

Nuclear Plant Overview

Upon completion of this section, you should be familiar with the layout of the major plant buildings and how the plant basically operates.

To do this, you should be able to:

- Given a drawing of the site, identify locations of major plant buildings, including:
  — turbine building*
  — reactor building (or equivalent)*
  — security access points*
  — [radiologically restricted area] (RRA)*
  — drug screening reporting site*
  — emergency assembly areas*
  — auxiliary building*

- Describe the basic process used to produce electricity at a nuclear facility.

- Identify the appropriate communication system to be used for:
  — reporting emergencies*
  — locating an individual in the plant*
  — lengthy discussions*

Site Layout (*)

Several important plant buildings house the equipment and personnel necessary to operate the plant. Some of those buildings are as follows:

- turbine building—This building houses the main turbine, generator, and much of the supporting equipment such as the main condenser and condensate pumps.

- reactor building (or equivalent)—This building houses the reactor, important isolation valves, reactor instrumentation, and other safety-related equipment.

- security access points—These are the points where you may enter the site. To do this, you must first pass through security.

- [radiologically restricted area] (RRA)—This is the part of the plant that contains radiological areas, and access is restricted to personnel who have received Basic Radiation Worker Training.

- drug screening reporting location—If you are ever directed to report for drug screening, this is where you report.
- auxiliary building—(*)

Generation of Electricity

The basic operation of the power station involves the conversion of nuclear energy into electrical energy (electricity). To understand this process, you need to look at how nuclear energy is converted to thermal energy, thermal to mechanical energy, and mechanical to electrical energy.

Overview

Nuclear energy is energy released from the fission process. When a uranium atom fissions or splits energy is released in the form of heat. The heat is used to heat water and produce steam (thermal energy). The steam causes the steam turbine to spin, producing mechanical energy. The turbine is connected to the generator and causes the generator to spin, producing the electricity the company will supply to its customers.

Nuclear Energy

Fission occurs when a neutron strikes the nucleus of a uranium atom. The atom usually splits into two smaller atoms and releases about two free neutrons, which continue the chain reaction.

To control the chain reaction, the control room operator in a pressurized water reactor uses control rods and/or boron to absorb some of the neutrons and prevent them from fissioning other uranium atoms. In a boiling water reactor, the operator uses control rods and the amount of water flowing through the reactor core to control this process.

When fission occurs, heat is released, which is used to heat the water in the reactor vessel. In a PWR, this water, called primary water, is prevented from boiling by using a pressurizer to maintain a high pressure on the primary system. The pressurized water is circulated inside tubes that are submersed in a second water system (secondary system). The secondary system is at a much lower pressure and, therefore, the reactor water will cause it to boil and produce steam. The steam is used to turn the steam turbine, which turns the generator, producing electricity.

In a BWR, the water actually boils in the reactor core, and the resulting steam is piped directly to the turbine.

Steam Cycle

Once the steam passes through the turbine, it exhausts into the main condenser where it is condensed back into water. (There are many tubes inside the condenser with cooling water flow for condensing the steam.) The water from the condenser is pumped through some filters and heaters and eventually returns to the steam generator or reactor, depending on the plant type, where the process begins again.

Communications

As with any large industrial complex, several types of communication systems are used. In general, the following guides should be used:

- To report emergencies, call (*).
- To locate an individual in the plant, use (*).
- For discussions that may be lengthy, use (*).

INDUSTRIAL SAFETY

Industrial Safety

At the completion of this section, you should be able to comply with basic station industrial safety policies, including identifying and reporting workplace hazards.

Individual Responsibilities

You should be able to discuss your industrial safety responsibilities regarding:

- reporting of unsafe working conditions*
- reporting of industrial safety near-misses*
- reporting of work-related injuries/accidents*
- administration of first aid (if qualified)*
- adherence to safety instructions (procedures and permits)
- observation of safety postings, barriers, tags, and signs
- use of personal protective equipment*
- general location of safety equipment such as eyewash stations, first aid kits, and safety showers*

Health Hazards

You should be able to recognize the following as potential health hazards:

- use of asbestos on some plant components
- electrical equipment
- steam leaks
- confined spaces
- trip and fall hazards
- heat stress
- compressed gases
- moving/rotating equipment
- high noise areas
- falling objects
- eye hazards
- hazardous chemicals

Industrial Hazards

You should be able to discuss methods for reducing the risk involved with the following industrial hazards:

- chemical products
- electrical equipment
- steam leaks
- confined spaces
- trip and fall hazards
- heat stress
- compressed gases
- moving/rotating equipment
- high noise areas
- asbestos (be able to recognize postings)
- eye hazards

You should be able to state where information may be obtained explaining the risks, hazards, and handling associated with a chemical or toxic substance.

Industrial Safety Policy

You should be able to state plant policy regarding the use of the following personal protective equipment:

- hard hats*
- safety glasses*
- hearing protection*
- protective footwear*
- hand protection*

Students should be able to state how the personal protective equipment will be worn.*

Individual Responsibilities

There are many safety rules in the plant. Many of them are covered in this training. However, you as an individual are the most important factor in determining how safe the plant is as a place to work. Plant management expects you to respect all the station's safety rules. If you are not sure of a policy, take the minute necessary and call your supervisor and ask for clarification *before* you start the job. All the following policies are intended to assist in making the plant a safe place to work.

Any intentional disregard for safety will not be tolerated. This can put you and your coworkers in a situation that can realistically be life-threatening. Disregarding any plant safety policy can result in disciplinary action.

Proper maintenance and use of tools and equipment, and good housekeeping practices, will help ensure pleasant and safer working conditions. Always remember that the job is not finished until everything is cleaned up and put away.

Reporting Problems

You are responsible for recognizing unsafe working conditions in the plant. If you should discover an unsafe working condition, correct it if you can, or report it to your supervisor. If necessary, your supervisor will give you the proper form to get the problem resolved. Just a few examples of problems that should be reported are a:

- missing safety sign
- trip or fall hazard
- frayed electrical cord
- missing guardrail or handrail

Additionally, if you are ever involved in a "near-miss" accident (that is, you almost have an injury), plant management would like to know so it can evaluate and take actions to prevent recurrence. To report this type of problem, contact your supervisor.

Personnel Injuries

You and your supervisor are expected to work together to prevent injuries and to strive for a safe work environment free of hazards. However small the chance, you must be prepared for the possibility of an on-the-job injury. If there is a serious injury, your response time must be as short as possible.

If you ever discover someone who is seriously ill or injured, you should immediately:

- Render any immediate lifesaving aid that you are qualified to perform.

- Notify control room personnel or call (*) and inform them of the nature of the first aid emergency using the fastest means of communication available. Be certain to clearly state the victim's location.

- When the [medical] team arrives, offer assistance and then stay clear of the area.

The [medical] team is composed of on-site personnel. The Nuclear Regulatory Commission (NRC) requires the plant to have a minimum number of first-aid trained personnel for each shift. If further medical attention is required, the injured person will be transported to the proper medical facility.

When nonemergency injuries occur that need minor medical attention, report to the [nurse's station]. All injuries, regardless of how small they seem, must always be reported to your supervisor immediately. This will provide evidence that the injury occurred while on the job in the event that it develops into something more serious. This could also help prevent similar, or more serious, injuries from occurring in the future.

Compliance With Safety Postings and Permits

Warning signs or barriers are used throughout the plant to warn you of potential dangers. Examples include: Danger—No Smoking, Confined Space—Entry by Permit Only, Authorized Personnel Only. Always read and obey posted warnings.

Some activities, such as welding, propping a fire door open, or entering a tank, require a permit. Always get the necessary permit and authorization *before* starting the job.

These signs and permits are required for the protection of you and your coworkers. Safety is one of the most important aspects of any job, and plant management expects everyone to conform to all safety standards and requirements.

Safety Tags and Postings

Tags are another way of protecting you from potential danger, communicating special requirements, or providing other types of information. A few examples include:

- Information tags have a variety of uses and come in various shapes and colors. When working in the plant, take care to read and obey any information tags you may find in an area before starting work.

- [DANGER] tags are used to ensure personnel safety or to prevent equipment damage. Operating a component with a [DANGER] tag attached can cause injury, death, or equipment damage.

Operations personnel perform all safety tagging activities in the plant. You should never hang, remove, or clear a safety tag unless it is done with the permission of the control room. If a safety tag is found that is not attached to a component, or is attached to the wrong component, notify the control room immediately. This could be a life-threatening situation.

Authorization must always be obtained from the control room before starting work on equipment or components having a safety tag attached to them.

Postings in the form of ropes, signs, and barriers are also used in the plant to warn you of potential safety hazards. You may see postings such as:

- trip hazard
- flammable material
- energized equipment

You are expected to follow all instructions posted in the plant for the safety of you and your coworkers.

Personal Protection Equipment

Industrial safety experience has shown that the individual has the most control over reducing on-the-job injuries. This experience also shows that most injuries will involve the head, feet, eyes, and hands. For this reason, the company will issue you personal safety equipment and expects you to use it as discussed in the following material.

Hard hats are to be worn at all times within (*). If you are not certain whether a hard hat is required, check with your supervisor.

Safety glasses are required [anytime hard hats are required]. Safety glasses must conform to ANSI and company standards. If you are not sure if your glasses meet these standards, check with your supervisor.

Substantial footwear must be worn in the plant anywhere hard hats are required. Shoes must also meet [ANSI and] company standards.

You must wear hearing protection (ear plugs or ear muffs) when working in a designated high-noise area. Being exposed to excessive noise without protection can result in an immediate or a gradual hearing loss. Since the effects of not using hearing protection may not be immediately observable, don't assume that hearing protection is not needed because you don't feel like your ability to hear is being reduced. Some employees may be required to take periodic hearing tests.

When performing work with your hands, wear gloves if there are rough surfaces or a possibility of slivers. Always be on the watch for pinch points. These are places where two surfaces come together and can pinch a finger or hand.

Plant Safety Equipment

The plant contains many types of industrial hazards. In some areas of the plant, you will find safety equipment installed near specific hazards and other equipment strategically placed for emergency use. This equipment should never be tampered with unless there is a real need for it.

Emergency showers and eyewash stations are located throughout the plant to wash spilled chemicals off your skin and out of your eyes. These stations may consist of either a portable squeeze bottle or a permanent eyewash/shower. The permanent eyewash station is activated by [either a foot pedal or hand lever]. The safety showers are activated by [either pulling on the chain or by your weight on the shower floor. Some of the showers are equipped with alarms that actuate with any use of the shower].

If you or a coworker needs to use an emergency shower, enter the shower, if the water does not turn on, pull the chain. Stay in the shower for at least [20] minutes if chemicals are involved. If you need to use the eyewash station, place your face near the water fountains and depress the foot/hand handle for [20] minutes.

If you are assigned to work in an area with a particular hazard, make sure you know where the safety equipment is and how to get to it before starting the job.

Asbestos

Asbestos is a fiber that was once popular for use in the fabrication of lagging, insulation gaskets, and other applications. After many years of use, it was discovered that asbestos could cause serious health problems. Any asbestos that was used during the construction of the plant has either been removed or labeled ["ASBESTOS"]. If you are directed to perform work in an area containing asbestos, inform your supervisor. Disturbing asbestos requires special training and permits prior to starting work.

Electrical Hazards

Many types of electrical power are used in the plant, and both alternating and direct current can cause injury. Electrical power used in the plant ranges from a few volts to thousands of volts.

Damaged electrical cords, a liquid leaking into electrical cabinets, missing ground plugs, and exposed wiring are just a few of the potential hazards of working around electrical equipment. Always use caution when working around any component that uses electricity.

If assigned to work on or around any exposed conductors or equipment that uses electricity, make sure it has been removed from service and safety tagged. Working on energized equipment is extremely hazardous and requires special authorization from management. Always assume all conductors, circuits, and equipment are energized.

Some conductors are imbedded in the concrete and other structures in the plant. If you need to drill into one of these structures, make sure there aren't any electrical conductors in it before you start.

Steam Leaks

As discussed earlier, one of the main products produced in the plant is steam. This steam is used in a variety of applications at pressures that range from one pound to over a thousand pounds. Occasionally, a steam leak will develop from a plant component such as a valve or pipe fitting. Some indications of a steam leak are:

- visible vapor coming out of a plant component
- whistling noise
- increased area temperatures
- moisture on walls or ceiling

You should always use caution when in an area containing a steam leak. Steam can cause burns if it comes in contact with your body. If you find a steam leak, report it to the control room or your supervisor.

Efforts are made to identify steam leaks by performing preventive and corrective maintenance and by periodic operator inspections. When leaks are identified, they are posted with warning ropes and signs.

Confined Spaces

Confined spaces may contain a life-threatening atmosphere. An area is referred to as a confined space if it meets all three of the following criteria:

- any space not intended for continuous human occupancy

- any space having a limited means of egress

- any space subject to the accumulation of an actual or potentially hazardous atmosphere or potential for engulfment

Some examples of a potential confined space are:

- storage tanks
- ventilation or exhaust ducts
- manholes
- underground utility vaults
- acid tanks
- tunnels

Open-top spaces such as pits, tubes, vaults, and vessels may also be confined spaces if the three criteria above are met. If you ever have to work in one of these spaces, check with your supervisor to make sure it is not a confined space.

