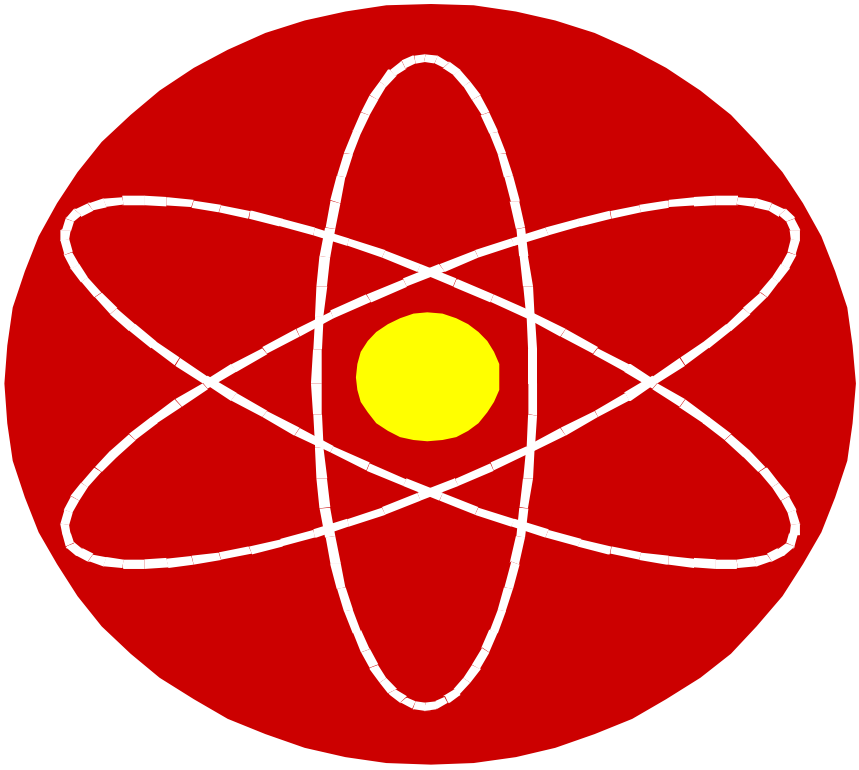
Radiation Worker Training
RWT 010/000



TVA NPG

NUCLEAR TRAINING
TRAINING MATERIALS COVERSHEET

GENERAL EMPLOYEE TRAINING PROGRAM	
RADIATION PROTECTION (RP) INITIAL AND RETRAINING COURSE	**RWT010 COURSE NO.**
RADIATION WORKER TRAINING LESSON TITLE	**RWT010 LESSON PLAN NO.**

INPO ACCREDITED YES ____ NO **X**

MULTIPLE SITES AFFECTED YES **X** NO ____

PREPARED BY	*Original signed by Barbara Brooks 05/14/2009* Signature / Date
PROCESS REVIEW	*Original signed by David Glover 06/01/2009* Signature / Date
LEAD INSTRUCTOR/PROGRAM MGR. REVIEW	*Original signed by Rob L. Coleman 06/02/2009* Signature / Date
PLANT CONCURRENCE	*Electronic approval Paul Sawyer 05/18/2009* Signature / Date
TVA NUCLEAR CONCURRENCE	*Electronic approval by Mark A. Palmer 05/18/2009* Signature / Date

Receipt Inspection and Distribution: _____
Training Materials Coordinator / Date

_____

Standardized Training Material Copies to:
BFN Technical Training Manager, BFT 3A-BFN
SQN Technical Training Manager, STC 2T-SQN
WBN Technical Training Manager, WTC 1D-WBN
COC, EB 10B-C

NUCLEAR TRAINING
REVISION/USAGE LOG

Rev. #	Description of Changes	Date	Pages Affected	Reviewed By
0	New lesson plan to coincide with implementation of CBT GET. Lesson material follows guidance of ACAD 93-009. Training Process Comment: This LP is primarily for CBT use. The standard format requirements are waived for "user friendly" purposes.	01-01-1996.	All	J.R. Waldrep/N.E. Scott
1	Corrected errors and editorial changes	11-01-1996.	2,4,6,8,21,25,31,33,34,35, 36,37,39,50,51,52,56,57,5 8,63,& 64.	N.E. Scott
2	General revision	04-20-1998.	All	N.E. Scott
3	General revision (Added objective references, CBT screen references and practice questions; Incorporated HIS-20 and deleted REXS, and made the lesson plan and CBT Modules consistent).	09-05-1999.	All	J.D. Buchanan
4	General revision	02-05-2001.	All	Reed, T. Sawyer, R. Waldrep.
5	General revision (Incorporated all non-intent changes since last revision).	Effective Date: 6/3/02	All	Thomas Sawyer/Randy Waldrep.
	Non-intent change to standardize RADIATION PROTECTION (RP) phone numbers in TVA Nuclear.	6/10/02	2,8	Randy Waldrep
	Non-intent change to incorporate change regarding workers who have partial hearing loss having difficulty hearing ED audible alarms and responsibilities for these workers.	6/28/02	2,37,90	Randy Waldrep
	Non-intent change to list as a reference SOER 01-1, "Unplanned Radiation Exposures".	7/11/02	2,3	Randy Waldrep
	Non-intent change to add Portal Monitor and turnstile information.	10/21/02	2,40,55,76	Randy Waldrep
6	General revision to capture non-intent changes since revision 5, update references, correct identified typos, expand instructions for workers on use of EDs, add reminder to workers to ensure no error messages are received when logging in on HIS-20, add instructions on use of Portal Monitors, add instructions for use of Small Article Monitors, instructions for use of PCM-2s, delete reference to highly contaminated area, add information on wearing of personal hardhats in c-zones, as well as add information on use of PM-7s and turnstiles at RCA access points.	Effective Date: 01/06/03	All due to total pages changed from 91 to 92. Lesson body changed on the following pages: 2,3,6,8,16,17,37,38,41, 42,44,48,49,51, 52-56,58,68,74, 76-78,83,92	Randy Waldrep

NUCLEAR TRAINING
REVISION/USAGE LOG

Rev. #	Description of Changes	Date	Pages Affected	Reviewed By
7	General revision to incorporate non-intent changes since last revision, add change in CAM alarm for BFN, add info on Radiation Protection (RP) Peer team recommendation, "How To Prevent Personnel Contamination", correct reference to SOER 01-1 and add info on Radwaste Peer team recommendation to update information on how to reduce generation of radioactive waste.	06/01/04	All due to total pages changed from 93 to 97. Lesson body changed on the following pages: 3, 40, 50-52, 77, 78, 82, 89 and 92-93.	B. A. Brooks
8	Add info on Control of Radioactive Material due to recent events where radioactive material was found outside the RCA.	Effective date 01/19/05	All due to total pages changed from 97 to 101 Lesson body changed on the following pages: 3, 62-65,	B. A. Brooks
9	Add info on reaching over barriers in response to SQN PER 80322-Action 2	Effective Date 10/14/05	All due to total pages changed from 97 to 100 Lesson body changed on the following pages: 3, 83-84.	B. A. Brooks
10	To ensure consistency with Nantel TVAN specific material. Incorporate expectation for TLD not to be worn after receiving medical isotope treatment. Add OE on BFN PER 98679. Change Radiation Protection (RP) to Radiation Protection (RP)	Effective date 09/11/06	All due to total pages changed from 100 to 95 Lesson body changed on the following pages: 3, 35, 39, 68, and 79.	B. A. Brooks
11	To add Corporate Training request to emphasize SOER01-01.	Effective Date 06/30/07	All due to total pages changed from 95 to 96 Lesson body changed on the following pages: 3 and 7	B. A. Brooks
12	Update information on use of SAMs, definition of overhead, and other general revisions (includes SQN and WBN update requests).	Effective Date 01/18/08 for BFN & SQN. 02/15/08 for WBN.	All due to total pages changed from 96 to 97 Lesson body changed on the following pages: 3, 46, 47, 50-55, 57,58, 60, 81-83 and 97.	B. A. Brooks
13	Added statement to Locked High Radiation Area (LHRA) area to describe how LHRAs are posted in large open areas. Corrective action for PER 154685.	06/26/09	3 and 85	B. A. Brooks

REFERENCES

NUREG 0713 "Occupational Radiation Exposure at Commercial Nuclear Power reactors and other Facilities," Vols. 12, 1990

10 CFR 19, "Notices, Instructions and Reports to Workers; Inspection", 1995

10 CFR 20, "Standards for Protection against Radiation", 1999

Presidential Document, Federal Register, Volume 52, No. 17, January 27, 1987, Radiation Protection Guidance to Federal Agencies for Occupational Exposure

U.S. NRC Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposure will be As Low As Reasonably Achievable", June 1978

U.S. NRC Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable", September 1975

U.S. NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure", June 1999

U.S. NRC Regulatory Guide 8.29, "Instruction Concerning Risks From Occupational Exposure", February 1996

NRC Form 3, "Notice to Employees", NRC, August 1997

SPP 5.1, "Radiological Controls", Revision 4

Nuclear Power Training Manual TRN-2, "General Employee Training", Revision 9

TVA Radiological Emergency Plan, Revision 61

INPO, Significant Event Report (SER) 88-006, Uncontrolled Radiation Exposure, March 1988 DO NOT DELETE

NRC Licensee Event Report (LER) SQN, 327/86052, Personnel Error Resulting in Failure To Maintain Administrative Control of a High Radiation Area DO NOT DELETE

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Operating Experience (OE) 2398, Hot Particle Contamination (Docket No. 50-312), February 1988 DO NOT DELETE

Division of Nuclear Licensing and Regulatory Affairs (DNLRA) Information Bulletin, July 28, 1988, Internal Contamination of Worker DO NOT DELETE

INPO SER 88-037, Personnel Radiation Overexposure Due to Work Generated "Hot Spots", December 1988 DO NOT DELETE

INPO SER 88-034 Work in Radiation Areas Subject to Changing Radiological Conditions, November 1988 DO NOT DELETE do not delete do not

ACAD 00-007, Guidelines for Radiation Worker and Radiological Respiratory Training, April 2000

INPO, Good Practice OEM-06, Conduct of Practical Exercises During General Employee Training, June 1985

Bushong, Stewart C., Radiological Science for Technologist, C.V. Mosby Company, Fourth Edition, 1988

Eisenbud, Merrill, Environmental Radioactivity, Academic Press, Inc., Third Edition 1987

Gollnick, Daniel A., Basic Radiation Protection Technology, Pacific Radiation Press, First Edition, 1986