Entry into a confined space is not permitted unless the requirements of the confined space permit are met and you have completed the confined space training program.

Heat Stress

Some plant areas can get extremely warm. The stay time, or the length of time permitted at a work site, may be limited to protect you against heat stress. Special clothing may also be required.

Heat stress concerns should be discussed with your supervisor. Plant procedures can provide guidance for stay times in those areas, based upon the temperature and humidity.

You can minimize the risk of heat stress illness by drinking plenty of fluids, using cooling devices such as fans and ice vests, and by limiting the amount of time you are exposed to the heat environment.

If you are working in a hot and/or humid area and begin to feel overheated or dizzy, inform your coworkers and move to a cooler area and rest. Notify your supervisor of the situation so that remedial actions can be taken.

Trip and Fall Hazards

When working in the plant, special care must be taken regarding hazards that can cause you to trip or fall. Steps at an unexpected place, pipes close to the floor, and low conduit trays are only a few examples of trip hazards.

There may be times when you will be required to work in the overhead or on elevated equipment. When working in a position where there is more than a [10] foot potential fall, [a safety line and harness are required].

Always be alert to what is in front of and below you.

Compressed Gases

Compressed gas cylinders can also present a safety hazard. These cylinders contain compressed gas that may be flammable or poisonous. The gases are stored outside whenever possible but should always be protected from the weather and direct sunlight. The following precautions should be observed when working with compressed gases:

- When you are working around a compressed gas bottle, stay clear of any relief or blowoff valves.
- If you are using compressed air for pneumatic tools or cleaning, be sure the hoses are in good repair, and do not direct compressed air at any part of the body.

- If using portable compressed gases, ensure the storage bottle is securely stored in an upright position.
- A compressed gas bottle must be moved by either a cart designed for compressed gas bottles or by rolling it and using the bottom of the bottle as a rolling point.
- Compressed gas cylinders shall be stored as neatly as possible in an upright position and secured to prevent falling.
- Do not store compressed gas bottles exposed to the weather or direct sunlight.
- The caps should always be in place when the cylinder is stored or moved.

Rotating/Moving Equipment

Many types of rotating equipment are in the plant. Some of this equipment operates intermittently. Examples are pumps, motor-operated valves, lathes, and cranes.

Your clothing and accessories should always be worn in a manner to promote safety. You should not wear loose clothing or jewelry that could get caught in moving machinery or equipment. Also pay attention to postings, and do not tamper with shrouds around moving shafts.

High Noise

As discussed earlier, there are some high-noise areas in the plant. In addition to the posted areas, areas where it is difficult to hear or converse should also be considered high-noise areas. As stated earlier, when in a high-noise area, ear protection is required. Company-provided ear plugs and ear muffs are available for use in the plant.

Falling Objects

Falling objects are also a potential hazard in the plant. Plant equipment, scaffolding, tools, and other objects are examples of what could fall and cause an injury. In some areas, objects can be 30 or more feet in the air. These hazards can be minimized through the use of equipment such as hard hats, scaffold toe boards, tool lanyards and good housekeeping. Also, when you are working in the overhead remember that there may be people passing below you.

Eye Hazards

Some activities in the plant can represent a serious eye hazard. Chipping, grinding, and welding are only a few examples of activities that require special eye protection. When involved in activities that may present a hazard to your eyes, wear your safety glasses and goggles or a face shield. If you have a need for other eye protection, discuss it with your supervisor.

Hazardous Chemicals

According to the Occupational Safety and Health Administration (OSHA), you have the right to know the potential hazards of any chemical you use. Chemicals used in the plant include acids, caustics, cleaners, and petroleum.

Some indications of a potential chemical hazard are:

- liquid spills
- labeled or unlabeled containers
- unusual vapors or odors
- posted chemical storage areas

When using a chemical, always follow the label's instructions and be careful not to deface the label on a chemical container. Never mix chemicals, and don't use a chemical if you're not sure what it is.

All chemicals used on site must have an Material Safety Data Sheet (MSDS) with the following information:

- physical hazards
- protective clothing needed
- storage requirements
- spill and leak procedures
- respiratory protection

You can obtain information about MSDS through [your supervisor].

Some plant areas have large quantities of very dangerous chemicals such as strong acids and caustics. These areas are posted and should not be entered unless you meet the entry requirements. If you need to enter a posted chemical area and are not sure if you are authorized, contact your supervisor.

To dispose of chemicals, (*)

The company employs methods such as training, labeling, a chemical control program, and protective equipment to reduce the risk of chemical injuries.

Hazardous Waste Operations and Emergency Response

Hazardous Waste Operations and Emergency Response (HAZWOPER) regulates the safety and health of employees involved in any emergency response to incidents involving hazardous substances.

If you believe a spill or release of a hazardous chemical and/or substance has occurred, notify the control room immediately.

The Resource Conservation and Recovery Act (RCRA) was established to properly manage, dispose of and minimize hazardous wastes in the United States. Hazardous waste can be solid, liquid, or gaseous. Not all wastes are hazardous. Common hazardous wastes are paint solvents, degreasers, and outdated chemicals. These types of wastes are sent to licensed recycling plants or treatment and disposal facilities. RCRA contains specific waste-handling regulations with harsh penalties for violators. To avoid any violations and to help keep our environment clean, you must be aware of the type of wastes that are generated from your work, the rules that regulate these wastes, and the need to properly dispose of any waste when the job is done.

Industrial Safety Policies

Earlier we discussed personal protective equipment. It is also important to wear this equipment properly.

A hard hat should be worn with the sides parallel to the ground and the bill in front. It should not have holes or cracks or any conductive material on the outside. The suspension on the inside of the hard hat should be periodically checked for fraying and tears.

Eye protection must meet ANSI and company requirements to protect from flying particles/debris and be shatterproof. Safety glasses with side shields, safety goggles, or face shields may be needed to meet these requirements. Your eye protection should be inspected periodically for scratches and cracks that may obscure vision or lessen protection. Additionally, you should clean your eye protection to prevent obscured vision.

Safety shoes in good condition should not have any of the following:

- crushed toe guard
- cracked, split, or cut outer covering
- cracks or holes in the soles
- slick heels or soles

They should fit comfortably to ensure proper support and protection.

Any safety incidents, injuries, or violations of industrial safety policies will be evaluated and discussed with the individual's supervisor. Disciplinary actions for blatant safety violations may include suspension or possible termination.

Fire Protection

Fire Protection

Upon completion of this section, you should be able to minimize the potential for causing a fire and properly respond to a fire should one occur.

To do this, you should be able to:

- State your responsibilities regarding fire barriers such as fire dampers, doors, and seals.
- State actions you are required to take upon discovery of a fire.
- State your responsibilities regarding the control of fire loading (wood, solvents, oil) and the disposal of flammable materials.
- State examples of the types of hot work requiring a permit.
- Recognize and state the response to a station fire alarm.*

Fire Barriers

Fire barriers are required by federal law and are designed into the plant to limit the spread of a fire and to restrict the movement of smoke and gases. A fire barrier penetration is an opening in a fire barrier such as a floor, wall, or ceiling for the passage of conduit, cables, cable trays, piping, HVAC ducting, dampers, equipment, which has been sealed to maintain a fire barrier rating. If you discover a problem with a fire barrier, immediately notify the control room.

Fire doors are specially marked doors that allow passage through a fire barrier. If you pass through a fire door, *always* self-check to make sure the door closes completely behind you.

If you have to leave a fire barrier open for a period of time, check with [your supervisor] before beginning.

Discovering a Fire

If you should discover a fire, report it to the control room immediately using the plant page, radio, or telephone at extension (*). Make sure you stay on the line until the control room acknowledges the information has been received.

- Inform the control room of the location and source of the fire if you know.
- Upon notification, the control room will [activate the fire alarm and] announce the location of the fire. The station fire brigade will respond to the alarm. The fire brigade is responsible for providing quick assessment and suppression of fires.

- [After reporting a fire, stand by in a safe location and be prepared to advise the fire brigade of any personnel still in the area, work evolutions in progress, hazards that may be in the area (for example, flammable liquids, energized components), and possible source of the fire.] If others are in the area, warn them of the fire. If no further assistance is needed, you should leave the area.

- Do not attempt to fight the fire [unless it is clearly within your ability to extinguish]. Wait for the fire brigade to arrive to put the fire out. Fighting a fire in the plant may not be as easy as it appears due to the electrical hazards, nuclear safety concerns, and chemicals that can be involved.

Fire-suppression systems may use chemicals such as carbon dioxide and halon in several areas of the station where there is the potential for serious fires. Carbon dioxide or halon can cause you to suffocate should you remain in the area. Should you be in an area when one of these systems activates, leave the area immediately and report it to the control room.

Hot Work

Work in the plant involving an open flame, welding, or grinding requires a special work permit. These permits must be obtained prior to starting the work. If you are not sure if a job requires a permit or how to obtain a permit, discuss it with your supervisor.

Personnel may be assigned to fire-watch duties whenever work activities present a fire risk or when a fire system is out of service. To be qualified for fire-watch duties, further training is required.

Fire Loading

A transient fire load is any combustible or flammable material that is temporarily installed or stored in the plant. Any flammable material, such as fuel or lubricants, must be stored in special fire-rated cabinets. Consult your supervisor and the proper procedure before storing combustible material in any area of the plant, including your work area.

Limit the amount of flammable material to the amount needed to do the job. Limiting the amount of flammable material will not only reduce the fire hazard but will also save on material that will need to be disposed of. All combustible material must be removed at the [end of the shift] from all safety-related areas unless special permission is obtained.

Wood used in the plant must be fire-retardant, unless written permission is obtained to use another type of wood. Fire-retardant treated wood is distinctively marked, most often with a [blue or green] coating.

Fire Alarms

Various types of horns, buzzers, and bells are located throughout the station. These are warning alarms for the various local fire systems. If you should hear any of these alarms, leave the area immediately and notify the control room. Do not use an elevator in the same building as the fire.

The fire brigade will respond to the fire. All other personnel should stay out of the area once the fire brigade arrives.

Should you hear the station fire alarm, listen to the instructions and follow them.

Quality Assurance and Quality Control

The Quality Program

Upon completion of this section, you should be familiar with the purpose of the quality program, how the program is accomplished, and how to report quality-related problems.

Quality Assurance

You should be able to:

- State the function of the quality assurance [(QA)] Program.
- Identify individual responsibilities with regard to QA.
- State the authority of QA.
- State the purpose of QA audits and surveillances.

[Quality Control]

You should be able to:

- State the function of the [quality control (QC)] program.
- State basic worker responsibilities regarding [QC] hold points.
- State the authority of [QC] inspectors.
- State company policy on harassment of [QA/QC] personnel.

Reporting Potential Items of Noncompliance

You should be able to:

- Identify potential items of noncompliance.
- State how to report items of noncompliance.*
- Explain how to report nuclear safety concerns to the Nuclear Regulatory Commission (NRC).

Background

The Code of Federal Regulations (10CFR50) requires a nuclear power station to have a quality assurance (QA) program. The function of the quality assurance program is to plan and perform activities to verify that the plant is meeting the requirements contained within the federal regulations. These activities include the review of written documentation, programs, procedures, and management involvement. This program strengthens quality measures on equipment and activities that can affect the safe, reliable, and economical operation of the station.

Quality Assurance

Quality assurance personnel verify quality and accompanying documentation. They do not supervise work but provide an independent check of completed work through the review of paperwork and some types of plant activities. This may involve an inspection at a job site or an audit of records.

A comprehensive system of planned and periodic audits and surveillances is carried out to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program being audited. Surveillances are observations of activities and hardware and/or the review of documentation to verify conformance with specified requirements and to evaluate their adequacy and effectiveness.

Worker Responsibilities

In striving for excellence in nuclear power plant operations, individuals within the various line and support organizations are held responsible for the quality of their work. Pride of craftsmanship and the desire to accept nothing less than a quality product should be your goal, as well as your supervisors' goal. You are responsible for performing your job in a quality manner and doing every job right the first time.

QA Authority

Since the NRC requires the quality assurance function, any threat, assault, or interference with an inspector while performing his job is a federal offense punishable by a fine and/or imprisonment. It is also important to remember that quality assurance personnel have the authority to stop a job if there are any questions concerning any aspect of quality.

[Quality Control]

Quality control [(QC)] is a function within the quality program. [QC] checks and tests verify that preestablished characteristics have been met. A quality assurance inspector may observe the entire job, or review the documentation of the job, whereas a quality control inspector may only monitor a specific step in a job.

[Quality control] inspections verify compliance with the documented instructions, procedures, and drawings for accomplishing an activity. To ensure quality work, activities may require a [QC] inspector to perform:

- examinations
- measurements
- tests of materials or products processed
- work observations

Procedures have been established for the control of materials, parts, and components that do not conform to specified requirements to prevent their inadvertent use or installation. Nonconforming items may be identified:

- by station personnel performing work in the plant
- during the QA receipt acceptance inspection process
- by receipt of an NRC IE Notice or Bulletin

[QC] Hold Points

When using a procedure, you may encounter a ["QC hold" or "QC witness"] point. Either of these requires you to contact [QC] so that the step can be observed. The [QC] inspector has the option of observing or not observing a step with a [QC] witness point. However, all [QC] hold points must be observed. Therefore, if you encounter a [QC] hold point in a procedure (including work packages), you are required to stop until a certified [QC] inspector performs an inspection. It may help to call [QC] ahead of time to avoid having to wait for an inspector.

Willful violation of a [QC] hold or witness point is a serious action and is subject to discipline up to termination of employment.

QC Authority

Like the QA inspectors, [QC] inspectors are protected by federal law from any threat, assault, or interference in the performance of their job. They also have the authority to stop any job in progress if there is any concern with quality.

Reporting Potential Items of Noncompliance

A noncompliance item is any item that does not meet regulatory requirements. Examples of reportable items include:

- an incorrect part installed
- a safety-related valve out of position
- use of an outdated procedure on a safety-related component
- a fire barrier that has been left out of position

A specific list of noncompliance items can be found in the plant administrative procedures that govern this program.

Plant management encourages you to report any potential problems that you may find. Identifying and resolving problems are key ingredients for a successful plant. If you discover a problem in the plant, you should:

- Discuss the problem with your immediate supervisor.

- Document the problem with (*).

- If the results are not satisfactory, contact a member of the QA department management team.

- If the results are still not satisfactory, you may wish to contact the NRC with your concern.

NRC Form-3

Several copies of NRC Form-3 are posted throughout the plant. This shows a map of the United States and the NRC regions. At the bottom of this form are the phone numbers for the various region offices. Look at the map to determine what region the plant is in and then look at the bottom to find the phone number for that region. Any worker at the station has the right to request an NRC inspection.

NRC Response

If a request for an NRC inspection is made, the NRC will:

- Keep the complainant's identity anonymous.
- Protect the complainant from being discharged by the licensee for filing the complaint.
- Notify the complainant in writing if the complaint is rejected because no reasonable grounds exist.

Interfacing With the NRC

It is our policy to provide complete and accurate information to the NRC in all our communications and to do so in a timely manner. We expect all employees to conduct themselves with both openness and a cooperative spirit. Any action taken by an employee or contractor to willfully violate NRC requirements, or to cause the company to be in violation of NRC requirements, will be deemed as willful misconduct. These actions may include, but are not limited to:

- recognizing a violation of procedural requirements and not taking corrective action
- falsifying records
- willfully providing, or causing someone else to provide, the NRC with inaccurate or incomplete information
- willfully withholding safety-significant information from supervisory personnel
- submitting false information to gain unescorted access to a nuclear station

Willful misconduct by any employee or contractor will not be tolerated and may result in the following:

- disciplinary action up to and including termination
- civil penalties to include fines and/or imprisonment

Plant Security

Plant Security

Upon completion of this section, you should be able to enter and exit the plant and comply with plant security requirements.

To do this, you should be able to:

- State the purpose of the station security program.
- Identify areas of the station that are controlled by security including the owner-controlled area, protected area, and vital areas.
- Recognize the types and purpose of each type of photo identification badge in use at the plant.*
- Describe the procedure for entering and exiting the station.*
- Describe the procedure for entering and exiting security doors such as those used for vital areas.
- State when security personnel may perform physical searches.
- State where and when photo identification badges will be worn and the actions to be taken if lost or found.
- Identify materials/items that are prohibited in the owner-controlled area or the protected area.*
- Describe escorting responsibilities.
- State the action(s) to be taken upon discovery of an unescorted visitor or an individual without a security badge.
- State individual roles and responsibilities regarding the plant security program.
- Define "tailgating" and explain why it is not allowed.

Purpose of Security

The purpose of security at the station is to protect the health and safety of the public. This is accomplished by the following:

- protection against radiological sabotage

- protection of plant personnel
- protection of company assets

Security Areas

The station is divided into three designated areas for security purposes. These areas are:

- owner-controlled area—This is all the land located outside the plant [double] fence line barrier belonging to the company. Access is normally limited to persons entering for official business.

- protected area—This is the area inside the [double] fence line. It can be thought of as the plant and all the area inside the security fence.

- vital areas—These are areas within the protected area that house safety-related equipment. The failure or destruction of this equipment could directly or indirectly endanger the public health and safety by exposure to radiation.

Just as access to the plant is controlled, so is access to the vital areas. You must be authorized to enter any of these areas. If you need authorization, contact your supervisor.

Protected and vital areas must be secured at all times. Any maintenance activity that may cause a breach of the area boundary must be reported to security in advance, and a security officer must be posted until the situation is corrected. Any employee who finds an opening in an area boundary that is not guarded should notify security.

Security Badges

The station uses security badges for access and identification purposes. In general, there are two types of security badges:

- a visitor badge—The visitor badge does not require any background investigation or training. However, anyone wearing a visitor badge must be escorted by an authorized individual while inside the protected area.

- a badge that allows unescorted access to the plant—The specific areas of the plant that may be entered are based on the need of the individual and completing this training.

Wearing a Badge

All security badges must be displayed facing out on the upper front portion of your body on the outer garment at all times. If you lose your security badge, you should check the immediate area first. If you are unable to locate the badge, notify security immediately and wait for the security officer to arrive.

If you find a lost badge, you should notify security immediately. No one is allowed into the protected area without his or her security badge. No one is allowed to use your badge; therefore, control of the badge is essential.

Prohibited Items

All employees on company property are subject to a search at any time. These searches are conducted to detect items such as the following:

- explosives
- weapons
- incendiary devices
- alcohol
- drugs
- fixed blade knives not normally used in work
- Mace
- ammunition

Searches

All searches are by implied or expressed consent. Signs are posted near the entrance to the station explaining that employees are subject to search. Passing these signs is implied consent.

Consent may be withdrawn at any time. If an employee refuses to be searched, the employee will be escorted off company property and will be subject to termination.

Random searches may be conducted on badged individuals at the discretion of security. Personal vehicles may be searched at any time while on company property.

Entering the Protected Area

You must use the following procedure for entering the protected area:

[Note: Order may need to be changed to reflect site-specific layout.]

- Enter through the security building at the designated entrance.

- Place all hand-carried items on the conveyor belt for the x-ray machine.

- Proceed through the special purpose detector (for explosives and weapons detection on the person). Failure to clear these detectors after two attempts requires that the individual be subject to a hands-on search prior to entry.
- State your badge number to the security officer at the badge issue window.
- State your name to the security officer.
- Upon receipt of your badge, verify that you have received the correct badge, and proceed to the turnstile entry.

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*Exiting the Protected Area**

(*)

Entering and Exiting Vital Areas

Personnel requiring unescorted entry to vital areas must possess a security badge and be properly zoned for that area. Visitors needing to enter a vital area must be escorted by an authorized individual. If you are not certain if you have authorization for unescorted entry into a vital area, check with [security] before attempting to enter.

If you are qualified, the following procedure must be used to enter and exit a vital area:

- (*)

Security Violations

Following another person into a vital area without properly accessing the area is called tailgating. Tailgating is strictly forbidden. Always use your key card to access a vital area. Failure to use your key card to access the area bypasses the security measures put in place and may also make personnel accountability more difficult in the event of an emergency.

In general, the following are other common security violations:

- holding a door open too long or improperly closing a door
- [failing to use the card reader when entering and then attempting to use the card reader to exit]
- opening a vital area door without authorization
- tampering with any security-related alarm equipment

- using the card reader to enter, then failing to exit properly
- opening an emergency exit

Vital area doors left open for an extended period of time must have a security officer posted at the door. Removing a door from service requires authorization from security.

Escorting Visitors

All visitors must be escorted into the protected area and vital areas. An escort must be an authorized badged employee with unescorted access for the area the visitor needs to enter. Escorting visitors is a serious responsibility. If assigned the task of escorting visitors, you must:

- Make sure the visitor is properly wearing the visitor's badge before leaving the security area. The badge should be visible, on the front part of the body, about chest high.
- Maintain visual contact and control of the visitor at all times. The visitor may enter a bathroom or locker room unescorted if there is only one entrance/exit and the entry/exit is observed by the escort.
- Ensure the visitor does not enter any radiological area unless authorized.
- Ensure the visitor follows all plant policies and procedures.
- Escort no more than [10] visitors. Additionally, you cannot escort any more than [5] visitors in any vital area.

When the visit is over, return the visitor(s) to the security access point and do not leave until you are positive that the visitor(s) has either left the protected area or is being escorted by security personnel.

Transferring Visitor Responsibility

Should you ever have to transfer a visitor to another individual, ensure that the new escort is qualified and willing to accept escort responsibilities. [Additionally, you must (*).]

Improper escort of a visitor can result in access privileges to the protected area being revoked for an indefinite time.

Actions for an Unescorted Visitor

If you ever find an individual with a visitor's badge who does not appear to have an escort:

- [Escort the individual to security and] inform a security officer of the problem.

- If the individual refuses to cooperate, notify security. Do not attempt to force the individual to comply with your instructions.

[Emergency Plan]

Emergency Response/ Preparedness

Upon completion of this section, you should be able to properly respond to an [emergency plan] activation.

To do this, you should be able to:

- State the purpose of the [emergency plan].
- State the classifications of station emergencies.
- Recognize the emergency alarms, and state the proper response for each.*
- State the actions required during [emergency plan] implementation.
- State the purpose of accountability during an emergency.
- [State the location of the employee's assigned assembly area.]*
- Discuss evacuation plans, including identification of evacuation routes.*
- State the company's policy concerning the release of information to the public and news media regarding an emergency.

Purpose

The purpose of the [emergency plan] is to provide for the radiological protection of the public, employees, and the plant if an unplanned event occurs at the station. The [emergency plan] for all nuclear plants is very similar with minor variations due to design, location, and organization.

The Code of Federal Regulations (10 CFR 50) requires that a nuclear power station have an approved [emergency plan] before an operating license is issued.

Emergency Classifications

There are four emergency classifications in the [emergency plan]. These are listed in order from least severe to most severe:

- [notification of] unusual event
- alert
- site area emergency
- general emergency

An emergency will initially be declared based on plant conditions and information received in the control room. As conditions change, an emergency may be escalated or de-escalated from one classification to another.

Personnel on the control room team initially classify the event and assume the role of emergency director until relieved by station management.

Employee Response

The station may go into a [notification of unusual event] status without making all personnel aware of it. This happens occasionally, and the only people who realize it are those directly concerned with the situation. State and local governments and the NRC are notified of the event. It is at the next classification—the alert—that the station begins to change into an emergency organization.

If station management declares an alert, or a higher classification, an announcement will be made informing you of the circumstances and any required action. If a site [area] emergency is declared, [the site emergency alarm will sound and you will be directed to the assembly areas].

If a general emergency is declared, the [site emergency alarm] will sound as well as the off-site emergency sirens. All station personnel who are not part of the emergency response organization will be directed to evacuate the site and to go to the remote assembly area.

In any of the [emergency plan] classifications, your responsibility is to listen to and respond to the announcement(s) that is made on the plant page system.

Evacuation Process

If emergency management determines that an evacuation of nonessential site personnel is necessary, the alarm will sound and an announcement will direct personnel to report to [the designated remote assembly area].

Should an announcement be made, you should:

- Place any equipment that you may be using or a task in which you may be involved in a safe condition.
- If you are escorting visitors, escort them to [security].
- If you are working in the [radiologically restricted area], you should exit [using normal procedures].

[If immediate evacuation is required, accountability will be determined by security by collecting security badges from personnel exiting the protected area.] This process gives plant management a method to account for the location of all personnel who are or were inside the protected area and will also ensure the well-being of all personnel.

Upon hearing the announcement, you should:

- [Take the shortest and safest route to the designated exit.]
- [Leave your security badge at the exit.]
- Proceed to the designated area using appropriate transportation. [Provide site information of the locations of the assembly/evacuation areas*.]
- (*)
- Proceed to the following designated remote assembly area(s). [Provide information here on the location and route to the remote assembly areas.*]

Security and radiological protection personnel will have personnel available for accountability and radiological control.

Other Emergency Information

During a radiological emergency, emergency management may implement a policy of no eating, drinking, or chewing. This would be a precautionary measure to assist in the radiological protection of employees.

A spokesperson will also be designated to release information to the public and the media. If anyone asks you for information, refer him/her to this designated company spokesperson.

Your family may obtain information during an emergency by listening to the radio (Emergency Broadcast System) and by calling the telephone number given during the announcements. It is important that they do not try to call the station since those lines will be needed for emergency response.

Radiological Orientation

Radiological Orientation

Upon completion of this section, you should be familiar with the radiological restrictions placed on nonradiation workers, and some of the basic risks associated with radiation.