Ionizing Radiation Exposure of the Population of the United States, NCRP, Report No. 93, September 1987

Primer of Medical Radiology, Travis, Elizabeth L., Year Book Medical Publishers, Inc., 1975

All About the Atom, Iva M. Freeman, Random House, Incorporated, 1955

Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V. National Research Council, National Academy Press, Washington DC, 1990

NCO-86-0174-003, Attention to Posted Areas DO NOT DELETE

NCO-90-0022-016, Special Nuclear Material, NRC Inspection Report No. 259/86-38 DO NOT DELETE

NRC Licensee Event Report (LER), QS, 327-86052, Personnel Error Resulting in Failure to Maintain Administrative Control of a High Radiation Area DO NOT DELETE

SER 89-001, Impact of Failed Fuel, February 1989 DO NOT DELETE

NRC Inspection Report No. 50-390/97-11

INTRODUCTION

A nuclear power plant has common potential hazards found in other industrial facilities, but the additional hazard of exposure to radiation exists. Your duties will require you to enter and work in areas where access is controlled for the purpose of protecting you from radiological hazards. Therefore, this training is intended to familiarize you with some procedures and requirements of the nuclear plant and to provide you with the knowledge to work safely around radioactive material. The guidelines provided in ACAD 00-007, "Guidelines for General Employee Training" have been followed to develop course content. An examination with a score of greater than or equal to 80% is required for this course. In addition, Radiation Worker Practical Dressout (RWP000) with a score of greater than or equal to 80% is required for the initial course.

trn2 C.R. - 99-0086

Entry into the test portion of this course is through signature (electronic signature if participating in Computer Based Training). This signature acknowledges you have been presented information concerning the possible health risk to children who are exposed to radiation during pregnancy. The signature also verifies that a written copy of material concerning the risks of prenatal exposure was made available to you. It also acknowledges that you understand that you may consult the Health Physicist at any time concerning this subject. The signature acknowledges that you shall read the Radiation Work permit and adhere to its requirements. Also, you are acknowledging that you understand by your failure of these exams, you will be restricted from entering any area for the purpose of radiological protection

New Screen Expectations

Radiation Worker Expectations While Working at TVA Nuclear Facilities

New Screen Exp1

Safety is the most important priority at TVA Nuclear . To that end, we have worked to put into place the policies, procedures, and tools to protect your health and safety and to create a safety-conscious work environment. But even the best tools are of low value if they are not used properly. Safety glasses won't protect your eyes if they remain in your shirt pocket; safety gloves won't protect your hands if they're fastened to your hip.

New Screen Exp1a

Radiation safety is a particularly important responsibility that is unique to our industry. The TVA NUCLEAR management team is committed to providing all employees with a radiologically safe work environment. However, it is critical that we all realize the importance of maintaining a high level of awareness and a sense of individual responsibility with regard to personal radiation safety. The Institute of Nuclear Power Operations (INPO) has documented issues in our industry in a Significant Operating Experience Report (SOER-01-1, titled "Unplanned Radiation Exposures"). This report documents several examples where radiation workers' disregard for the radiation controls resulted in unnecessary radiation exposure. We expect everyone to comply with our radiation protection requirements and procedures. If you have questions or need clarification on the radiation protection requirements, please consult the site radiation protection group.

New Screen Exp1b

Please take time to examine your personal responsibility for making our work environment as safe as possible each year when you review Radiation Worker training materials or if you're coming in for the first time at one of our nuclear sites. It begins with each of us. We are our own last line of defense.

RIGHTS AND RESPONSIBILITIES

Screen rrobj

OBJECTIVES

State the TVA NUCLEAR worker's responsibilities for:

RNR-01 – **keeping personal dose ALARA,**

RNR-02 – **maintaining awareness of current personal dose,**

RNR-03 – **adhering to instructions provided by Radiological Control (both written and verbal).**

RNR-04 – **remaining within federal limits and TVA Nuclear administrative goals and guidelines.**

Screen rrobj2

State your responsibilities/rights regarding:

RNR-05 – **identifying actions and reporting responsibilities when abnormal radiological conditions and/or violations of requirements are encountered,**

RNR-06 – **your rights and process to obtain personal radiation dose data,**

RNR-07 – **the use and control of special nuclear material (SNM) and radioactive byproduct material.**

Screen surprise

RADIATION WORKER'S RESPONSIBILITIES

Surprised at all the new responsibilities you will have being a qualified radiation worker?

screen review

Let's look at a radiation worker's responsibilities…

Screen RWR

Maintain your dose As Low As Reasonably Achievable (ALARA) at all times.

RNR-01: State the TVA NUCLEAR worker's responsibilities for keeping personal dose ALARA.

Screen RWR2 trn2 cr 99-0129

Work in accordance with the Radiation Work Permits that are in effect.

Screen RWR3

Always follow directions from RADIATION PROTECTION (RP) personnel (either written or verbal), including stopping work when directed.

RNR-03:State the TVA Nuclear worker's responsibilities for adhering to instructions provided by RP (both written and verbal).

Screen RWR4
trn2 cr 99-0129

RNR-02:State the TVA Nuclear worker's responsibilities for maintaining awareness of current personal dose.

Always be aware of your personal dose including your remaining allowable dose (RAD).

Your RAD may be referred to as your dose margin.

Screen RWR5

RNR-04: State the TVA Nuclear worker's responsibilities for remaining within federal limits and TVA Nuclear's administrative goals and guidelines.

Stay within the limits and guidelines regarding personal dose.

Screen RWR6

RNR-05: State your responsibilities/ rights regarding actions and reporting when abnormal radiological conditions or violations of requirements are encountered.

Keep plant management or RADIATION PROTECTION (RP) informed of radiological violations and abnormal conditions.

Screen RWR6a

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RNR-07:State your responsibilities/ rights regarding the use and control of special nuclear material (SNM).

Special Nuclear Material (SNM)

You must contact the SNM Custodian prior to working with SNM. SNM is plutonium or enriched uranium and is usually found in nuclear fuel and certain monitors in the plant. The SNM custodian is responsible for the control and inventory of all SNM. Notify the SNM custodian prior to working with or handling SNM.

Screen RWR6b

RNR-07: State your responsibilities/ rights regarding the use and control of radioactive byproduct material.

Radioactive Byproduct Material

You must receive any byproduct material (radioactive material other than SNM) through Nuclear Stores. The Byproduct Material Custodian keeps an accurate inventory of this type material at the nuclear plant.

Screen RWR6c

If there are any questions concerning the use, storage, receipt, shipment, disposal etc. of radioactive material, contact RADIATION PROTECTION (RP) for assistance.

Screen RWR7

RNR-06: State your rights and process to obtain personal radiation dose data.

Finally…

You have the RIGHT to review your radiation dose record. To do this contact RP.

Screen TCRRB

RNR-05: State your responsibilities/ rights regarding actions and reporting when abnormal radiological conditions or violations of requirements are encountered.

NRC - Form 3

The NRC Form 3 lists the rights and responsibilities of workers. If a worker notices a violation of an NRC regulation or site requirement, he/she must report the violation as soon as possible.

Report violations by:

1. **informing RP at extension 7865**

2. **informing your supervisor.**

Screen TCRRC

If a worker does not wish to use the chain of command, or if he already has and no changes are made, the worker now has the responsibility to notify the NRC. The basic function of the NRC is to ensure the safe operation of the Nuclear Industry by enforcing the Code of Federal Regulations (CFRs). Contact the on-site representative or the regional office. By law, a worker can not be fired or intimidated / harassed in any way for reporting a violation to the NRC. Also, NRC inspectors are protected by Federal law. Interference with them can result in criminal prosecution.

Screen TCRRC1

TVA Nuclear may be subject to civil enforcement actions for violations of NRC regulations. Individuals who intentionally violate these requirements may also be subject to civil or criminal prosecution.

Screen TCRRD

Occupational Radiation Exposure

Occupational Radiation Exposure is the radiation exposure that you receive at any facility that monitors for radiation or radioactive material.

Screen TCRRE

All radiation workers have the right to examine their OCCUPATIONAL RADIATION EXPOSURE RECORD at any time. These records are maintained by RP and are sent directly to you on an annual basis. Make requests to see your records through your supervisor. Any questions regarding your radiation exposure records will be answered by RP

Screen rrsum
trn2 cr 99-0129

SUMMARY

Your responsibilities include:

- **Keeping your dose ALARA at all times.**
- **Working in compliance with RWPs.**
- **Always following directions from RP Staff.**
- **Knowing current personal dose and dose margin.**
- **Staying within dose limits, levels, and guidelines.**
- **Informing plant management of radiological violations and abnormal conditions.**

Screen rrsum2

Your rights include:

- **Radiation workers have the right to review their dose record. To do this contact RP.**

NRC FORM 3
(1-96)

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, DC 20555-0001

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

WHAT IS THE NUCLEAR REGULATORY COMMISSION?

The Nuclear Regulatory Commission is an independent Federal regulatory agency responsible for licensing and inspecting nuclear power plants and other commercial uses of radioactive materials.

WHAT DOES THE NRC DO?

The NRC's primary responsibility is to ensure that workers and the public are protected from unnecessary or excessive exposure to radiation and that nuclear facilities, including power plants, are constructed to high quality standards and operated in a safe manner. The NRC does this by establishing requirements in Title 10 of the Code of Federal Regulations (10 CFR) and in licenses issued to nuclear users.

WHAT RESPONSIBILITY DOES MY EMPLOYER HAVE?

Any company that conducts activities licensed by the NRC must comply with the NRC's requirements. If a company violates NRC requirements, it can be fined or have its license modified, suspended or revoked.

Your employer must tell you which NRC radiation requirements apply to your work and must post NRC Notices of Violation involving radiological working conditions.

WHAT IS MY RESPONSIBILITY?

For your own protection and the protection of your co-workers, you should know how NRC requirements relate to your work and should obey them. If you observe violations of the requirements or have a safety concern, you should report them.

WHAT IF I CAUSE A VIOLATION?

If you engaged in deliberate misconduct that may cause a violation of the NRC requirements, or would have caused a violation if it had not been detected, or deliberately provided inaccurate or incomplete information to either the NRC or to your employer, you may be subject to enforcement action. If you report such a violation, the NRC will consider the circumstances surrounding your reporting in determining the appropriate enforcement action, if any.

HOW DO I REPORT VIOLATIONS AND SAFETY CONCERNS?

If you believe that violations of NRC rules or the terms of the license have occurred, or if you have a safety concern, you should report them immediately to your supervisor. You may report violations or safety concerns directly to the NRC. However, the NRC encourages you to raise your concerns with the licensee since it is the licensee who has the primary responsibility for, and is most able to ensure, safe operation of nuclear facilities. If you choose to report your concern directly to the NRC, you may report this to an NRC inspector or call or write to the NRC Regional Office serving your area. If you send your concern in writing, it will assist the NRC in protecting your identity if you clearly state in the beginning of your letter that you have a safety concern or that you are submitting an allegation. The NRC's toll- free SAFETY HOTLINE for reporting safety concerns is listed below. The addresses for the NRC Regional Offices and the toll-free telephone numbers are also listed below.

WHAT IF I WORK WITH RADIOACTIVE MATERIAL OR IN THE VICINITY OF A RADIOACTIVE SOURCE?

If you work with radioactive materials or near a radiation source, the amount of radiation exposure that you are permitted to receive may be limited by NRC regulations. The limits on your exposure are contained in sections 20.1201, 20.1207, and 20.1208 of Title 10 of the Code of Federal Regulations (10 CFR 20) depending on the part of the regulations to which your employer is subject. While these are the maximum allowable limits, your employer should also keep your radiation exposure as far below those limits as "reasonably achievable."

MAY I GET A RECORD OF MY RADIATION EXPOSURE?

Yes. Your employer is required to advise you of your dose annually if you are exposed to radiation for which monitoring was required by NRC. In addition, you may request a written report of your exposure when you leave your job.

HOW ARE VIOLATIONS OF NRC REQUIREMENTS IDENTIFIED?

NRC conducts regular inspections at licensed facilities to assure compliance with NRC requirements. In addition, your employer and site contractors conduct their own inspections to assure compliance. All inspectors are protected by Federal law. Interference with them may result in criminal prosecution for a Federal offense.

MAY I TALK WITH AN NRC INSPECTOR?

Yes. NRC inspectors want to talk to you if you are worried about radiation safety or have other safety concerns about licensed activities, such as the quality of construction or operations at your facility. Your employer may not prevent you from talking with an inspector. The NRC will make all reasonable efforts to protect your identity where appropriate and possible.

MAY I REQUEST AN INSPECTION?

Yes. If you believe that your employer has not corrected violations involving radiological working conditions, you may request an inspection.

Your request should be addressed to the nearest NRC Regional Office and must describe the alleged violation in detail. It must be signed by you or your representative.

HOW DO I CONTACT THE NRC?

Talk to an NRC inspector on-site or call or write to the nearest NRC Regional Office in your geographical area (see map below). If you call the NRC's toll-free SAFETY HOTLINE during normal business hours, your call will automatically be directed to the NRC Regional Office for your geographical area. If you call after normal business hours, your call will be directed to the NRC's Headquarters Operations Center, which is manned 24 hours a day.

CAN I BE FIRED FOR RAISING A SAFETY CONCERN?

Federal law prohibits an employer from firing or otherwise discriminating against you for bringing safety concerns to the attention of your employer or the NRC. You may not be fired or discriminated against because you:

- ask the NRC to enforce its rules against your employer;
- refuse to engage in activities which violate NRC requirements;
- provide information or are about to provide information to the NRC or your employer about violations of requirements or safety concerns;
- are about to ask for, or testify, help, or take part in an NRC, Congressional, or any Federal or State proceeding.

WHAT FORMS OF DISCRIMINATION ARE PROHIBITED?

It is unlawful for an employer to fire you or discriminate against you with respect to pay, benefits, or working conditions because you help the NRC or raise a safety issue or otherwise discourage you from engaging in protected activities. Violations of Section 211 of the Energy Reorganization Act (ERA) of 1974 [42 U.S.C. 5851] include the harassment and intimidation by employers of (i) employees who bring safety concerns directly to their employers or to the NRC; (ii) employees who have refused to engage in an unlawful practice, provided that the employee has identified the illegality to the employer; (iii) employees who have testified or are about to testify before Congress or in any Federal or State proceeding regarding any provision (or proposed provision) of the ERA or the Atomic Energy Act (AEA) of 1954; (iv) employees who have commenced or caused to be commenced a proceeding for the administration or enforcement of any requirement imposed under the ERA or AEA or who have, or are about to, testify, assist, or participate in such a proceeding.

HOW DO I FILE A DISCRIMINATION COMPLAINT?

If you believe that you have been discriminated against for bringing violations or safety concerns to the NRC or your employer, you may file a complaint with the U.S. Department of Labor (DOL) pursuant to Section 211 of the ERA. Your complaint must describe the firing or discrimination and must be filed within 180 days of the occurrence. Filing an allegation, complaint, or request for action with the NRC does not extend the requirement to file a complaint with the DOL within 180 days. You must file the complaint with the DOL. The NRC cannot file the complaint for you.

Send complaints to:

Office of the Administrator
Wage and Hour Division, Room S3502
Employment Standards Administration
U.S. Department of Labor
Constitution Avenue, NW
Washington, DC 20210

or any local office of the DOL, Wage and Hour Division. Check your telephone directory under U.S. Government listings.

WHAT CAN THE DEPARTMENT OF LABOR DO?

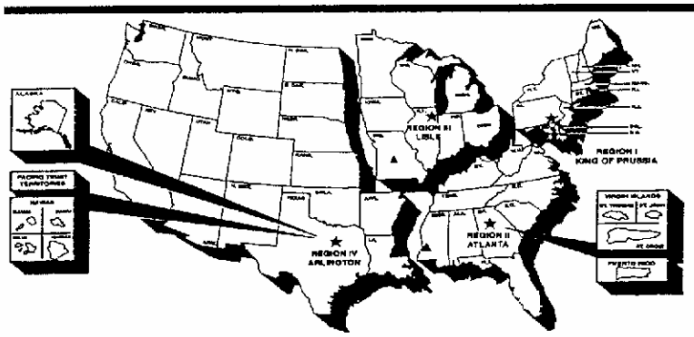
If your complaint involves a violation of Section 211 of the ERA by your employer, it is the DOL, NOT THE NRC, that provides the process for obtaining a personal remedy. The DOL will notify your employer that a complaint has been filed and will investigate your complaint.

If the DOL finds that your employer has unlawfully discriminated against you, it may order that you be reinstated, receive back pay, or be compensated for any injury suffered as a result of the discrimination.

WHAT WILL THE NRC DO?

The NRC will evaluate each allegation of harassment, intimidation, or discrimination. Following this evaluation, an investigator from the NRC's Office of Investigations may interview you and review available documentation. Based on the evaluation, and, if applicable, the interview, the NRC will assign a priority and a decision will be made whether to pursue the matter further through an investigation. The assigned priority is based on the specifics of the case and its significance relative to other ongoing investigations. The NRC may not pursue an investigation to the point that a conclusion can be made whether the harassment, intimidation, or discrimination actually occurred. Even if NRC decides not to pursue an investigation, if you have filed a complaint with DOL, the NRC will monitor the results of the DOL investigation.

If the NRC or DOL finds that unlawful discrimination has occurred, the NRC may issue a Notice of Violation to your employer, impose a fine, or suspend, modify, or revoke your employer's NRC license.



Callaway Plant Site in Missouri and Grand Gulf Plant Site in Mississippi are under the purview of Region IV.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted by employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations at the following addresses and telephone numbers.

REGIONAL OFFICES

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission, Region I 475 Allendale Road King of Prussia, PA 19406-1415	(800) 432-1156
II	U.S. Nuclear Regulatory Commission, Region II 101 Marietta Street, N.W., Suite 2900 Atlanta GA 30323-0199	(800) 577-8510
III	U.S. Nuclear Regulatory Commission, Region III 801 Warrenville Road Lisle, IL 60532-4351	(800) 522-3025
IV	U.S. Nuclear Regulatory Commission, Region IV 611 Ryan Plaza Drive, Suite 400 Arlington, TX 76011-8064	(800) 952-9677
WALNUT CREEK FIELD OFFICE	U.S. Nuclear Regulatory Commission 1450 Maria Lane Walnut Creek, CA 94596-5368	(800) 882-4672

To report safety concerns or violations of NRC requirements by your employer,

telephone:

NRC
SAFETY HOTLINE

1-800-695-7403

To report incidents involving fraud, waste, or abuse by an NRC employee or NRC contractor,

telephone:

OFFICE OF THE
INSPECTOR GENERAL

HOTLINE

1-800-233-3497

SOURCES, TYPES, AND MEASURES OF RADIATION

Screen obj1
SOR-01
SOR-02

OBJECTIVES

State the basic structure of an atom including the three primary components and describe how radiation results from the nuclear process.

SOR-03

List the sources of radiation in the plant including the following: fuel, reactor coolant, activation and corrosion products, plant components, reactor operations.

Screen obj2
TMR-01

State the four types of radiation found in a commercial nuclear power plant.

TMR-02

Characterize the four types of ionizing radiation by the following: penetrating ability, methods of shielding, exposure hazard, where found.

TMR-03

Define the terms REM and total effective dose equivalent (TEDE).

Screen obj3
TMR-04

Perform conversions from rem to millirem and from millirem to rem.

TMR-06

Identify the type of radiation that contributes the most to a worker's dose.

TMR-05

Calculate a worker's dose given a dose rate and time spent in an area.

Screen stm1

Training our staff to be safe radiation workers cannot begin without an understanding of the SOURCES, TYPES, and MEASURES of radiation

Screen stm2

ATOMS

All things in our universe 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.

Screen stm3

Atoms are so small that they cannot be seen, even using a microscope!

Screen stm4

The atom is composed of THREE major parts:

SOR-01: State the basic structure of an atom including the three primary components.

Screen stm5
Screen stm6
Screen stm7

NEUTRONS
PROTONS
ELECTRONS.

Screen stm8

Structure of an Atom

Neutrons and protons form the nucleus of an atom.

Screen stm9

These two particles are approximately the same in size.

Screen stm10

Protons have a positive electrical charge, and neutrons have no electrical charge.

Screen stm11

The number of protons determines what the element is. The Periodic Table illustrates the relationship between elements based on their structure.

Screen stm12

The number of protons determines chemical identity of the atom, for example, oxygen, iron, or any other element.

Screen stm14
trn2 cr 99-0039

Surrounding the nucleus is a "cloud" composed of electrons in orbit. The number of electrons depends on the element and usually equals the number of protons. The electron has a negative electrical charge.