To do this you should be able to:

- Define "radioactive material," "radiation," "contamination," and "dose."
- State the difference between radioactive material, radiation, and contamination.
- Define the term "background radiation."
- Contrast the average amount of radiation received by radiation workers and members of the general public.
- State the purpose of the thermoluminescent dosimeter (TLD) and whole-body contamination monitor.
- Identify potential long-term effects from exposure to low levels of radiation.
- Contrast the risk of working in a nuclear facility to the risk in other industries.
- State the colors and symbols used on radiological postings.
- Identify the methods used to identify radiological areas (for example, signs, ropes, tape).
- State the action(s) to be taken if a radiological area or radioactive material is encountered.

Definitions

All matter, such as trees, rocks, air, and water, is composed of atoms. These atoms combine to form the different elements of nature. Sometimes, however, an atom may become unstable. When this occurs, an atom will emit packets of energy or particles, called radiation, in an effort to become more stable. This means that:

- Radioactive material is any material that emits radiation as it decays.

- Contamination is radioactive material anywhere it is not wanted.

- Dose is the amount of radiation absorbed by the body or a particular organ.

Background Radiation

Radioactive decay is part of nature. We are continuously being bombarded with low levels of radiation from both natural and man-made sources. This radiation is called background radiation. The average person in the United States receives about 200 mr per year. The amount of radiation received depends on geographical location, altitude, and other factors. A few examples of things that contribute to background radiation exposure are:

- natural radioactive materials in the earth's crust (varies with geographic location)

- weapons testing fallout

- cosmic radiation

- man-made products (for example, luminous watch dials, gas mantle)

- the amount of potassium 40 in the body

Radiation is not limited to nuclear plants but surrounds us due to the activity of the atom.

Radiation Monitoring Devices

Several types of radiation monitors are used in a nuclear power plant. Each has a particular purpose and application. For the nonradiation worker, there are only a few of these instruments that are of any concern. These are as follows:

- The thermoluminescent dosimeter (TLD) is a small device that is used to record the amount of radiation an individual is exposed to when in a radiation area. The TLD is used for the permanent dose records of all radiation workers on site. It is worn on the front of the body about chest high.

- The whole-body contamination monitor is a device that you walk through on the way out of the controlled access area. This device checks all personnel leaving the site for radioactive contamination.

Health Effects of Low Levels of Radiation

Research has shown that there is an increase in the risk of cancer and other potential illnesses due to exposures to high levels of radiation. Therefore, scientists feel it is prudent to assume that there may be a risk associated with low levels of radiation. Because of this, the federal government has established limits that are low enough to minimize this risk. As mentioned earlier, the average person receives about 200 mr of background radiation per year. This compares to about 500 mr per year for a nuclear power plant worker.

Nuclear Power Plant Risks

The delayed effects of radiation exposure, such as cancer, are not a certainty but are expressed in terms of increased risk. Risk can also be expressed in terms of life expectancy.

Estimated Loss of Life Expectancy From Industrial/Health Risks**

Health and Safety Risk	*Estimates of Days of Life Expectancy Loss (Average)*
Smoking 20 cigarettes a day	2,370 (6.5 years)
Overweight (by 20 %)	985 (2.7 years)
All accidents combined	435 (1.2 years)
Mining and quarrying	328
Construction	302
Agriculture	277
Radiation dose of 5 rem/yr for 50 years	250
Auto accidents	200
Transportation and Utilities	164
Alcohol consumption (U.S. average)	130
Home accidents	95
All industrial hazards	74
Industrial accidents at nuclear facilities (nonradiation)	58
Manufacturing	43
Radiation dose of 0.65 rem/yr. (industrial average) for 30 years, calculated	20
Natural background radiation	8
Medical diagnostic x-rays (U.S. average), calculated	6
All catastrophes	3.5

*(** Adapted from Regulatory Guide 8.29, and Cohen and Lee, "A Catalogue of Risks", Radiological protection, Vol. 36, June 1979.)*

Postings

As you work in the plant, you may see a posting that has a yellow background and a black or magenta foreground. These signs will also have a trifoil symbol on them. The postings are usually in the form of signs but can also be in the form of a yellow and magenta rope or tape. If you see a posting like this, it means that there is some type of radiological area behind the sign or posting. Only personnel who have been trained to enter a radiological area are allowed to do so.

Therefore, unless you have had Basic Radiation Worker Training, do not enter any of these areas. This includes reaching into one of these areas to retrieve a tool, removing a manway cover with a sign on it, working on a pipe that has yellow and magenta tape on it, or entering a radiological area to pick up trash.

Radiation

Sources of Radiation

Upon completion of this section, you should be familiar with the sources of radiation.

To do this, you should be able to:

- State the basic structure of an atom including the three primary components.
- Describe how radiation results from the nuclear process.
- List the sources of radiation in the plant including the following:
  — reactor coolant
  — activation and corrosion products
  — plant components
  — reactor operations

Atomic Structure

All things consist of matter, which, in turn, is composed of atoms. Atoms are defined as the smallest part of an element that retains the characteristics of the element. Atoms are so small that they cannot be seen, even using a microscope. The atom is composed of three major parts: the neutron, proton, and electron.

Neutrons and protons form the nucleus of an atom. These two particles are approximately the same size. The particles differ in that protons have a positive electrical charge, and neutrons have no electrical charge. The number of protons determines what the element is, for example, oxygen or iron.

Surrounding the nucleus is an electron cloud composed of electrons in orbit. The number of electrons generally depends on the element and usually equals the number of protons. The electron has a negative electrical charge.

Radioactive Decay

Radioactive material may be defined as any material that emits radiation as it decays. Some atoms may become unstable due to the number of protons, neutrons, and electrons not being correctly balanced. Since atoms "like" to be stable, they will emit packets of energy or particles to attain that stability. This emission is called radiation.

Certain forms of radiation can cause the ionization of atoms. One form of ionization of an atom is simply the removal of one of its orbital electrons. When an electron is removed, two charged particles result. These are the electron that escaped from its atom and is electrically negative, and the rest of the atom, which bears a net positive charge (it now has more protons than electrons). The positively charged atom and the negatively charged electron are called, collectively, an ion pair.

Sources of Radiation

The plant contains many potential sources of radiation. Just a few examples include the following:

- water that has been in the reactor
- corrosion products that have been exposed to radiation such as cobalt and iron
- reactor fuel
- reactor operations causing radiation
- filters that have had reactor coolant flowing through them
- Reactor components that have been exposed to radiation

Types and Measurement of Radiation

Upon completion of this section, you should be familiar with the basic types of radiation found in a nuclear plant and some of their characteristics.

To do this, you should be able to:

- State the four types of radiation found in a commercial nuclear power plant.
- Characterize the four types of radiation by the following:
  - — penetrating ability
  - — methods of shielding
  - — exposure hazard (for example, whole body, skin, eyes)
  - — where found
- Define dose rate.
- Define total effective dose equivalent (TEDE).
- Perform conversions from rem to millirem and from millirem to rem.

Types of Radiation

In a commercial nuclear power plant, there are four primary types of ionizing radiation. It is called "ionizing" because when an atom interacts with some types of radiation, there can be an effect on the overall electrical charge of the atom. When this occurs, the way the atom reacts with other atoms is changed.

The types and characteristics of these four types of radiation are discussed below.

Alpha

The characteristics of an alpha particle include:

- It's the same as a helium atom without electrons—two protons and two neutrons.
- Has a plus two electrical charge.
- Has the least penetrating power. Travel in air is just an inch or two.
- The major source of alpha particles is the nuclear fuel.
- Can be shielded by a piece of paper, by the dead layer of skin on the surface of the body, or clothing.
- Alphas are primarily an internal hazard.
- Can result in high dose to a sensitive organ.
- When its energy is expended, it attracts two electrons and becomes a helium atom.

Beta

The characteristics of a beta particle are:

- Originates from the nucleus of an atom.
- Penetration in air is usually limited to a few feet, but it has more penetrating power than an alpha particle. It normally can only penetrate a few layers of skin.
- The source of most beta particles is from activated corrosion and fission products.
- The best shielding is a few layers of lightweight plastic or light metal.
- The eyes and skin can be affected by beta radiation.

- Personnel must work close to a beta source to receive much exposure.

Neutron

The characteristics of a neutron are:

- It is part of the atomic nucleus that has been freed by decay or fission.
- There is no electrical charge.
- It is very penetrating.
- Source is nuclear fission.
- It is best shielded by water, concrete.
- Neutron exposure is mainly a problem when personnel enter the containment when the reactor is operating. Because it has high-penetration capabilities, it gives a whole-body dose.

Gamma

The characteristics of a gamma are:

- Has no mass or electrical charge—it's pure energy.
- Is a very penetrating form of radiation; penetrates the whole body.
- Sources include fission, fission products, and activation products.
- Most dose at the station is from this type of radiation.
- Is best shielded by very dense material; usually lead, steel, and concrete is used because of availability and cost.
- Because of the penetrating ability, gamma radiation also gives a whole-body dose.

Dose Rate and TEDE

In plant access training, dose was defined as "the amount of radiation absorbed by the body or a particular organ." Dose rate is the amount of dose received in a specified period of time. Dose rate is usually given in units of mrem per hour. Dose is determined by multiplying the dose rate and the time exposed to the radiation. For example, if you spend 4 hours in an area with 12 mr/hr, your dose would be 48 mr.

The amount of radiation dose you receive is called the total effective dose equivalent (TEDE). It is determined by adding the external dose to the internal dose and is corrected for the type of radiation. Your dose is in units of rem, which is a measure of any type of ionizing radiation in terms of the estimated biological effects and is used to measure dose.

Converting rem and millirem

Since measurements of radiation are frequently in very small fractions of rem, the prefix milli, meaning 1/1000, is used with these units.

To convert rem to millirem (mr), multiply the number of rem by 1,000 or move the decimal point three places to the right. For example, 1.3 rem would be 1,300 mr.

To convert from mr to rem, divide by 1,000 or move the decimal point three places to the left. For example, 2,700 mr would be 2.7 rem.

Biological Effects

Biological Effects

Upon completion of this section, you should be aware of the risks associated with radiation.

To do this, you should be able to:

- State the effect of radiation on cells.
- Define "chronic radiation exposure" and the associated risks.
- Define "acute radiation exposure" and the associated risks.
- Define "genetic" and "somatic" effects.
- Compare somatic versus genetic effects of radiation exposure.
- Identify the possible effects of radiation on an unborn child due to prenatal exposure.
- Compare the radiosensitivity of different age groups.
- State the purpose to NRC Form-4.

Effects on Cells

The human body is composed of millions of cells that, through natural processes, are always dying and being replaced by new cells. Excessive exposure to radiation may cause permanent damage or destruction of cells. Radiation causes cell damage by ionizing atoms and molecules in the cell, thus disrupting normal cellular chemistry, and by damaging chromosomes in the cell nucleus, thus impairing the cell reproductive process.

Four things may happen when cells are exposed to excessive amounts of ionizing radiation:

- nothing
- cell damage
- cell death
- cell mutation

Generally speaking, radiosensitivity increases as the cell's division rate and metabolism rate increase. For example, a child is much more sensitive to radiation dose than an adult.

Radiation exposure, both internal and external, can cause adverse effects on the body. The effect on the body depends on:

- area or organ of the body exposed to radiation
- type of radiation exposure
- length and amount of exposure

Acute/Chronic Exposure

Exposure of an individual to radiation may occur over a short period of time or over months or years.

- A series of small exposures spread out over months or years is chronic exposure. Scientific studies show that there may be an increased chance of developing health effects such as cancer from chronic exposure to low levels of radiation. A member of the general public receives about 200 mr per year of chronic radiation, depending on the area of the country and other factors.

- An exposure received in a short period of time, usually less than 24 hours, is called an acute exposure.

The following chart shows the probable effects of an acute radiation exposure as determined by one authority. Other reliable sources may have different opinions as to the effects of these levels of radiation.

Prompt Effects of Acute Radiation Exposure

Acute Dose (rem)	*Probable Clinical Effect*
0 - 25	No observable effects.
25 to 100	Slight blood changes, no other observable effects.
100 to 200	Vomiting may occur in 5 to 50 percent within three hours, with fatigue and loss of appetite. Moderate blood changes are likely. Except for the blood-forming system, recovery will occur in essentially all cases within a few weeks.

200 to 600	Vomiting, fatigue, and loss of appetite occur in 50 to 100 percent within three hours. For doses over 300 rads, these effects will appear in all cases within two hours. Loss of hair after two weeks. Other effects include severe blood changes, accompanied by hemorrhage and infection. Death occurs in 0 to 80 percent within 2 months; for survivors, recovery period is one month to a year.
600 to 1000	Vomiting occurs within one hour. Severe blood changes, hemorrhage, infection, and loss of hair. Death occurs in 80 to 100 percent within two months; survivors convalesce over a long period.

The above effects are based on:

- exposure to the entire body
- exposures to the entire population
- no medical treatment

(Adapted from: S. Gladstone, Sourcebook on Atomic Energy)

Somatic and Genetic Effects

Somatic effects are effects of radiation that take place in the exposed individual. There are two classes of somatic effects: prompt and delayed.