Screen stm15

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 eject packets of energy or particles to attain that stability.

Screen stm16

This excess energy emitted from unstable atoms is called ionizing RADIATION.

Screen stm17

Energy in the form of ionizing radiation may also be created when larger atoms are FISSIONED into two or more smaller atoms.

SOR-02 Describe how radiation results from the nuclear process.

Screen quiz1
trn2 cr 99-0083

QUESTION: The negatively charged particle which orbits the nucleus of the atom is the:

neutron or proton or electron

Screen quiz1c

ANSWER: The electron is the particle with a negative charge which orbits the nucleus of the atom.

Screen stm18

Certain forms of radiation can cause the IONIZATION of other atoms.

Screen stm19

One form of ionization of an atom is simply the removal of one of its orbital electrons.

Screen stm20

When an electron is removed, TWO charged particles, or ions, result - the negatively charged electron that escapes from its atom and the remaining positively charged atom.

Screen stm21

Ion Pair

The positively charged atom and the negatively charged electron are called, collectively, an Ion Pair.

Screen stm22
trn2 cr 99-0040

These ions react differently in certain materials. In living things, ions can cause changes that can be biologically harmful. More on the biological effects of radiation later…

Screen stm23

SOURCES OF RADIATION

SOR-03: List the sources of radiation in the plant including the following: reactor coolant, activation and corrosion products, plant components, and reactor operations.

The plant contains many potential SOURCES of radiation:

Screen stm24

- **Water that has been in the reactor (reactor coolant).**

Screen stm25

- **Certain residue from nuclear fuel (Fission Products) and plant systems (Activated Corrosion Products) that have been through the reactor and have been deposited on plant components.**

Screen stm26

- **Reactor fuel.**

Screen stm27

- **Reactor operations (as power increases, dose rates increase; as power decreases, dose rates decrease as well).**

screen stm28

- **Filters that had reactor coolant flowing through them**

Screen stm29

- **Reactor components that have been exposed to radiation.**

Screen tre1

FOUR TYPES OF IONIZING RADIATION

Screen tre1a

TMR-01: State the four types of radiation found in a commercial nuclear power plant.

α Alpha Radiation

An alpha particle is a helium atom without electrons. It consists of two protons and two neutrons, thus it has a plus two electrical charge. When an alpha particle's energy is expended, it attracts two electrons and becomes a helium atom.

Screen tre1b

TMR-02: Characterize where alpha radiation is found.

- α **Major source of alpha particles is the nuclear fuel.**

Screen tre1c

TMR-02: Characterize alpha radiation by its penetrating ability.

- α **Has the LEAST PENETRATING power of all ionizing radiation - travels in air just an inch or two.**

Screen tre1d

TMR-02: Characterize the methods of shielding alpha radiation.

- α **Alpha particles can be shielded by a piece of paper, by the dead layer of skin on the surface of the body, or by clothing.**

Screen tre1e

TMR-02: Characterize the exposure hazard of alpha radiation.

- α **However, because alpha particles are highly energetic, they can damage the softer internal tissues if deposited for a period of time.**

  We say then, that it is primarily an INTERNAL HAZARD.

Screen tre1p

TMR-01: State the four types of radiation found in a commercial nuclear power plant.

γ Gamma Radiation

Gamma radiation has no electrical charge or mass. It's a wave of pure ENERGY!

Screen tre1q

TMR-02: Characterize where gamma radiation is found.

- γ **Sources include fission, fission products, and activation products.**

Screen tre1r

TMR-02: Characterize gamma radiation by its penetrating ability.

- γ **Gamma radiation is a VERY penetrating form of wave radiation.**

  Gamma ray can easily penetrate the walls of piping containing radioactive materials.

Screen tre1s

TMR-02: Characterize the methods of shielding gamma radiation.

- γ **Gamma radiation can be REDUCED by shielding the source of the radiation with very dense material such as lead, steel, or concrete.**

Screen tre1t

TMR-02: Characterize the exposure hazard of gamma radiation.

TMR-06: Identify the type of radiation that contributes the most too a worker's dose.

- γ **Gamma radiation is an extremely penetrating wave that is an external hazard to the whole body. The majority of nuclear plant worker dose is from GAMMA radiation.**

Screen tre1f

TMR-01: State the four types of radiation found in a commercial nuclear power plant.

Screen tre1g

TMR-02: Characterize where beta radiation is found.

Screen tre1h

TMR-02: Characterize beta radiation by its penetrating ability.

Screen tre1I

TMR-02: Characterize the methods of shielding beta radiation.

Screen tre1j

TMR-02: Characterize the exposure hazard of beta radiation.

β Beta Radiation

Beta radiation is made up of high speed particles with a negative electrical charge which originate from the nucleus of an atom.

- β **Source of most beta particles is from activated corrosion and fission products.**

- β **Penetration in air is usually limited to a few feet, but beta particles have more penetrating power than alpha particles.**

- β **The best shielding for beta is a few layers of lightweight plastic or light metal.**

- β **Eyes and skin can be affected by beta radiation, but normally it can only penetrate a few layers of skin.**

  Personnel would have to work fairly close to a beta source to receive much exposure.

Screen tre1k

TMR-01: State the four types of radiation found in a commercial nuclear power plant.

Screen tre1l

TMR-02: Characterize where neutron radiation is found.

Screen tre1m

TMR-02: Characterize neutron radiation by its penetrating ability.

Screen tre1n

TMR-02: Characterize the methods of shielding neutron radiation.

Screen tre1o

TMR-02: Characterize the exposure hazard of neutron radiation.

η Neutron Radiation

Neutron particles are part of the atomic nucleus that has been freed by either decay or fission. Neutrons have no electrical charge.

- η **Fission process creates neutron particles.**

- η **Neutron particles are very penetrating.**

- η **They are best shielded by water, concrete, or thick polyethylene.**

- η **Due to the high-penetration capabilities of neutron radiation, it is an external hazard to the whole body.**

  Neutron exposure mainly occurs when in close proximity to the reactor only while it is operating.

Screen quiz2
trn2 cr 99-0083

QUESTION: Most ionizing radiation dose at the station is from this type of radiation:

alpha or beta or neutron or gamma

Screen quiz2d

ANSWER: Gamma radiation is very penetrating and is located at various locations in the plant, therefore causing most of our dose.

Screen quiz3
trn2 cr 99-0083

QUESTION: This type radiation is a particle with no electric charge and gives a whole-body dose:

alpha or beta or neutron or gamma

Screen quiz3c

ANSWER: Neutron radiation is a particle with no electric charge and gives whole body dose.

Screen stm30

MEASURES OF RADIATION (DOSE RATE AND TEDE)

Remember that DOSE is defined as "the amount of radiation absorbed by the body or a particular organ."

Screen stm31

DOSE RATE is the amount of dose received in a specific period of TIME.

Dose rate is usually given in units of MREM PER HOUR (mrem/hr).

Screen stm32

Dose = Dose Rate X Time

Screen stm33

Dose is determined by multiplying the dose rate and the time exposed to the radiation. For example:

TMR-05: Calculate a worker's dose, given a dose rate and time spent in an area

Screen stm34

If you spend 4 hours in an area with a dose rate of 12 mrem/hr, your dose would be 48 mrem.

Screen stm35
DOSE = 12 mrem/hr X 4 hours
screen stm36
DOSE = 48 mrem

Now it's your turn to try…

Screen quiz4
trn cr 99-0083

QUESTION: You spend 2 hours in a plant area where the dose rate is 40 mrem/hr. How much dose will you receive?

20 mrem or 80 mrem, or 100 mrem

Screen quiz4c

ANSWER: You would receive a dose of 80 mrem.

Screen quiz5
trn cr 99-0083

QUESTION: The Dose Rate in the room you are working in for 30 minutes is 80 mrem/hr. What dose do you receive for your entry?

20 mrem or 40 mrem or 50 mrem

Screen quiz5c

ANSWER: You would receive a dose of 40 mrem.

Screen stm38

TMR-03: Define the term rem.

Your dose is "expressed" in units of rem (or mrem) which is a measure of any type of ionizing radiation in terms of the ESTIMATED BIOLOGICAL EFFECTS.

Screen stm39

TMR-03: Define the term Total Effective Dose Equivalent (TEDE). Screen stm40

The AMOUNT of radiation dose you receive is termed the Total Effective Dose Equivalent (TEDE). TEDE is determined by adding the body's external dose to the internal dose and is corrected for the type of radiation.

<u>Units of Measurement</u>

Since measurements of radiation are often in very small fractions of rem, the prefix milli, meaning 1/1000, is used with these units.

Screen tre2

<u>CONVERTING REM TO MREM</u>

Screen tre2a

To convert rem to millirem (mrem), multiply the number of rem by 1000:

(1.335 rem) x (1000) = 1335 mrem

TMR-04: Perform conversions from rem to millirem.

.. or ..

move the decimal point three places to the RIGHT!

screen tre2b

1.335 rem = 1335.0 mrem

Screen tre2d

For example, to convert 1.3 rem to mrem…

multiply 1.3 (number of rem) by 1000:

(1.3 rem) x (1000) = 1300 mrem

.. or..

move the decimal point three places to the right:

1.300 rem = 1300 mrem

Screen tre2

<u>CONVERTING MILLIREM TO REM</u>

Screen tre2e

To convert from mrem to rem, divide the number of millirem by 1000:

(2700 mrem) / (1000) = 2.7 rem

TMR-04: Perform conversions from millirem to rem.

.. or..

move the decimal point three places to the LEFT!

screen tre2f

2700.0 mrem = 2.7000 rem

Screen quiz6 trn2 cr 99-0083

QUESTION: To convert 1.7 rem to mrem, multiply the number 1.7 rem by 1000.

True or False

Screen quiz6c

ANSWER: True. Multiply by 1000 or move the decimal point three places to the right.

Screen quiz7 trn2 cr 99-0083

QUESTION: 1850 mrem equals _____ rem.

0185 or 1.85 or 18.5

Screen quiz7c

ANSWER: 1.85. You divide 1850 by 1000 and you get 1.85 rem.

Screen sum1

SUMMARY

- **The three major parts of an atom are the neutron, proton, and electron.**
- **Ionizing radiation is emitted from unstable atoms.**
- **Corrosion and fission products found in the reactor coolant system are examples of sources of radiation.**
- **Radiation may be present close to the reactor when it is operating.**

Screen sum2

- **The four basic types of ionizing radiation are alpha, beta, gamma, and neutron.**
- **Dose rate is the amount of dose received in a specific period of time.**
- **The rem is a unit used to measure any type of ionizing radiation in terms of estimated biological effects.**
- **The sum of the internal and external dose received is termed Total Effective Dose Equivalent (TEDE).**

Screen sum3

- **To convert rem to millirem, move the decimal point three places to the right. To convert from millirem to rem, move the decimal point three places to the left.**

BIOLOGICAL EFFECTS

Screen bioobj1

OBJECTIVES

BEF-01 **State the effect of radiation on cells.**

BEF-02 **Define chronic radiation exposure and the associated risks.**

BEF-03 **Define acute radiation exposure and the associated risks.**

BEF-04
BEF-05 **Define somatic and genetic effects and compare somatic versus genetic effects of radiation exposure.**

Screen bioobj2
BEF-06 **Compare the radiosensitivity of different age groups and identify the possible effects of radiation on an embryo/fetus due to prenatal exposure.**

BEF-07 **State the purpose of the NRC Form 4.**

BEF-08 **State the purpose of the NRC Form 5**

Screen Bio

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 these CELLS.

Screen Bio2

Radiation causes cell damage by IONIZING atoms and molecules in the cell, which disrupts normal cellular chemistry.

Screen Bio2a

This radiation also damages chromosomes in the cell nucleus, which may impair the cell's REPRODUCTIVE process.

Screen Bio3

Four things may happen to cells when exposed to excessive amounts of ionizing radiation:

Screen Bio3a

BEF-01: State the effect of radiation on cells.

1. **Nothing**
2. **Cell damage**
3. **Cell mutation**
4. **Cell death**

Screen Bio4

Generally speaking, RADIOSENSITIVITY increases as the cell's division rate and metabolism rate increase…

Screen Bio5

…For example, blood-forming cells are more sensitive to radiation dose than bone cells, and children are more sensitive than adults!

Screen Boi6

Radiation exposure, both internal and external, can cause adverse effects on the human body. These effects on the human body depend on:

Screen Bio6a

- **Length and amount of exposure.**

Screen Bio6b

- **Area or organ of the body exposed to radiation.**

Screen Bio6c

- **Type of radiation exposure.**

Screen Bioquiz
trn cr 99-0083

QUESTION: Which one of these two individuals would be more sensitive to ionizing radiation dose:

a woman or a child

Screen BioquizC

ANSWER: Children are more sensitive to ionizing radiation than adults.

Screen Chronic

ACUTE/CHRONIC EXPOSURE

An individual's exposure to radiation may occur over a short time period or over months or years.

Screen Chronic1a

BEF-02: Define chronic radiation exposure and the associated risks.

A series of small exposures spread out over months or years is known as CHRONIC exposure.

Screen Chronic2

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.

Screen Chronic3

Recall that members of the general public receive about *360 mrem per year* of chronic radiation (due to background sources), depending on the area of the country and other factors.

Screen Acute

Acute Exposure

BEF-03: Define acute radiation exposure and the associated risks.

A large exposure received in a short period of time, usually less than 24 hours, is called an ACUTE exposure.

Screen Acute2

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.

Screen Acute3

Prompt Effects of Acute Ionizing Radiation Exposure

Acute Dose (rem)	***Probable Clinical Effect***
0 - 25	**No observable effects.**
Screen Acute3a **25 to 100**	**Slight blood changes, no other observable effects.**
Screen Acute3b **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.**
Screen Acute3c **200 to 600**	**Vomiting, fatigue, and loss of appetite occur in 50 to 100 percent within three hours. For doses over 300 Rem, 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.**
Screen Acute3d **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.**

Screen Acute4

These effects are based on:

- **Exposure to the entire body.**
- **Exposures to the entire population.**

(Adapted from: S. Gladstone, Sourcebook on Atomic Energy)

Screen Class

CLASSES OF BIOLOGICAL EFFECTS

BEF-04: Define somatic effects.

Somatic Effects

Somatic effects occur in the INDIVIDUAL that received the radiation exposure. There are TWO types of somatic effects: Prompt & Delayed

Screen SomFast

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.

Screen SomSlow

DELAYED EFFECTS

These 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 these delayed effects may be caused by many influences other than radiation exposure. Cancers induced by radiation are indistinguishable from cancer caused by other sources.

Screen SomSlow2

For example, was a nuclear plant worker's cancer caused by radiation exposure while working in a power plant for 30 years or because he or she had smoked 3 packs of cigarettes a day since age 16?

Screen SomSlow3

Delayed effects may result from acute or chronic radiation exposure. Some of the known delayed effects of radiation exposure are cancer and cataracts.

Screen Cancer

The American Cancer Society estimates that 46% of males and 38% of females will develop cancer.

In a group of 10,000 adults, we would estimate 4000 to develop cancer at some time.

If these same 10,000 workers were exposed to 1 Rem (lifetime), we would anticipate an additional 12 cancers, or a total of 4,012 (0.12% increase).

Screen Gene

Genetic Effects

BEF-05: Define genetic effects.

Genetic effects appear in FUTURE GENERATIONS of an individual who receives the radiation exposure.

Screen Gene1a

Genetic effects are caused by damage to the genetic material and may appear as birth defects or other conditions in the future children of an exposed individual and succeeding generations.

Screen Gene2

According to NRC Regulatory Guide 8.29:

Genetic effects clearly caused by radiation have NOT been observed in human populations exposed to radiation. This includes the atomic blast survivors of Hiroshima and Nagasaki.

The probability of occupational exposure producing a genetic mutation in a worker's offspring is EXTREMELY REMOTE.

Screen Mnemon

When trying to remember biological effects…

Screen Mnemon1a

BEF-06: Compare somatic versus genetic effects of radiation exposure.

Somatic = Self

You receive the radiation exposure, and the effects are seen in you (yourself)!

Screen Mnemon1b

Genetic = Generation

You receive the radiation exposure, and the effects are seen in your future generations!

Screen Baby

Effects on the Unborn Child

BEF-05: Identify the possible effects of radiation on an embryo/fetus due to prenatal exposure.

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 death, structural abnormalities, abnormal growth, and mental retardation.

Screen Baby2

Due to the slight increased risk of teratogenic effects from exposure to radiation, regulations contained in 10CFR20.1208 are closely enforced within the nuclear power industry.

Screen Baby3
trn2 cr 99-0003

This document restricts the amount of dose a pregnant worker, who has notified her licensee of her condition, can receive.

These limits will be covered in a later section of Radiation Worker Training.

Screen Age

Effects of Age

BEF-06: Compare the radiosensitivity of different age groups.

As we know, the faster the reproduction rate of the cell, the more sensitive the body or organ is to radiation.

As a person ages, most cell-reproduction rates slow, leaving the person less sensitive to the effects of exposure to radiation.

Screen Acquiz
trn2 cr 99-0083

QUESTION: A large exposure received in a short period of time is called an acute exposure.

True or False

Screen AcquizC

ANSWER: True. Acute exposure is a large exposure received over a short time period.

Screen Acquiz2
trn2 cr 99-0083

QUESTION: Which range of acute whole-body radiation exposure (in rem) would cause death in almost all of the people exposed?

100 - 200 or 200 - 600 or 600 - 1000

Screen Acquiz2C

ANSWER: Death would occur in 80 - 100% of people within 2 months if exposed to 600 - 1000 rem of acute whole body radiation.

Screen Doc

NRC FORM-4 & NRC FORM-5

Because ANY exposure to radiation carries some degree of biological risk, it is important to keep track of these occupational doses and record them. Let's look at documenting radiation dose.

Screen Doc2

Dose received at other nuclear facilities must be recorded, included in the accumulated dose for the individual, and applied toward the exposure limit.

BEF-07: State the purpose of the NRC Form-4.

A special form, the NRC Form-4, is required to be completed which documents all previous LIFETIME occupational radiation exposures.

Screen Doc3

It is YOUR responsibility to ensure all exposure is reported to the company prior to starting work in the plant.

It is also true if a company worker visits another nuclear facility.

Screen Doc3a

In addition to the NRC Form-4, an NRC Form-5 is used to document the individual radiation worker's record of occupational radiation exposure received during the year at one plant.

BEF-08: State the purpose of the NRC Form-5.

Screen biosum

SUMMARY

- **Radiosensitivity increases as the cell's division rate and metabolism rate increase. For this reason, a child is more sensitive to radiation dose than an adult.**
- **Chronic exposure is long term exposure to low levels of radiation. A large exposure received in a short period of time, usually less than 24 hours is called an acute exposure.**
- **Direct biological effects on workers exposed to radiation are termed somatic.**

Screen biosum2

- **Genetic effects appear in future generations of an individual who receives the dose.**
- **Teratogenic effects may be observed in children who were exposed to radiation during the fetal and embryonic stages of development.**
- **The NRC Form-4 documents all previous lifetime occupational radiation exposure.**
- **The NRC Form-5 documents an individual's occupational radiation exposure received during the year at one plant.**

LIMITS, LEVELS, AND GUIDELINES

Screen llgobj

OBJECTIVES

LNG-02 **State the federal radiation dose limits for total effective dose equivalent (TEDE), lens of the eyes, shallow dose equivalent (SDE), extremities, and internal organ dose.**

LNG-03 **State the possible consequences if any federal radiation dose limit is exceeded.**

Screen llgobj1
LNG-04 **State TVA Nuclear administrative goals for TEDE radiation dose.**

LNG-05 **State the actions to be taken if TVA Nuclear administrative TEDE dose goal is being approached.**

Screen llgobj2
LNG-01 **Describe the limits and exposure guidelines for an embryo/fetus.**

LNG-06 **State the rights of a declared pregnant worker.**

LNG-07 **Recognize the definition of a Planned Special Exposure (PSE).**

Screen Extlnt1a

EXTERNAL AND INTERNAL RADIATION DOSE

Before entering a discussion of dose limits and guidelines, it is important to have a clear understanding of the differences between external and internal dose.

Let's take a close look at external versus internal dose!

Screen Ext

External Dose

External dose is dose received from radiation sources located OUTSIDE of the body. With external whole-body dose, the entire body, inside and out receives the dose.

Screen Int

Internal Dose

Internal dose is dose received from radioactive material deposited INTO the body. With internal dose, the majority of the dose is to organs where the radioactive material is located.

From the standpoint of overall health risk, what is important is not only HOW MUCH dose you get, but also HOW MUCH OF YOUR BODY gets the dose!

Screen USNRC

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.

Screen Risks

Federal 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.