- Prompt effects may occur in a time range from immediately following the exposure up to several months following the exposure. Prompt effects are generally considered the result of a large acute exposure.

- Delayed effects do not occur until months or years following an exposure. This delay in time creates a problem in linking the exposure with the delayed outcome since the delayed effects may be caused by many influences other than the radiation exposure. Thus, there can be no positive assignment of the cause in most cases. Delayed effects may result from acute or chronic exposure. Some of the known delayed effects of radiation are cancer and cataracts.

Genetic effects appear in future generations of an individual who received the dose. Genetic effects cause damage to genetic material and may appear as birth defects or other conditions in the future children of an exposed individual and succeeding generations.

Effects on an Unborn Child

Teratogenic effects may be observed in children who were exposed to radiation during the fetal and embryonic stages of development. These effects may slightly increase the chances of effects such as death, structural abnormalities, abnormal growth, and mental retardation. Due to the slight increased risk of teratogenic effects from exposure to ionizing radiation, regulations contained in 10CFR20.1208 are observed within the industry. This document restricts the amount of dose a pregnant female who has notified management of her condition can receive. These limits will be covered later.

Effects of Age

As previously discussed, the faster the cell-reproduction rate, the more sensitive the body or organ is to ionizing radiation. As a person ages, most cell-reproduction rates slow. Therefore as an individual ages, he/she becomes less sensitive to radiation.

NRC Form-4

Dose received at another nuclear facility must be recorded and included in the accumulated dose for the individual and applied toward the exposure limit. A special form required to be completed documents all previous occupational exposures. This form is NRC Form-4. Before you will be allowed to work as a radiation worker, you must have a completed and signed NRC Form-4 (or company equivalent) on record. It is your responsibility to ensure all exposure is reported to the company prior to starting work in the plant. This is also true if a company employee visits another nuclear facility. This form is also used to document all your dose.

Limits and Guidelines

Limits and Guidelines

Upon completion of this section, you should be aware of the federal and plant administrative limits on radiation dose.

To do this, you should be able to:

- State the federal radiation dose limits for total effective dose equivalent (TEDE), for the skin, extremities, and lens of the eye.
- State the possible consequences if any federal radiation dose limit is exceeded.
- State the plant administrative limits/guidelines for radiation dose.*
- State the actions to be taken if ad[illegible]rative dose limits are being approached.*
- State the federal and plant administrative limit/guideline for the embryo/fetus.*
- State the rights of a declared pregnant female.*
- Recognize the definition of a planned special exposure.

Federal Dose Limits

Radiation dose limits are set by the United States Nuclear Regulatory Commission (USNRC). These legal limits are based on the present understanding of the biological effects of radiation.

The limits are set low enough to prevent prompt effects, to minimize delayed effects, and to ensure that risks due to radiation exposure are comparable with other industrial risks.

Since effects on some parts of the body are greater than those to other parts, the USNRC has divided the body into different areas.

Title 10 Code of Federal Regulations, Part 20 states that no licensee shall allow any individual to receive a total occupational dose in excess of the standards specified in the following table:

Area of Concern	*Rem per Year*
Skin - of whole-body regions	50
Extremities - hands and forearms; feet and ankles	50
Internal Organs	50
Lens - of the eyes	15
Whole-body - head and trunk; active blood-forming organs; and gonads (TEDE)	5
Pregnancy Term	0.5

The regulations also state that the licensee should not allow radiation levels in unrestricted areas that may result in a member of the general population receiving greater than 100 mr/yr.

Exceeding the Limits

If any of these limits are exceeded, there could be an increase in the risk of health effects. Additionally, plant management will evaluate how the dose limit was exceeded and explain it to the NRC. Depending on the nature of the event, the individual could receive disciplinary action, and the NRC may chose to fine or take other actions against the plant and/or the individual.

Remember that it is each individual's responsibility to keep radiation exposure as low as possible.

Administrative Guides

Administrative guides have also been established by the company to provide an added measure of radiation protection for nuclear power plant workers. This will help minimize the potential for a worker exceeding federal limits.

The administrative guides set for radiation workers are as follows:

- The TEDE guide is (*) per year.
- The guide for the skin is (*).
- The guide for the extremities is (*).
- The guide for the lens of the eye is (*).
- Other guides (*).

An evaluation will be conducted if you exceed your administrative limit.

Approaching the Administrative Guides

It could happen that you find yourself about to reach your administrative guide limit. It is possible to increase your allowed dose but only if authorized prior to exceeding your current authorized levels. To increase your authorized dose levels:

- (*)

Embryo/Fetus Exposure Guideline

A pregnant employee should understand the potential effects of radiation on an embryo/fetus, including those produced by ionizing radiation. Both NRC Reg Guide 8.13 and 10CFR20.1208 contain an exposure limit of 500 mr spread over the term of the pregnancy. The company will, upon learning of the pregnancy, [maintain the total dose as close to 0 as possible].

Employees who choose to limit their exposure must submit a written statement declaring pregnancy to [their supervisor]. This request is voluntary and may be withdrawn at any time for any reason. The withdrawal must also be submitted in writing.

Once this request is received, the company will [make all efforts to provide work that does not require any radiation exposure] and will thereby limit the dose to the minimum possible. A declared pregnant worker will not be allowed to exceed the 500 mr limit.

Planned Special Exposure

A planned special exposure is an authorized exposure that is separate from and in addition to the annual dose limits. Use of a planned special exposure is a serious undertaking that can result in intentionally exceeding the federal limits. It is not anticipated that this type of exposure will be used, but in the unlikely event that it is, there are several requirements, including senior management approval.

Radiation Exposure Reduction Program

ALARA

Upon completion of this section, you should be able to practice basic methods to minimize radiation exposure.

To do this, you should be able to:

- State the purpose of ALARA.
- Describe the plant ALARA program.*
- Explain how time may be used to reduce dose, and state methods to implement this concept.
- Explain how distance may be used to reduce dose, and state methods to implement this concept.
- Explain how shielding may be used to reduce dose, and state some methods that may be used to implement this concept.
- State individual responsibilities regarding temporary shielding.
- Calculate stay time given a dose rate, current exposure, and an exposure limit.

ALARA Purpose

ALARA is an acronym, meaning As Low As Reasonably Achievable. The purpose of ALARA is to keep the dose of both the individual and group involved with the performance of a task as low as reasonably achievable and still get the task accomplished. This includes internal as well as external dose.

ALARA Program

A formalized ALARA program represents a management commitment to minimize personnel dose. This program will help ensure that ALARA concerns are addressed in a systematic manner and will help make all employees aware of ALARA in their daily work activities.

To make the ALARA program effective, several policies and procedures have been established. These are as follows:

- pre-job reviews
- job planning including worker experience

- training using mock-ups
- use of radiological practices for dose reduction such as temporary shielding
- engineering controls
- The individual worker is perhaps the most important part of the program. The worker's actions on the job determine the dose received and, consequently, the success of the ALARA program.

Time

Time is one of the most important tools that you, the worker, can use in keeping dose to a minimum. Making the most efficient use of time in a radiation field will certainly be effective in reducing your exposure and, consequently, your dose. Assume it takes a worker 20 minutes to adjust a valve using a wrench or 12 minutes using a ratchet. Using the ratchet will save a considerable amount of dose.

Effective planning can also help reduce time. Take the few extra minutes necessary to keep dose down by:

- talking to others about the job and area
- knowing what tools to take
- prefabricating where possible
- locating the work area on a map

Make sure you understand the job by reviewing the radiological survey data, knowing what areas to avoid, and leaving the area as soon as the work is complete.

Distance

Distance is also a very effective way of reducing dose. In general, the greater the distance from a source of radiation, the less the dose received.

The dose received may be greatly reduced by moving a small distance from the source. Standing four feet from a valve instead of two feet can reduce your dose rate by as much as 75 percent. This reduction assumes that you are not moving closer to another source.

Dose may also be reduced by using extension tools, taking breaks in low-dose-zones, and stepping away from the radiation source when reading a procedure.

Shielding

Permanent and temporary shielding in the plant can significantly reduce the dose you receive by reducing the intensity of a radiation field. Standing behind a large building support and using it as shielding while examining a defective part will help reduce dose.

Temporary Shielding

For temporary shielding to be used, a total dose savings must be realized for the plant. That is, the overall dose for the job, including the dose received during the installation and removal of the shielding, must be less to make it a sound ALARA decision.

Whenever shielding is installed, it is important that workers do not tamper with the shielding as this could drastically change the dose rates in the area. If shielding is blocking the equipment you must work on or your tools, contact [RP] for resolution.

Calculating Stay Time

A time limit, called stay time, may also be imposed on an individual due to the amount of exposure the individual has already received and the dose rate in an area. Stay time is used to ensure an individual does not exceed a limit by restricting the amount of time allowed in a radiation field. It can be calculated using the following formula:

$$\text{Stay time} = \frac{\text{Dose limit} - \text{Current dose}}{\text{Dose rate in the work area}}$$

For example, assume you have an administrative guide of 1,000 mr and have received 200 mr so far this year. You are directed by your supervisor to work for the duration of an eight-hour shift in a 20 mr-per-hour area. Will you exceed your stay time?

Answer: Stay time is (1,000 mr - 200 mr) divided by the dose rate in the area, or 20 mr:

(1,000 mr - 200 mr)/20 mr = 40 hours

You can work in the area for up to 40 hours without exceeding your stay time.

Extra Reading on ALARA

The phrase "source term reduction" means the removal or reduction of area dose rates by actions such as flushing, purging, or removing the component that is the source of radiation. Source term reduction is being used in the plant and is a very efficient means of helping to maintain dose ALARA.

Even with the precautions mentioned, workers must be alert to changing radiological conditions due to certain plant operations such as radiography (testing of pipes or welds with radioactive sources), changes in reactor power level, and changes in system lineups. If abnormally high radiation levels are noticed, workers should leave the area immediately and notify [radiological protection].

As a result of lessons learned from industry events, certain tasks require a more comprehensive pre-job review as part of the overall ALARA effort. Pre-job briefings can include active participation by [Radiological Protection] personnel who may even physically provide [RP] coverage for the job. The pre-job briefing should also address any anticipated problem areas in performance of the task, available alternatives, and expected radiological protection impact.

Radiation Dosimetry

Radiation Dosimetry

Upon completion of this section, you should be able to use dosimetry devices properly to monitor dose as well as to respond to dosimetry problems.

To do this, you should be able to:

- State the purpose of dosimetry.
- List the types of radiation detected by the following devices:
  - thermoluminescent dosimeters (TLDs)
  - self-reading dosimeters (SRDs)
  - electronic alarming dosimeters (EADs)
- Identify how to wear dosimetry devices properly including placement and orientation.
- Identify the modes, methods, and frequency for operating and reading self-reading dosimetry.*
- Identify where and when the following dosimetry devices are issued and returned:*
  - TLDs
  - SRDs
  - EADs
- State the action(s) to be taken if dosimetry is lost, off-scale, or alarming.

Purpose and Sensitivity

Many types of dosimeters are used in the industry; however, they all fall into three general categories as discussed below:

- The thermoluminescent dosimeter (TLD) allows the company to measure your external exposure while in the station. The TLD is used for the permanent occupational external dose record.

  The TLD detects and measures dose from beta, gamma, [and neutron] radiation. The TLD has a window that allows measurement of skin dose from both beta and gamma radiation. Other portions of the badge are used to measure gamma, [neutron], and some penetrating forms of beta radiation.

  If the TLD is lost, immediately leave the area or do not enter any radiological area, and contact the [RP] department.

- Self-reading dosimeters (SRDs), sometimes called pencils or pocket dosimeters are issued to allow you to have an estimate of the dose received while on the job. The SRD is designed to measure gamma radiation.

- Electronic alarming dosimeters (EADs) may also be issued to allow you to have an estimate of dose received while on the job. The EAD also provides you with general area dose rates and alarms that will activate if some preset conditions are exceeded. These will be covered in more detail later.

  The EAD is designed to measure gamma and X-radiation.

Wearing Dosimetry

If you are required to wear dosimetry, it should be worn on the front part of the body between the waist and shoulders. The beta window should face away from the body and be located next to the SRD or EAD.

Additional or special dosimetry may be required for certain jobs where dose rates to areas of the body are higher than those to the chest region. Typical placements for whole-body dose include the head, back, and thigh. For extremity dose considerations, the wrists or ankles may have special dosimetry attached. The higher value of the whole-body placements and of the extremity placements will be recorded on the legal record in the respective category. If you are required to wear any special dosimetry, [RP] will provide you with instructions.

Use of Dosimetry

The SRD will provide you with an approximation of dose received while on the job. To obtain the dose, look through the SRD cylinder while pointing it at a light with the scale held horizontally. A vertical hair line, which can be seen inside the cylinder, crosses a numerical scale. The point at which the line crosses the scale is the dose (assuming the SRD was at 0 at the beginning of the job).

If the SRD is bumped or dropped, it may be incorrect. If the SRD is lost, or if it indicates an unusually high reading (3/4 to off-scale), you should leave the area and contact [RP].