Screen Body

Since the effects on some parts of the body due to radiation exposure are greater than those to other parts, the USNRC has divided the body into different areas…

Screen Body2

Extremities

For example, the body's extremities are defined as: hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

Screen Body3

Whole Body

And the whole body is defined as: head, trunk (including gonads), arms above the elbow, or legs above the knee.

Screen CFR

10CFR20 states that no licensee shall allow any person to receive a total occupational dose in excess of the LEGAL LIMITS specified in the following table:

Screen LegLim

Legal Limits

LNG-02: State the federal radiation dose limits for total effective dose equivalent (TEDE), lens of the eyes, shallow dose equivalent (SDE), extremities, and internal organ dose.

Area of Concern	Rem/Year
Shallow Dose Equivalent (SDE)	50 Rem/year
Extremities	50 Rem/year
Internal Organ (highest)	50 Rem/year
Lens of the Eyes	15 Rem/year
Whole Body (TEDE*)*	5 Rem/year

Screen LegLim2

The regulations also state that the licensee shall not allow radiation levels in unrestricted areas that may result in a member of the general population receiving greater than 100 mrem/yr.

Screen LegLim3

If any of these limits are EXCEEDED, there could be an increase in the risk of health effects.

Screen LegLim3a

Additionally, plant management would have to evaluate how the dose limit was exceeded and explain it to the NRC...

Screen LegLim4

Depending on the nature of the event, the individual could be disciplined, and the NRC may choose to fine or take other actions against the plant and/or the individual.

LNG-03: State the possible consequences if any federal radiation dose limit is exceeded.

Screen LegLim4a

But remember it is each INDIVIDUAL'S RESPONSIBILITY to keep radiation exposure as low as reasonably achievable!

Screen Bodquiz trn2 cr 99-0083

QUESTION: For dose limit purposes, your hands are considered which of the following:

whole body or extremities or part of your trunk

Screen BodquizC

ANSWER: Your hands are considered to be part of the extremities.

Screen Dosquiz trn2 cr 99-0083

QUESTION: The federal dose limit for the extremities is ____ rem per year.

40 or 45 or 50 or 60

Screen DosquizC

ANSWER: 50. The federal dose limit for extremities is 50 REM/year.

Screen Admin

ADMINISTRATIVE LIMITS

LNG-04: State TVA Nuclear administrative goals for TEDE radiation dose.

TVA Nuclear has established an administrative goal of 1 Rem Total Effective Dose Equivalent (TEDE) to provide an added measure of radiation protection for our workers. This helps to minimize the potential for a worker to exceed the NRC limit.

Screen AdmLim3

You may find yourself about to reach your administrative limit.

Screen AdmLim3a

If this happens, administrative dose goals may be increased upon written request by your supervisor and approval by the RADIATION PROTECTION (RP) Superintendent.

LNG-05: State the actions to be taken if the TVA Nuclear administrative TEDE dose goal is being approached.

Screen Goal3

Administrative Dose Goals

Exceeding an administrative goal without proper approval is NOT an overexposure, but is a violation of TVA Nuclear procedures.

Screen Fetus

EMBRYO/FETUS EXPOSURE GUIDELINES

A pregnant employee should understand the potential effects of radiation on an embryo/fetus, including those produced by ionizing radiation.

Screen Fetus1a

Both NRC Reg. Guide 8.13 & 10CFR20.1208 contain an exposure limit of 500 mrem (TEDE) for the declared pregnant worker, spread over the entire term of the pregnancy.

LNG-01: Describe the limits and exposure guidelines for an embryo/fetus.

Screen Fetus2

In order for a worker to decide if she should continue working in a radiation environment during pregnancy, NRC Reg Guide 8.13 compares the risk of radiation exposure to the embryo/fetus with the prenatal risks from various social factors.

Screen Fetus 3

Risks from Alcohol…

Screen Fetus3a

- **Effects include reduced growth, faulty brain function, and abnormal facial features in the unborn child.**

Screen Fetus3b

- **The natural rate for these symptoms in children whose mothers did not consume alcohol is 1 to 2 cases per 1000 infants.**

Screen Fetus3c

- **The frequency of these effects occurring for 2 to 4 drinks per day is 102 cases per 1000. For more than 4 drinks per day, the risk increases to 202 cases per 1000.**

Screen Fetus4

Risks from Smoking…

Screen Fetus4a

- **The natural rate of prenatal infant death for mothers who do not smoke is 23 per 1000.**

Screen Fetus4b

- **Mothers who smoke one pack or more per day have a risk factor of 33 per 1000.**

Screen Fetus5

Risks from Radiation …

Screen Fetus5a

- **The natural rate of cancer death in children is 1.4 per 1000. A prenatal radiation dose of 1000 mrem may increase this risk to 2 cases per 1000.**

Screen Fetus5b

- **The natural rate of small head size in infants is 40 cases per 1000. A prenatal dose of 1000 mrem may increase this risk to 49 cases per 1000.**

Screen Fetus5c

- **The natural rate of mental retardation in children is 4 per 1000. A prenatal dose of 1000 mrem may increase this risk to 8 cases per 1000.**

Screen Fetus6

From this data, it is clear that the social factors of drinking and smoking can have a more significant impact on fetal development than the risk of 1000 mrem radiation dose.

Screen Fetus7

LNG-06: State the rights of a declared pregnant worker.

However, it is also clear that a dose of 1000 mrem may increase fetal risk as well. Accordingly, when a worker declares her pregnancy, her dose will be limited in order to provide fetal protection.

Screen Fetus8
trn2 cr 99-0003

A "Declared Pregnant Worker" is a woman who has voluntarily informed her licensee, IN WRITING, of her pregnancy and the estimated date of conception. Documented proof of pregnancy is not required. TVA Nuclear also includes those who declare their intent to become pregnant.

Screen Fetus9

The policy regarding prenatal radiation exposure is implemented to maximize the radiological protection afforded the unborn child of any declared pregnant worker or any radiation worker intending to become pregnant while assigned duties here.

Screen Fetus10

Counseling on the potential radiation hazard to an embryo/fetus will be provided by RP to any woman who requests it.

Screen Fetus10a

Because of the uncertainties in assigning dose to the embryo/fetus due to the uptake of radionuclides, women participating in the prenatal radiation exposure program should not enter surface contamination or airborne radioactivity areas.

Screen Fetus11

Reasonable efforts will be made by management to retain participants in the program in their current job status subject to the needs of the facility and the provisions of the applicable negotiated agreement. Retention of current job status cannot be guaranteed.

Screen Fetus12

LNG-01: Describe the limits and exposure guidelines for an embryo/fetus.

Requests to enter the voluntary prenatal exposure program must be made to RADIATION PROTECTION (RP). While in the program, her occupational dose should be maintained ALARA, and not more than 50 mrem TEDE in a single month. The federal dose limit for a declared pregnant worker is 500 millirem for the entire gestation period.

Screen Fetus13

The woman will confirm her intent to become pregnant in writing every two months until she either declares pregnancy, states she no longer intends to become pregnant, or chooses to leave the program. Regulatory Guides 8.13 and 8.29 are available for your review.

Screen PSE

PLANNED SPECIAL EXPOSURE

LNG-07: Recognize the definition of a Planned special Exposure (PSE).

A planned special exposure (PSE) is an authorized exposure that is SEPARATE FROM and IN ADDITION TO the annual dose limits.

Screen PSE2

Use of a PSE is a serious undertaking that can result in intentionally exceeding 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 after careful evaluation.

Screen PSE3

Emergency Worker Dose Limits

Emergency worker dose limits are implemented by the Radiological Emergency Plan and the plant's emergency procedures. These emergency worker dose limits are for non-pregnant workers only!

- **10 Rem TEDE can be received to prevent serious damage to the plant or hazard to personnel.**
- **25 Rem TEDE can be received to save a life.**

Screen PSE3a

Additionally, these dose limits are received on a voluntary basis only. Every emergency team member must have a completed NRC Form-4 on file in order to receive emergency dose.

Screen llgsum

SUMMARY

- **Federal Dose limits:**
  Shallow Dose Equivalent (SDE) - 50 rem/year
  Extremities - 50 rem/year
  Internal Organs - 50 rem/year
  Lens of the Eyes - 15 rem/year
  TEDE - 5 rem/year
- **If any federal dose limits are exceeded, an evaluation will be conducted by station management and the NRC may possibly fine the plant or take some other action.**

Screen llgsum2

- **TVA Nuclear administrative goal for TEDE is 1 rem/year**
- **This goal is established to provide an additional measure of radiation protection.**

Screen llgsum3

- **Federal dose limit for a declared pregnant worker is 500 millirem per gestation period.**
- **The prenatal program is strictly voluntary. While in the program every effort will be made to maintain the declared worker's dose ALARA and not more than 50 mrem TEDE in a single month**

Screen llgsum4

- **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 must be approved by senior management after careful evaluation.**

ALARA AND RADIATION DOSIMETRY

Screen obj1

OBJECTIVES

ALA-01 **State the purpose of ALARA.**

ALA-02 **Describe TVA Nuclear ALARA program**

ALA-03
ALA-04
ALA-05 **Explain how time, distance, and shielding are used to reduce dose and state some ways to implement these concepts.**

ALA-06 **State individual responsibilities regarding temporary shielding.**

DOS-01 **State the purpose of dosimetry.**

Screen obj2
TMR-05 **Calculate STAY TIME, given work area dose rates and individual exposure limits.**

DOS-02
trn2 cr 99-0006 **List the types of radiation detected by the following devices: Thermoluminescence Dosimeters, and Electronic Dosimeters**

Screen obj3
DOS-03 **Explain how to wear dosimetry devices properly, including placement and orientation.**

DOS-04 **Describe the proper methods for monitoring personal exposure with secondary dosimetry.**

DOS-05 **Identify where and when whole body dosimetry devices are issued and returned.**

DOS-06 **State the actions to be taken if dosimetry is lost, off scale, damaged, or alarming.**

Screen aldo1
trn cr 99-0036

ALARA

What in the world is ALARA?

Screen aldo2

ALARA is a Radiation Protection term meaning As Low As Reasonably Achievable.

ALA-01: State the purpose of ALARA.

Screen aldo3

The principle of ALARA seeks to avoid unnecessary dose to workers performing tasks in radiologically controlled areas.

Screen aldo4

This includes INTERNAL as well as EXTERNAL dose.

Screen aldo5

Our ALARA program represents our commitment to minimize personnel dose.

It ensures that:

1) **ALARA concerns are addressed systematically;**
2) **All employees are aware of ALARA in their daily work activities.**

Screen aldo6

ALA-02: Describe TVA Nuclear's ALARA program.

To make the TVA Nuclear ALARA Program effective, several policies and procedures have been established:

Screen aldo7
- **Pre-job reviews.**

Screen aldo8
- **Job planning including worker experience.**

Screen aldo9
- **Training using lecture and mock-ups.**

Screen aldo10
- **Use of radiological practices for dose reduction such as temporary shielding.**

Screen aldo11
- **Engineering controls (for example; shielding, ventilation).**

Screen aldo12

The TVA Nuclear worker is the most important part of our ALARA program.

Worker actions on the job have the greatest effect on avoiding radiation dose, and consequently, determine the success of TVA Nuclear's ALARA Program.

Screen aldot1

TECHNIQUES TO MINIMIZE EXPOSURE

ALA-03-ALA-05: Explain how time, distance, and shielding may be used to reduce dose, and state some ways to implement these concepts.

There are 3 major ways you can reduce your dose while working in a radiation area: time, distance, and shielding.

Screen aldot1h

More Shielding = Less Dose

Permanent and temporary shielding can significantly REDUCE the dose you receive by reducing the intensity of a radiation field.

Screen aldot1i

Even standing behind a large building support or wall and using it as shielding while examining a component helps reduce your dose!

Screen aldot1j

Temporary shielding must justify its use.

That is, to be ALARA, the total dose for the job with shielding (including the dose received for shielding installation and removal) must be less than the total dose for the job without shielding.

Screen aldot1k

Temporary shielding, in the form of lead blankets or lead bricks, SHOULD NOT be tampered with since this may drastically change dose rates in the area.

ALA-06: State individual responsibilities regarding temporary shielding.

It must never be installed, removed, or moved without permission from RP.

Screen aldot1b

Less Time = Less Dose

Time is an important tool that workers can use to minimize dose. Making the most efficient use of time in a radiation field will reduce dose.

Screen aldot1c

Effective planning can also help to reduce time. Take the few extra minutes to reduce dose by:

- **Talking to others about the job and area.**

Screen aldot1d
- **Knowing what tools to take.**

Screen aldot1e
- **Prefabricating where possible.**

Screen aldot1f
- **Locating the work area on a map.**

Screen aldot1g

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.

Screen aldot1n

More Distance = Less Dose

Distance is also a very effective way of reducing your dose.

In general, the more distance you have from a source of radiation, the less dose you will receive in a given amount of time.

Screen aldot1o

Dose may be greatly reduced by moving a small distance away from the source.

Screen aldot1p

For example, standing four feet from a radioactive valve instead of two feet can reduce the dose rate by as much as 75%.

This example assumes that you are not moving closer to another source.

Screen aldot1r

Dose may also be reduced by…

- **Using extension tools.**

Screen aldot1s

- **Taking breaks in low dose areas.**

Screen aldot1t

- **Stepping away from the radiation source when reading procedures.**

Screen alqd1q
trn2 cr 99-0083

QUESTION: A worker needs to adjust a valve in a High Radiation Area. Based on experience, it takes 20 minutes using a wrench and 12 minutes using a ratchet. Which tool should the worker use?

Wrench or Ratchet

Screen alqd1qc

ANSWER: The worker should use the ratchet since it decreases the amount of time spent in a High Radiation Area, therefore, less dose would be received.

Screen quiz2
trn2 cr 99-0083

QUESTION: You must adjust a set screw on a highly radioactive component. Would you use a long-handled or a short-handled screwdriver?

Screen quiz2c

ANSWER: The long-handled screwdriver is a better tool to use, since it puts greater distance between the source of radiation and your extremities. Therefore, your hands would receive LESS dose.

Screen aldo16

Remember…

Less Time = Less Dose
More Distance = Less Dose
More Shielding = Less Dose

Screen aldo17

Calculating Your STAY TIME

Screen aldo18

Time limits called STAY TIMES are imposed on radworkers based on the dose limit and the dose rate in the area to be entered.

Screen aldo19

The calculations are used to ensure individuals do not exceed their dose limits by RESTRICTING the amount of TIME allowed in radiation areas.

Screen aldo21
trn cr 99-0037

Stay time can be calculated using the following formula:

Stay Time = dose limit / Dose rate in work area

Screen aldo22
trn cr 99-0037

For example, You have a dose limit of 50 mrem. Your work area dose rate is 20 mrem/hr. What is your stay time?

TMR-05: Calculate stay time given work area dose rates and individual exposure limits.

Answer: Stay time = 50 mrem / 20 mrem/hour = 2.5 hours

Your stay time is two and a half hours.

Screen aldo24

Now it is YOUR turn to try a Stay Time Calculation!

Screen quiz3
trn2 cr 99-0083

QUESTION: RP instructs you not to exceed a dose of 200 mrem while repairing a pump in an area where the dose rate is 50 mrem/hour. How long can you remain in the area without exceeding your dose limit?

3 hours or 4 hours or 5 hours or 6 hours

Screen quiz3c

ANSWER: 200 mrem divided by 50 mrem per hour equals a *stay time* of 4 hours.

Screen aldo25

OTHER TVA Nuclear ALARA TOPICS

Screen aldo26

Source Term Reduction

What is it?

"Source Term Reduction" are methods used to minimize area dose rates by removing the source of radiation.

At TVA Nuclear these methods include flushing, purging, or removing the component that is the source of radiation.

Screen aldo27

TVA Nuclear's efforts in Source Term Reduction have been effective and efficient in helping to maintain our plant personnel dose ALARA.

Screen aldo28

Changing Radiological Conditions

Even with all the precautions mentioned, workers must be alert to CHANGING radiological conditions due to certain plant operations.

One such example is RADIOGRAPHY (the testing of pipes or welds with radioactive sources)…

Screen aldo29

Other changing radiological conditions include changes in reactor power level or changes in system lineups.

Screen aldo30

If abnormally high radiation levels are noticed, workers should LEAVE the area immediately and NOTIFY RP.

Screen quiz4
trn cr 99-0083

QUESTION: A pump starts, sending highly radioactive liquid into an empty tank. As the tank fills with the liquid, what will happen to the tank room dose rates?

remain the same or will decrease or will increase

Screen quiz4c

ANSWER: As the tank fills with radioactive liquid, the dose rates should increase in the area.

Screen aldo31

As a result of lessons learned from industry events, certain tasks receive a formal pre-job analysis to ensure job exposures are maintained ALARA.

This usually includes planning, meetings with workers, radiological surveys, and possible RP coverage to assure dose is minimized while completing the work.

Screen aldo32

Pre-Job Brief

A pre-job briefing is a meeting with RP before the work commences.

The meeting provides a final verification - before work starts - that everybody involved with the job understands the methods for minimizing dose.

Screen aldo33

The pre-job briefing should also address possible problem areas in the performance of the task, available alternatives, and expected radiological protection issues.

Screen aldo33a

Any radiation worker who has suggestions/ideas on how to reduce radiation exposure or if workers see things that can be done better should submit them, in writing, via the ALARA Suggestion Program. See RADIATION PROTECTION (RP) to obtain this form and for instructions on completing this form.

Screen aldo34a

WBN Event NRC Inspection Report No. 50-390/97-11

On September 20-21, 1997, with the reactor defueled, a radiation worker noted four, small foreign objects lying on the reactor vessel flange. Because of his concern for foreign material exclusion (FME), the radiation worker placed three pieces of the material in a plastic bag without having the appropriate radiation survey conducted and subsequently removed the bag from the reactor vessel cavity area. One piece of foreign material was later determined to have a contact reading of 56 Rem/hour. Calculations indicate that the worker received 3.645 Rem to his hand or about 7% of the NRC annual extremity limit of 50 Rem. Although no limit was exceeded, this radiation worker received needless dose.

Screen aldo34b

When working around open potentially contaminated systems, always assume that any foreign material you find is radioactive and contact RP immediately! DO NOT pick up the material! You may believe that picking up a small piece of foreign material (point source) which has a dose rate of 12 mrem/hour at 3 feet away from the material would be insignificant. However, the distance principle would teach us that this same piece of foreign material would have a dose rate of 110 mrem/hour at 1 foot, 15,500 mrem/hour at 1 inch and 100,000 mrem/hour on contact (assuming contact being 1 cm from the source). Because of this possibility, never touch or pick up foreign objects which may have come from the primary system without RP survey and approval.

Screen aldo34

DOSIMETRY

DOS-01: State the purpose of dosimetry.

There are many types of DOSIMETERS used in the industry. Recall that dosimeters measure the amount of radiation that workers are exposed to.

Screen tre2

Types Of Dosimetry:

Screen tre2-1
trn cr 99-0006

Thermoluminescence Dosimeter (TLD)

DOS-02: List the types of radiation detected by Thermoluminescence Dosimeters.

Used to record permanent occupational EXTERNAL dose.

Screen tre2-2

Detects and measures dose from BETA, GAMMA, and NEUTRON radiation.

Screen tre2-3

The TLD has a mylar covered window. This window, commonly referred to as a "Beta Window," allows measurement of skin dose from both beta and gamma radiation.

Screen tre2-3a

Plant workers are responsible for their personal TLD at all times.

- **DO NOT store your TLD at the site racks.**
- **DO NOT store your TLD in humid, high temperature or dusty areas, or in direct sunlight.**
- **DO NOT place your TLD near televisions, microwaves, or other major appliances.**
- **DO NOT run your TLD through the x-ray machine at the Access Control Portal or wear it when receiving routine medical or dental x-rays.**
- **DO NOT wear your TLD after receiving a medical isotope treatment until authorized by Radiation Protection.**
- **TLDs will be changed out quarterly. Your new TLD can be picked up at the racks at your site at that time.**
- **Returned TLDs are to be dropped in the appropriate boxes at that time.**
- **If you are not going to be onsite during quarterly change out, return your TLD prior to leaving for a vacation for example.**

Screen tre2-23

Electronic Dosimeters (EDs)

EDs are used by individuals in all radiologically controlled areas and will measure gamma radiation only. Alarm set points are pre-programmed when the worker electronically logs in on the RWP. EDs should be read frequently and placed in a location where it can be easily read. This is extremely important. EDs SHOULD NOT BE PLACED ON LANYARDS INSIDE THE PROTECTIVE CLOTHING.