The TLD should never be tampered with as it is not possible to obtain any information from the TLD without a special TLD reader.

The EAD has two modes of operation: the dose mode and the dose rate mode.

- The dose mode provides a readout of estimated dose in units of [rem. For example, if 0.115 rem is displayed, the dose is 115 mr. When obtaining an EAD, verify the display indicates 0.000 rem; if not, return the EAD.]

- [A button] on the EAD allows you to change from the dose to the dose rate modes of operation or vice versa. Each mode has an active preset alarm that will notify you of a problem regardless of the mode you are in.

- The dose alarm will alarm if your allowable dose has been exceeded. Should the dose alarm activate, report immediately to [RP]. [The EADs in use require [RP] to reset the alarm.]

  [The dose rate alarm will sound if your dose rate is greater than expected. The dose rate alarm will stop if you move to an area that is below the predetermined dose rate setpoint. Remember to review your radiation work permit for instructions regarding the dose rate alarm prior to entering the [radiologically restricted area] (RRA).]

- The EAD should never be used as a dose rate meter.

Getting and Returning Dosimetry

(*)

Actions for Abnormal Conditions

When working in the RRA, several conditions will require you to take action. Some of these are as follows:

- If you should discover any of your dosimetry lost or missing, you should place your job in a safe condition, immediately leave the RRA, and report to [RP].

- If while on the job, you discover your dosimeter off scale high, or alarming, immediately notify your coworkers, leave the RRA, and notify [RP].

- If the dosimeter does not appear to be working correctly, leave the RRA and return the defective dosimeter to [RP].

CONTAMINATION

Contamination

Upon completion of this section, you should be able to minimize the probability of becoming contaminated, spreading contamination to clean areas, or contaminating other workers while working in a contaminated area or working with contaminated equipment.

To do this, you should be able to:

- Identify and compare the following types of contamination:
  - fixed contamination
  - loose contamination
  - discrete (hot) particle contamination
- State the units used to measure contamination.
- Explain why contamination is controlled.
- Describe the sources and indications of contamination including:
  - spills and leaks
  - open contaminated systems
  - maintenance activities
- Discuss the methods used to prevent contamination of personnel and areas including:
  - work planning and pre-job briefings
  - the use of protective clothing (PCs)
  - avoiding potentially contaminated water
  - avoiding skin contact with contaminated surfaces
  - use of step-off pads
  - restrictions concerning nonroutine surveyed areas (for example, overheads)*
  - engineering controls
- State the individual's actions for removing contaminated and non-contaminated materials from the RRA.*
- Explain how to monitor personnel and personal items for contamination including the use of:
  - friskers
  - personnel contamination monitors
- State the actions to be taken upon indication of becoming contaminated.

- State the method for control of contaminated tools, equipment, and materials including:
  - — minimizing materials contaminated
  - — [hot tool issue]
  - — bagging/surveillance requirements*
- State the methods used to designate contaminated areas including postings and step-off pads.
- Regarding discrete/hot particles, be able to state:
  - — the hazards
  - — methods to identify a discrete particle
  - — sources of discrete particles
  - — work activities that may result in discrete particle contamination
  - — special precautions to be used in an area that may contain discrete particles
- Identify situations that require immediate exit from a contaminated area (for example, torn PCs, wounds, and wet PCs).

Radioactive Contamination Introduction

Remember that contamination is defined as radioactive material where it is not desired.

A surface may be contaminated by a spill of radioactive liquid, settling of airborne particulate matter, or maintenance activities performed on a system.

Everyone should know that contamination gives off radiation.

The two major sources of contamination at a nuclear station are fission products as a result of the reactor fissioning process and activated corrosion and wear products (rust, metal, etc.). In either case, these products are transported throughout the systems that carry reactor water and steam. Leaks and maintenance operations in these systems may allow radioactive materials to be released and to accumulate on the floors and walls. This creates a contamination problem for personnel who have to work in these areas and may also contribute to the hot particle problem.

Fixed, Loose, and Discrete Particle Contamination

Contamination may be identified as fixed, loose, or discrete:

- Fixed contamination is surface contamination that has become embedded in an object and cannot be removed by normal cleaning techniques.

Since no results would be obtained by rubbing a smear across a surface where the contamination is fixed, a direct check for radiation on the item of concern is required to detect fixed contamination.

Workers should be aware that certain maintenance activities, such as welding and grinding, could cause fixed contamination to become airborne. Fixed contamination can also "leach" out of certain materials and become loose contamination.

- Loose surface contamination is radioactive material that is loosely adhered to an object. Loose contamination may be transferred to clean areas, or your coworkers by improper work practices such as leaning against components in contaminated areas and not using proper exit procedures from the contaminated area.

  Another potential problem associated with loose surface contamination is that it may become airborne.

- Some particles are very small, often invisible bits of radioactive material that can give a high dose. If a discrete, or hot, particle gets on the skin, the legal dose can be exceeded in a short period of time. If discrete particles are ingested, they can give a large dose to the internal organs.

Contamination Units

Since contamination is radioactive, it can be detected through the use of radiation detectors. However, contamination is frequently detected by wiping a piece of cloth or paper over a surface area and measuring the radiation being emitted from the "smear". The level of radiation is in disintegrations (or sometimes counts) per minute, and the surface area is usually 100 square centimeters (cm^2). Normally, this is written as dpm/100 cm^2 or cpm/100 cm^2.

Sources and Indications of Contamination

As you work in the plant around and in contaminated areas and systems, you will be working with many potential sources of contamination. Only a few examples of contamination sources are:

- spills and leaks from a system carrying reactor water
- contaminated systems that are open for maintenance
- grinding a pipe with fixed contamination
- disassembly of a plant component containing contamination

Some possible indications of potential contamination are:

- water leaking from a pump or valve that carries reactor water
- a pipe that has been removed from a contaminated system

- maintenance on a potentially contaminated system
- water standing near a contaminated system
- rise in frisker counts or frisker alarm

It is easy to see that if care is not taken around potentially contaminated systems, you could also become contaminated and even spread contamination around the plant.

Methods to Prevent Spread of Contamination

Contamination is radioactive, and if it were allowed to spread uncontrolled, it would soon be all over the office areas, your car, and at home. This would result in unmonitored radiation dose, an increase in radioactive waste, and decreased productivity (since someone will have to clean it up). Think of contamination as invisible wet paint that never dried. Now imagine people walking through the invisible paint day after day. It is not difficult to see that after a while the paint or contamination would be everywhere emitting radiation.

Preventing the spread of contamination is not difficult, but it does require good work practices. Some proven methods effective in limiting the spread of contamination are:

- having a good plan for the job and having a pre-job briefing to discuss the plan, hazards, and contingencies

- using protective clothing (PCs) when working on a contaminated system

- avoiding water that is around or under a contaminated system

- avoiding skin contact with contaminated surfaces

- using step-off pads and warning signs

- restricting entry to potentially contaminated areas that are not routinely monitored for contamination

- restricting entry to contaminated areas

- using engineering controls such as fans with filters, and containments

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PCs

When working in a contamination area, you may be required to wear protective clothing (PCs). When wearing these clothes:

- Remember that PCs will help protect you from contamination but does not protect against radiation.

- Protective clothing consists of a hood, coveralls, glove liners, rubber gloves, shoe covers, and rubber overshoes.

- The use of PCs will be specified by RP and/or the RWP.

- [Describe the items required for partial, full, and double sets of PCs.*]

Removing Material From the RRA

When leaving a contamination area, check everything for contamination prior to exiting. This includes items such as notebooks, tools, hard hats, parts, and flashlights.

If there are some items that you wish to remove from a radiological area, then you must:

- (*)

Personal Contamination Monitoring

There are two primary methods for monitoring for personal contamination: the frisker and the personal contamination monitor.

- The frisker is a radiation monitor that has a hand-held detector and a meter. To use the frisker, perform the following:
  - [Check the [daily] source check to make sure it is current.]
  - Check the background radiation. This is done by making sure the meter is not reading over [200 cpm] with the switch set at the X1 scale. If it is greater than [200 cpm] move to another area or call [RP].
  - Frisk your hands first. Pass your hands over the probe at a speed of about two inches per second at a distance of about one-quarter to one-half inch while observing the meter.
  - Pick up the probe, and move it over the body (or surface) at about two inches per second. It should take about two to five minutes to frisk your entire body.
  - If you see an increase in indicated counts hold the probe still and if there is an increase of [100] cpm or more, there may be contamination present. If this occurs, stay where you are and contact [RP].

- The second type of whole-body frisking is using the personnel contamination monitor. To use the personnel contamination monitor:
  - — Enter the monitor.
  - — (*)
  - — If the monitor alarms, stay where you are, minimize touching anything, and contact [RP].

Control of Contaminated Materials

When working on contaminated systems, it is possible to contaminate tools, equipment, or materials. Company policy is to minimize the contamination of these articles. Some of the things that you can do to help in this effort are:

- Minimize the amount of material contaminated while on the job. Use only those tools that are necessary, keep the amount of packing material taken into the RRA at a minimum, and minimize the amount of trash generated.

- When getting tools for use in the RRA, get the tools needed from the [hot tool] issue point. These tools are usually already contaminated with fixed contamination.

- If a contaminated article needs to be taken out of a contaminated area, it should be [bagged in a yellow poly bag].

Contaminated Area Postings

Signs warn you of plant areas that are known to be contaminated. These signs are as follows:

- contamination area—This is an area that has [1,000 dpm/100 cm2 of beta plus gamma or 100 dpm/100 cm2 of alpha contamination]. Entry requires RWP authorization and meeting the RWP entry requirements.

- high contamination area—This is an area that has [100,000 dpm/100 cm2 of beta plus gamma or 2,000 dpm/100 cm2 alpha]. Entry requires RWP authorization and meeting the RWP entry requirements.

Any area designated as a contamination or high contamination area will be posted. This area is typically roped off with yellow and magenta rope with signs hanging from the rope with the area designation. There is an entrance and exit to the area with a step-off pad. This entrance and exit are the only authorized ways in or out of the area.

Failure to adhere to these requirements can result in the spread of contamination, personnel contaminations, and potential disciplinary action.

Discrete Particles

Discrete or hot particles were discussed earlier and are a great concern because an individual may receive a large dose due to the high levels of radioactivity these particles are capable of. [Radiological protection] will provide special instructions when working in a discrete particle area. Several methods are employed by [radiological protection] to warn you of discrete particle hazards and keep dose ALARA. Ropes, signs, barrier tape, bull pens, or a combination may be used.

Awareness of hot particles, changing radiological conditions, and radiological hazard postings is helpful in alerting you to radiological hazards.

There are several ways to identify a discrete particle:

- When frisking, a hot particle can cause the meter to rapidly rise to a much higher count rate. Remember that the frisker will respond only if you have it close enough to the discrete particle and are moving it slowly enough for the detector to respond.
- The personnel contamination monitor is effective in finding discrete particles.
- The whole-body contamination monitor at the site exit is not the preferred method of detecting a discrete particle; however, industry experience shows that the WBCM is capable of detecting discrete particles.

As discussed earlier, discrete particles originate in the nuclear fuel or from corrosion products. Therefore, when working on systems connected to the reactor or systems with activated corrosion products, always be aware of the risk that they may contain discrete particles.

Some precautions that should be used in areas that may contain discrete particles are:

- careful review of the RWP survey map for discrete particle contamination areas
- use of PCs
- careful frisking when exiting an area with potential hot particles

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Conditions Requiring Exiting the RRA

Some situations require you to exit a CA immediately. If any of the following occur, you must immediately leave the CA:

- if you tear or cut your PCs

- if you suffer a cut, abrasion, or other type of open wound
- if your PCs become wet from a leak or spill
- if your SRD is upscale or off-scale, lost, or you observe any other abnormal condition
- if directed by [RP]
- if you lose or damage your dosimetry

Internal Exposure

Upon completion of this section, you should be aware of how contamination can enter the body, how to detect internal contamination, and how internal contamination is eliminated from the body. You should also be able to take measures that can reduce your internal dose.

To do this, you should be able to:

- State four pathways for radioactive material to enter the body:
  - — inhalation
  - — ingestion
  - — absorption
  - — open wounds/injuries
- State the methods used to limit the internal deposition of radioactive materials including respiratory protection and engineering controls.
- State the processes by which radioactive material is eliminated from the body (decay and biological).
- Recognize the methods used to determine the amount of radioactive material deposited in the body including whole-body counters and bioassays.
- Define the following:
  - — derived air concentration (DAC)
  - — annual limit on intake (ALI)
  - — committed effective dose equivalent (CEDE)
- State the relationship among DACs, ALIs, CEDE, and TEDE (DAC and mr/hr relationship).

- Discuss plant conditions that may increase the potential for airborne radioactivity such as:
  - — brushing or sweeping
  - — fan(s) blowing in dusty areas
  - — steam leaks
  - — sanding or grinding in contaminated areas
  - — wet contaminated areas that are drying out

Methods of Internal Deposition

There are four primary methods which will allow radioactive material into the body:

- inhalation—breathing it in
- ingestion -- eating, drinking, chewing, or swallowing
- absorption—absorbing it through the skin
- open wounds—entering through an open wound or sore

Limiting Internal Deposition

The amount of radioactive material deposited internally should be limited as much as possible because radioactive material deposited internally can become lodged within an organ and give a dose to that organ. However, there are some methods that you can use to help you reduce the amount of internal contamination:

- Not eating, drinking, smoking, or chewing within the RRA can reduce the amount of material deposited in the body.
- Engineering controls can also limit internal dose by establishing conditions that improve the radiological environment for workers. This could include controls such as installing ventilation systems with temporary filters, isolating potentially radioactive steam leaks, or shifting ventilation flowpaths.
- The use of respirators and other protective equipment can be effective in reducing the amount of material deposited in the body. However, it will normally take longer to accomplish a task wearing a respirator; therefore, the TEDE must be considered prior to wearing a respirator.
- Monitoring your time to track amount of internal dose is also important for keeping dose ALARA.

Elimination of Internal Depositions

Once radioactive material enters the body, there are two primary processes that will eliminate it:

- Biological processes will naturally occur that will cause many types of internal deposition to be eliminated from the body.
- Radioactive decay will occur to those radioisotopes that remain within the body. The decay process will make these isotopes less radioactive as time passes. The amount of time required for an isotope to decay to, for example, one-half of its initial activity is entirely dependent on the isotope. This can vary from seconds to many years.

Measuring Internal Activity

The body contains naturally occurring radioactivity such as from potassium. The internal dose we worry about is from the internal deposition of radioactive material. There are two primary ways to determine the level of internal radioactivity:

- Whole-body count—As a radiation worker, you will be required to have a whole-body count prior to initially entering the RRA. The whole-body count measures the level of radioactivity within the body. Periodically, another whole-body count will be performed. The two whole-body counts will be compared to determine if any changes have occurred.
- Bioassays may also be used to determine internal activity levels. The bioassay is an evaluation of a waste sample taken from the body and can be more effective in determining where the internal deposition is located in the body as well as how much is present.

CEDE, DAC, and ALI

Inhalation through the nose and mouth is the most common method of receiving internal dose. The amount of dose received is directly related to the activity level of the air being breathed and the duration of time in the environment. The amount of internal dose you are permitted to receive is limited by federal law.

- The term "committed effective dose equivalent" (CEDE) is defined as the amount of assigned internal dose that relates organ dose to the whole-body dose.
- The term "annual limit on intake" (ALI) is the concentration of radioactive material you would have to breath in to receive 5 rem effective dose equivalent or 50 rem to any organ. The federal limit is one ALI per year.

- A derived air concentration (DAC) is the concentration of radioactive material in air that would result in a dose of one ALI if breathed for 2,000 hours.

Relating DAC, CEDE, ALI, and TEDE

Since the ALI is based on 5 rem in 2,000 hours, then a DAC hour is equivalent to 2.5 mr of internal dose (5,000 mr/2,000=2.5 mr per DAC hour).

- A worker is assigned the task of repairing a door in a radiological area. The area has a dose rate of 24 mr/hr and also has some airborne radioactivity. From experience with this door, the worker knows it will take two hours and 20 minutes to make the repair with a respirator or two hours without a respirator. If the job is done without a respirator, he will receive two DAC hours internal exposure.
  — If the worker wears a respirator, what will the total dose be?

    Answer: The total dose will be 56 mr.
    (24 mr/hr)(2.33 hrs) = 56 mr

  — If the worker does not wear a respirator, what will the total exposure be?

    Answer: The total dose will be 53 mr.
    (24 mr/hr)(2 hour) + (2 DAC)(2.5 mr/DAC) =53 mr

  — Which worker received less dose?

    Answer: The worker not wearing the respirator.

Increasing Airborne Radioactivity

When in a radiological area, there are many types of activities that you may become involved in that can increase the amount of airborne radioactivity. Some of these activities include:

- brushing or sweeping
- fans blowing in dusty areas
- steam leaks
- sanding, grinding, or welding on a contaminated pipe
- a wet contaminated area that is drying out

Be alert to the types of conditions that can increase the airborne activity levels and your TEDE.

Radiation Work Permit

Radiological Work Permit (RWP)

Upon completion of this section, you should be able to interpret and apply information found in an RWP to a task in a radiological area.

To do this, you should be able to:

- State the function of an RWP.
- State the types of RWPs and the function of each.*
- Extract information from an RWP (for example protective clothing, dosimetry, special instructions).*
- State the responsibility for complying with RWP requirements.
- Extract information from a survey map.*
- State the required action(s) to be taken if the work scope or radiological conditions change so that they are not within the scope of an RWP.

Function of an RWP

A radiation work permit contains details concerning a radiological area that will help you minimize dose and reduce the likelihood of becoming contaminated or spreading contamination. As a radiation worker, the RWP is one of the most important tools you have available in achieving your ALARA goals. The RWP has three major functions:

- An RWP authorizes individuals to enter radiologically controlled areas. There are RWPs for all radiological areas of the plant.
- An RWP provides you with the radiological requirements necessary for you to work in the area including protective clothing, equipment required, special procedures, and precautions to be followed.
- An RWP provides you with information regarding the radiological conditions and hazards in the work area.

The types of RWPs in use in the plant are (*)

Extracting Information From an RWP

An RWP also contains information that will help you work radiologically safe by providing you with information such as clothing requirements, dosimetry requirements, and any other special requirements that will help you with your job. Specifically, an RWP contains the following information:

- *(Discuss site-specific contents of RWP.)

RWP Compliance

All requirements contained in an RWP are there for a reason: to protect you and your coworkers from receiving unnecessary dose. Therefore, it is important for you to ensure the requirements and the intent of the requirements are met. Plant management and your supervisor expect you to always be in full compliance with all RWP requirements. Not complying with the requirements established by the RWP may result in a radiological event, increased dose, spread of contamination, or other radiological problems. This could also result in the plant being fined, or other regulatory action, as well as possible disciplinary action.

Survey Maps

Some RWPs contain a survey map. The survey map generally shows a drawing of the area(s) covered by the RWP and includes information on dose rates, contaminated areas, types of contamination, and other radiological information:

- Contains information such as the [RWP number], date of the survey, area of the plant, and [purpose of the survey].

- The survey map contains a drawing of the area that was surveyed and provides radiological information such as local dose rates, contamination levels, and radiological postings.

- Different types of information are differentiated through the use of symbols and/or designators:
  - — A radiological posting is shown by (*).
  - — A smear location is shown by (*).
  - — A dose rate is shown by (*).
  - — (*).

A Change in Conditions

When working in some plant areas, the radiological conditions can rapidly change. If the radiation levels should increase, this will increase the dose rate. These changes may not be apparent since the cause of the change may not even be in the same building.

- Radiological conditions can change with reactor power level, equipment status changes, movement of shielding, and other reasons. Therefore, it is important to monitor dose.

- If you discover that the radiological conditions are different than expected, or if the conditions change unexpectedly, inform others that may be in the area, exit the area, and contact [RP].

- If, while working on a task in the RRA, the scope of the job changes, contact [RP] before proceeding. This could include having to move some components that were not originally within the scope of the work, having to open up a potentially contaminated system, or having to move some lead shielding. Contacting [RP] prior to proceeding will help prevent receiving unanticipated dose or unnecessarily spreading contamination.

Radiological Postings and Alarms

Radiological Postings

Upon completion of this section, you should be able to recognize and understand the plant radiological postings.

To do this, you should be able to:

- Define and recognize the following radiological areas and postings:
  - [radiologically restricted area]
  - radiation area
  - high radiation area
  - very high radiation area
  - [locked high radiation area]*
  - airborne radioactivity area
  - radioactive material area
  - radioactive materials storage area

- Define and recognize the following radiological postings:
  - hot spot
  - [low-dose zone]
  - hot-particle area

- State the potential consequences of violating, moving, or altering a radiological posting.

Types of Postings

Several different types of radiological conditions may exist in the plant. High-radiation levels and contaminated areas are only two examples. Before entering any type of radiological area, you must meet the requirements of the RWP. The following are common types of postings that may be encountered in the plant and what they mean:

- *[radiologically restricted area]*—This is an area with limited access to protect individuals from exposure to radiation and radioactive material.

- *radiation area*—This is an area with a dose rate greater than [5] mr per hour.

- *high radiation area*—This is an area where you could receive [>100] mr per hour.

- *very high radiation area*—This posting has the words GRAVE DANGER and is an area that has greater than [500] rad per hour.

- *locked high radiation area*—This is an area where you can receive [>1,000 mr/hr] in the general area. The access is locked due to the high dose rate.

- *airborne radioactivity area*—Occasionally, an area may contain radioactive material that has become airborne. This can be the result of steam leaks, a wet contaminated area drying out, or other conditions. An airborne radioactivity area is an area containing airborne radioactivity that exceeds [one DAC or 12 DAC hours per week].

- *radioactive materials (storage) area*—This is an area in which radioactive materials are stored.

- *hot spot*—This is a localized source of radiation that is [five] times greater than the general background radiation level and is at least [100] mr per hour. Hot spots are typically found in spots where crud may accumulate such as piping elbows, low-point drains, and others.

- *[low dose zone]*—When working in a radiation area, it is helpful to know which areas have lower levels of radiation. These areas are sometimes posted with low-dose zone/area. When not actively working on a task, it will help keep your dose ALARA if you use these areas for things such as breaks, waiting for QC, reviewing a procedure, or other activities that can be done in the low-dose area.

- *discrete (hot) particle area*—This is an area that contains discrete radioactive particles that can give a large localized dose in a short period of time.

Movement of Postings

The postings above serve an important purpose: They warn all station personnel of radiological hazards in the plant. If these postings are violated, it can affect the well-being of you and your coworkers. Therefore, any violation, movement, or removal of any radiological posting will not be tolerated. This can result in a radiological hazard, increased dosage to personnel, regulatory fines, and disciplinary action.

Radiological Alarms

Upon completion of this section, you should be able to recognize and respond to radiological alarms.

To do this you should be able to:

- Identify the radiological alarms used in the plant.*
- State the proper response to a given radiological alarm.*

- State the potential consequences of ignoring a radiological alarm.

Radiological Alarms and Responses

Many areas of the station are monitored for radiological conditions. Many of these monitors will alarm if the condition being monitored is not within the normal band. The following are typical radiological alarms that are used in the plant:

- [continuous air monitor alarm (CAM)—The continuous air monitors sample environmental points in the plant. If an abnormal amount of radiation is detected, the unit will alarm. This alarm indicates that the air being sampled by the CAM has exceeded a preset level of radioactivity. If this alarm is activated, it will (*). You should leave the area immediately and notify the control room.]

- area radiation monitor alarm (ARM)—Also within the plant are detectors that monitor radiation levels in various areas of the plant. If an ARM alarms, it indicates that the radiation level in the monitored area has exceeded a preset value. If this alarm is activated, it will (*). If you encounter this alarm, leave the area and [report it to the control room].

- [process radiation monitor (PRM)—This alarm indicates that a system or containment process radiation level has exceeded its alarm setpoint. In the event of an alarm, the PRM will (*). If you should discover the PRM in an alarming state, inform the control room.]

Ignoring Alarms

Radiological alarms can be one of the first indications of a serious radiological problem. Improper response or ignoring a radiological alarm can increase your radiation dose and, consequently, health risk.

Anyone who purposefully ignores a radiological alarm will be subject to disciplinary action.

Radioactive Waste

Radioactive Waste

Upon completion of this section, you should be aware of the importance of and methods for minimizing the generation of radioactive waste.

To do this, you should be able to:

- Define "radioactive waste."
- Contrast the disposal costs of radioactive waste versus nonradioactive waste.
- State the methods for minimizing the generation of radioactive waste.
- Explain why it is important to keep contaminated and noncontaminated waste separate.
- Explain why it is important to keep wet and dry contaminated material separate.
- Explain why it is important to keep contaminated and hazardous waste separate.

Definition

Radioactive waste is defined as any radioactive material that must be disposed of. Examples of potential radioactive waste are:

- used PCs that are no longer serviceable
- used tape, gloves, and plastic bags from a CA
- packing material brought into the RRA

Waste Cost and Reduction

Depending on the location, radioactive waste can cost [$2,500] or more per barrel of low-level waste. This compares to about [$8] per barrel of clean trash. Reduced low-level radioactive waste (LLRW) improves our economic position and reduces the amount of radioactive material that needs disposal. Additionally, due to the decreasing number of disposal sites, storage and burial costs are continually increasing. Some methods that you can use to reduce the amount of LLRW are to:

- Use cloth bags, protective clothing, and tool bags whenever possible. These can be recycled.

- Use good judgment and think ahead. Bring only those items and quantities into the RRA that you will really need.
- Never mix wet and dry wastes.
- Separate noncontaminated material from the contaminated material before disposal.
- Tape clothing only when required by an RWP.
- Many other practical ways exist to reduce radwaste. Use good judgment and common sense.

Keeping Wastes Separate

When putting waste into the trash, keep radioactive waste separate from nonradioactive trash. If the two are mixed together, there will be cross-contamination that, at best, will require someone to go through the trash and separate the two. This takes considerable time and manpower and it almost always increases the amount of LLRW. Put contaminated trash into [the yellow trash bag, or barrel marked for radioactive trash] and put the clean trash into the [green] bag or clean trash barrel.

Keep wet waste separate from the dry LLRW. If liquid and dry radwaste are mixed and put into a barrel, the barrel may leak or corrode and cause a radioactive spill. These barrels are not designed for wet LLRW. Also, most LLRW disposal sites will refuse to accept LLRW that is mixed. Therefore, if wet and dry LLRW are mixed, they will have to be separated and dried before disposal can occur.

If any chemicals are put into this trash, it becomes even more difficult to dispose of due to the additional restrictions that apply to chemical and hazardous waste disposal.

Rights and Responsibilities

Upon completion of this section, you should be aware of individual rights and responsibilities regarding working within radiological areas.

You should be able to state your rights and responsibilities regarding:

- keeping dose ALARA
- adhering to instructions provided by radiological protection personnel (including stop work authority), written policies and procedures, radiation work permits, and posted warnings and signs
- maintaining awareness of current personal dose

- remaining within federal and plant administrative dose limits and guidelines
- identifying the actions and reporting responsibilities when abnormal radiological conditions and/or violations of radiological requirements are encountered
- the right of the individual and the process to be followed in obtaining personal radiation dose data

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Being a qualified radiation worker brings new responsibilities to each individual. Most of these have already been discussed, however, due to their importance, we will review them once again. You are responsible for:

- maintaining your dose ALARA at all times
- always working in compliance with the RWPs that are in effect
- always following directions from [RP] personnel, including stopping work when directed
- always knowing what your personal dose is
- staying within the limits and guidelines regarding personal dose
- keeping plant management informed of radiological violations and abnormal conditions

You always have the right to review your radiation dose record. To do this, contact [RP].

Practical Exercise

Upon completion of this section, you should have demonstrated the ability to properly wear protective clothing, enter a radiologically contaminated area, remove tools, and exit the radiological area.

To do this you should be able to:

- Select the correct RWP.*
- Determine the protective clothing requirements.*
- Determine the dosimetry requirements.*

- Determine the respiratory protection requirements.*
- Determine any special conditions defined by an RWP.*
- Determine any special instructions to be followed.*
- Determine the dose rate and contamination levels.*
- Obtain access on the RWP.*
- Don protective clothing including hood, coveralls, glove liners, gloves, shoe liners, and shoe covers.*
- Properly wear dosimetry with protective clothing.*
- Meet the requirements on signs and postings within the simulated radiological area.*
- Read a self-reading dosimeter while wearing protective clothing.*
- Minimize dose and the spread of contamination.*
- Properly remove tools from the contaminated area.*
- Properly remove protective clothing when exiting the contaminated area.*
- Perform required monitoring for contamination.*
- Ensure that the radiation dose is properly recorded when exiting the simulated RRA.*

Extracting Information From an RWP

Several types of information are needed to work within the limits of an RWP. This information can be obtained from an RWP as follows:

- Select the correct RWP by (*).
- Review the RWP to determine what protective clothing will be required. This can be determined by (*).
- The dosimetry requirements are determined by (*).
- Determine if respiratory protection is required by (*).

- If there are any special conditions defined by the RWP, they can be determined by (*).
- If there are any special instructions to be followed, they are (*).
- The dose rates and contamination levels can be determined by (*).
- Obtain access on the RWP (*).

Donning PCs

Listed below are appropriate guidelines for donning PCs:

- Select applicable PCs in accordance with the RWP.
- Inspect the PCs for holes or tears. If any are found, obtain a replacement.
- Don shoe liners.
- Don the cotton glove inserts.
- Don coveralls.
- Place the legs of the coveralls over the shoe liners, and make sure the leg cuffs are sealed on the shoe liners.
- [Put the TLD in the coverall pocket or as directed by RP procedures.]
- If using an EAD, place it [in the protective packet and attach it to your coveralls].
- Don the rubber shoes.
- Don the rubber gloves over the cotton gloves.
- [Tape the wrists and other areas as directed by RP or plant procedures].
- Don the hood, ensuring that it is securely fastened.

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*Removing PCs**

Listed below is a logical sequence for removing PCs:

- Approach the step-off pad.
- [Remove your hardhat.]

- Remove any tape, and place it in the contaminated trash container.
- Remove the rubber shoe covers.
- Remove the outer pair of gloves.
- Remove your hood.
- Remove your respirator if one was used.
- [Remove all dosimetry if worn on the outside of the coveralls or in the coverall pocket.]
- Loosen the coverall cuffs at the ankle and wrists if necessary.
- Remove the coveralls.
- Remove the shoe liners, moving one foot at a time to the clean step-off pad.
- Remove the cotton liners.
- [Retrieve dosimetry and proceed to the nearest frisking station; frisk hands, dosimetry, feet, and any areas that you suspect may be contaminated.]
- Proceed directly to the nearest whole-body contamination monitor and perform a whole-body frisk. If a whole-body contamination monitor is not available, perform the whole-body frisk with the frisker.
- [A frisker is usually located at or near the step-off pad to monitor for contamination on personnel and personal effects that are being removed.]
- Frisk yourself to ensure you are not contaminated.
- [Explain tool removal process.]*

Fitness-for-Duty

Fitness for Duty

Upon completion of this section, you should be aware of the importance of being fit for duty, understand the potential consequences of substance abuse, and comply with the station fitness-for-duty policy.

To do this, you should be able to:

- State the basic fitness-for-duty (FFD) requirements for all nuclear workers.
- Recognize the personal, public health, and safety hazards associated with the abuse of drugs and alcohol.
- State the FFD policy.
- State the methods used to implement the FFD program, including:
  - — chemical testing
  - — searches
  - — training
  - — employee assistance program
- State the purpose of the employee assistance program.
- State the effects prescription drugs, over-the-counter drugs, and diet may have on job performance and test results.
- State the role of the medical review officer in the FFD program.
- State the consequences of nonadherence to the FFD policy.
- State individual rights regarding FFD.

Fitness-for-Duty Requirements

You are expected to be fit for duty by being neither mentally nor physically impaired from any cause that could adversely affect safe, competent job performance. These impairments may be a result of physical illness, mental illness, improper diet, substance abuse, or fatigue.

Federal law, part 10CFR26, requires each utility licensee operating a commercial nuclear facility to:

- Provide reasonable assurance that station personnel are reliable and trustworthy and are neither under the influence of any substance (legal or illegal) nor mentally or physically impaired from any cause that may adversely affect their ability to safely and competently perform their duties.

- Establish a fitness-for-duty program to create an environment free of drugs, alcohol, and their effects, and to provide employees with assistance for fitness-for-duty related problems.

Negative Impact of Substance Abuse

Many impacts are felt by society and in the workplace as a result of substance abuse.

Consider that in the work environment alone, substance abusers:

- Have four times as many accidents.
- File five times as many workers compensation claims
- Use three times the number of sick benefits.

In society, substance abusers:

- Are absent or tardy twice as often.
- Make twice as many mistakes as nonabusers.
- Cause 50 perc t of all vehicular accident deaths.
- Cause 500,000 serious injuries in vehicular accidents each year.
- Cost the public billions of dollars in health care costs, welfare payments, and law enforcement's "War on Drugs."

Fitness-for-Duty Policy

This company's fitness-for-duty policy states that you shall:

- Report to work fit for duty unimpaired from alcohol or drugs.
- Abstain from alcohol for at least [five] hours preceding scheduled work or longer if necessary to ensure blood alcohol content is less than [0.04] percent.

Note: The consumption of alcohol within [five] hours of reporting to work may cause a blood alcohol concentration (BAC) greater than [0.04] percent, depending on factors such as the quantity consumed and the size of the individual. An individual with a BAC greater than [0.04] percent would not be considered fit for duty.

- Notify your supervisor of any problems such as mental stress, fatigue, or illness that may affect your fitness for duty.
- Seek assistance for any problems that may affect your ability to safely and competently perform your duties.
- [Report to your supervisor the legitimate use of prescription or over-the-counter drugs that may adversely affect your performance.]
- Prevent and report actions that threaten the company or coworkers (includes reporting personnel with symptoms of substance abuse).
- Report any previous denial of unescorted access, positive chemical test, or involuntary participation in a substance abuse treatment program.
- Cooperate with the chemical testing program.
- Do not use, sell, or possess illegal substances on or off company property.

Implementation of FFD

The primary parts of the station's FFD program are:.

- chemical testing
- employee assistance program

Each of these aspects of the program is discussed in more detail below.

Chemical Testing

Chemical testing provides a means of detecting and deterring substance abuse in the workplace.

There are four test categories in chemical testing:

- Initial (preaccess) testing must be conducted within 60 days prior to:
  - — granting of unescorted access
  - — assignment to any emergency operation facility or technical support center
- Random testing will be conducted:
  - — at various times during the day (unannounced).

  - At a rate at least equal to 100 percent of the work force authorized unescorted access. This means that if there are 1,000 employees, there will be 1,000 random tests done per year. Since it is random, some employees may be tested more than once in a year and some not at all.

- For cause testing will be conducted:
  - as soon as possible following any observed behavior indicating possible substance abuse
  - after on-duty accidents or potential accidents involving failure or suspected failure of an individual's performance, including driver-controllable accidents
  - after receiving credible information that an individual is abusing drugs or alcohol

- Follow-up testing will be conducted:
  - for any employee whose unescorted access has been reinstated after testing positive for drugs or alcohol. These tests may be unannounced to verify continued abstention from the use of substances.

Testing Notification

When you have been selected for a random test, your supervisor will be notified (or the point of contact). Your supervisor or point of contact will notify you of the scheduled test time.

The collection site is staffed with personnel who will provide individuals with detailed instructions on how the collection process will be handled.

When you are selected and scheduled for a random test, you may only miss the test if you are [not on the plant site and are not expected to return for the day or there is an emergency]. You may not request time off once notified of the test.

Contractors will not be called in for testing if they work on a call-in basis. Regular employees are responsible for informing their supervisor if they have consumed alcohol within the past [five] hours or are not fit for duty for any other reason.

Substances Tested For

The chemical testing process screens for the following substances:

- alcohol
- marijuana
- cocaine

- opiates
- phencyclidine
- amphetamines

Urinalysis will be used for all substances except alcohol. A breathalyzer will be used for alcohol, and a second breathalyzer will be used if the test results exceed the company limit of [0.04] percent.

If you have two positive breathalyzer tests, you may request a blood test.

You should also be aware of the following:

- Certain prescription and over-the-counter medication may cause a positive test result.

- You should be aware of your medications and keep your supervisors informed as part of the fitness-for-duty program. You must also list on your drug screening consent forms all prescription and over-the-counter medication taken in the past [30] days. Prescription drugs taken into the station must be in a properly labeled container. Nonprescription drugs (for example, aspirin) must be in the original containers.

This company will make every effort to ensure that test analyses are accurate and that all possible causes for positive tests are explored prior to confirming a positive test. The medical review officer will review, interpret, and confirm all positive test results.

Employee Assistance Program

The company has an employee assistance program (EAP) to provide assessment, short-term counseling, and treatment monitoring.

Company employees may request assistance from the EAP (self-referral) or can be referred by their supervisor or by the company medical staff.

If the EAP staff determines that your condition constitutes a hazard to yourself, or to others, 10CFR26 requires notification of company management even if you are a self-referral.

Effects of Drugs

Drugs can have a significant impact on your job performance. The use of drugs, or other chemicals, can result in:

- impaired judgment
- impaired vision
- changes in reflexes

- reduced analytical ability

The use of drugs and chemicals may also have an impact on any testing for chemicals. This includes commonly purchased over-the-counter drugs such as aspirin and cold medicine. For this reason, it is important that you list all drugs you have taken prior to the test.

Medical Review Officer

The medical review officer (MRO) is responsible for:

- [overall administering of the chemical testing program]
- reviewing all positive chemical test results
- [recommending individuals to the employee assistance program]

Consequences for Violations

If you violate the fitness-for-duty policy, you can be suspended, have your unescorted access denied, and be referred to an employee assistance program.

- (*)

Individual Rights

If you test positive, you have the right to appeal the test results and any sanctions taken against you.

Appeals for a confirmed positive test:

- Apply to permanent employees [and contractors].
- Must be in writing.

You also have the right to privacy at the collection site unless there is reason to believe that you will tamper, alter, or substitute a specimen.

Personal information collected for the fitness-for-duty program will be protected and will not be disclosed except as required by the appropriate procedure.

Individual Responsibilities

You are responsible for keeping your supervisor informed of any medication or other substance or problems that could affect your performance.

You should also talk to your supervisor if you notice unusual behavior or suspect drug use by any of your coworkers. This could have a negative impact on the plant's performance.

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Guidelines for General Employee Training

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February 8, 1994

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Information and Records Management Branch
Division of Information Support Services

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