Screen tre2-25

EDs are used to measure and display the accumulated dose as well as continuously measure the dose rate. The accumulated dose is indicated in the display of the device. Workers need to be aware of their radiological work environment. Carefully review the radiological survey data before you enter the work area. Know your ED dose and dose rate alarms which are printed on the Radiation Work Permit and available on the HIS-20 access control screen. Read your ED frequently and monitor your cumulative dose; you should not rely solely on the audible alarm. LEAVE THE AREA BEFORE YOU REACH THE ALARM SETPOINT.

Screen tre2-25a

The dose rate is not normally indicated however, it may be observed by pressing and immediately releasing the button on the front of the ED. However, the ED is NOT to be removed from the designated location on the front of the body. It is NOT to be used as a survey meter by holding it out to components in the plant to measure dose rates. The ED is to measure personnel dose only. If it is removed from the proper location on the body, it cannot provide an accurate measurement of whole body dose.

Screen tre2-25b

Screen tre2-28

An alarm will sound if the preset dose or dose rate is reached. Alarm indications are:

- **an audible alarm emitted by the dosimeter buzzer**
- **a flashing message or symbol on the display**
- **a flashing light on the dosimeter**

In the event of simultaneous alarms, all corresponding messages and symbols are displayed. It is difficult to distinguish between the audible alarms for accumulated dose and dose rate; therefore, it is important to look at the display to determine the reason for the alarm.

Screen tre2-28a

<u>Accumulated Dose Alarm</u>

When the accumulated dose alarm set point is reached, the electronic dosimeter generates an audible alarm and the message "Dose Alarm" flashes in the display. Workers are expected to exit the work area *BEFORE* the dose alarm is received; however should the dose alarm sound, exit the area immediately and notify RP.

Screen tre2-29

<u>Dose Rate Alarm</u>

When the dose rate alarm set point is reached, the electronic dosimeter generates an audible alarm and the message "Rate Alarm" flashes in the display. In addition during the alarm, the LED indicator provides 3 short flashes emitted at a rate of 3 flashes per second. Exit the area immediately and notify RP if an unexpected dose rate alarm occurs.

Screen tre2.29a

If any of the following is displayed on the ED, leave the area and notify RP.

A) **The window is blank.**
B) **The window is reading "pause" when the dosimeter should be on.**
C) **The window is reading "DF BAT".**
D) **The window is reading "BA LO".**

Screen tre2-29b

Industry experience (OE12675, "Workers With Partial Hearing Loss Cannot Hear Audible Electronic Dosimeter Alarm") has revealed that some workers have difficulty hearing the ED alarms. Workers who cannot hear the alarms must notify RP prior to being briefed on a high radiation RWP and request supplemental protection such as Pocket External Alarm (PEA), continuous coverage (ALARA considerations), or other appropriate protection defined in Technical Specifications.

Screen aldo35

Wearing Dosimetry

DOS-03: Explain how to wear dosimetry devices properly including placement.

Where do I Wear it?

Dosimetry should be worn on the FRONT part of the body between the WAIST and NECK with the beta window of the Thermoluminescence Dosimeter (TLD) facing away from the body (clip toward body) and be located next to the Electronic dosimeter (ED).

New screen

When in contaminated areas, wear the TLD inside the coveralls and clip the ED to either upper pocket of the coveralls where it can be easily monitored. The digital readout may face in either direction. The ED may be required to be worn in a plastic bag on the outside of the coveralls during entries to High Radiation areas.

Screen aldo36
trn2 cr 99-0006

How do I Wear it?

DOS-03: Explain how to wear dosimetry devices properly including placement & orientation.

The beta window of the TLD should face away from the body (clip toward body) and be located next to the ED.

Screen aldo37

Other Wearing Information

High noise environments and protective clothing can muffle ED alarm sounds. A similar concern exists for workers with hearing problems.

In any case, check the ED display on a frequent basis.

Screen aldo37a

An important reason to check your ED often is that erroneous responses have resulted from welding operations and radio transmitters. If any unusual response is observed, contact RP.

Screen aldo38

Multi-badge TLDs

DOS-04: Describe the proper methods for monitoring personnel exposure with secondary dosimetry.

Additional or special dosimetry may be required for certain jobs where dose rates to an area of the body are higher than those to the chest region. Multi-badge TLDs will be issued for these situations. Multi-badge TLDs measure the same type of radiation as a single TLD.

Screen aldo39

Extremity TLDs

Extremity TLDs measure gamma radiation dose to extremities. They are issued for particular tasks where dose to the extremities will be significantly higher than the whole body dose.

Screen aldo40

The values of the whole body readings and the extremity readings are recorded on the legal record in their respective category.

Screen aldo41

NOTE:
RP will provide instructions if you are required to wear ANY special dosimetry.

Screen aldo42

The TLD should never be tampered with as it is not possible to obtain any information from the TLD without a special TLD reader.

Screen aldo43
trn cr 99-0041

Dosimetry Issue

DOS-05: Identify where and when whole body dosimetry devices are issued and returned.

TLDs are issued by RP at specific locations. Check with your instructor or supervisor for the issue location at your site. During off-duty periods, workers are responsible for maintaining their TLDs. Any special dosimetry (multi-badge TLDs or extremity TLDs) are issued by RP depending upon work conditions and personnel.

Screen aldo44
trn2 cr 99-0129

The EDs are picked up by workers prior to logging in on the computerized dose tracking system (HIS-20). They are found in racks by the computer terminals. They are returned to the racks after logging out on Access Control.

trn2 cr 99-0129

Log In Steps

NOTE: IF AN ERROR MESSAGE OR DENIAL SCREEN APPEARS DURING ACCESS CONTROL PROCESSING, NOTIFY RP IMMEDIATELY.

Screen aldo44b
trn cr 99-0042

- **Read your RWP completely.**
- **Ensure you are on the Access Control "Insert Dosimeter" screen (contact RP if not).**
- **The ED should be reading "PAUSE" when removed from the rack. After ensuring it is reading "PAUSE" insert it into the ED reader with the clip facing down.**

Screen aldo44ba
trn2 cr 99-0129

- **Scan your SSN if using the Bar Code Reader or manually enter your SSN and press the enter key.**

Screen aldo44ba1
trn2 cr 99-0129

- **Information screens will appear indicating that your dosimeter is being read and communicating with the computer. DO NOT TOUCH!**

Screen aldo44ba2
trn2 cr 99-0129

- **Scan the RWP number if using the Bar Code Reader or manually enter the RWP number and press the enter key.**
-

Screen aldo44ba2a

- **The display will require the worker to acknowledge this statement, "I understand and will comply with the requirements of this RWP," by pressing F4 for a "YES" response, or F5 for a "NO" response. If the individual enters a F4 response, then the process continues. If the individual enters a F5 response, then the process aborts. Logging in is considered an electronic signature and indicates workers have read and understand their RWP.**

Screen aldo44ba3
trn2 cr 99-0129

- **DO NOT TOUCH the computer while it is sending the entrance request and programming the dosimeter.**

Screen aldo44ba4
trn2 cr 99-0129

- **Review the system display of all input information. Ensure you receive a green "ENTRY Granted" message.**

Screen aldo44
trn2 cr 99-0129c
Screen aldo44ca

- **Remove the ED from the ED reader and verify that the ED is reading zero. Remember to ensure there were no error messages noted on the screen during the Log in Steps.**

New Screen Internal OE (BFN PER 98679)

- **An employee entered a Locked High Radiation Area on an incorrect RWP and received a dose rate alarm. The individual was performing work in Radwaste in the Condensate Phase Separator room and was supposed to be on RWP 06040033 with a dose rate alarm set point of 500 mrem/hr. He was briefed on the correct RWP by RP but became distracted while logging onto HIS-20 and signed in on RWP 06220344 in error. This RWP has a dose rate alarm of 50 mrem/hr.**

New Screen Internal OE (BFN PER 98679)

- **Upon entering the Phase Separator room he received an ED alarm and exited the area. After checking with RP it was determined that he was logged on the incorrect RWP. He received a dose rate alarm of 376 mrem/hr. and a total dose of 5 mrem for the entry. He was excluded from the RCA pending investigation.**

New Screen Internal OE (BFN PER 98679)

- **Apparent/Root Cause**

  After receiving High Rad RWP briefing employee was distracted by amount of traffic at the REX terminals and stopped to help individuals remove items from SAM units. Employee then failed to re-focus on the job assignment after the disruption and signed in on normal RWP. Failure to adequately self-check is the apparent cause for this incident.

Screen aldo44dn trn2 cr 99-0129

Log Out Steps

NOTE: IF AN ERROR MESSAGE OR DENIAL SCREEN APPEARS DURING ACCESS CONTROL PROCESSING, NOTIFY RP IMMEDIATELY.

Screen aldo44d trn2 cr 99-0129

- **Insert the ED into the ED reader.**

Screen 44e trn2 cr 99-0129

- **Review the system display for exit information. Remove ED when you receive a green screen with the message "EXIT GRANTED PLEASE REMOVE DOSIMETER."**
- **Verify ED is in "PAUSE" mode and place back in storage rack.**

Screen aldo45

DOS-06: State the actions to be taken if dosimetry is lost, off scale, damaged, or alarming.

If your dosimetry is lost, damaged, alarming or does not appear to be working, put the job in a safe condition, notify your co-workers, LEAVE the area, and report to RP.

Screen 45b trn2 cr 99-0019

Radiation Exposure from Other Sites

It is required of employees who are temporarily leaving a TVA Nuclear plant to visit or work at another facility (including other TVA Nuclear sites), where radiation exposure may be accrued, to check-out with RP. This ensures their assigned dosimetry is returned and a whole body count performed prior to the individual being monitored at another location. It also ensures the exposure information from the other facility can be included in the TVA Nuclear record system, as required by federal regulations. It is the employee's responsibility to ensure this requirement is met. If there are any questions about the dosimetry check-out requirements, call RP. Employees must also report to RP upon their return.

Screen end1

SUMMARY

- **The purpose of ALARA is to keep the radiation dose of TVA Nuclear Radworkers as low as reasonably achievable while effectively getting their tasks accomplished.**
- **To keep your dose ALARA, minimize time spent in areas containing radiation, maximize your distance from radiation sources and use shielding between you and the source of radiation.**
- **Temporary shielding MUST NOT be installed, removed, or moved without permission from RADIATION PROTECTION (RP).**

Screen end2
trn2 cr 99-0006

- **Stay times are used to ensure individuals do not exceed dose limits by restricting the amount of time allowed in a radiation field.**
- **Thermoluminescence Dosimeters are used to accurately measure your occupational exposure to gamma, beta, and neutron radiation.**

Screen end3
trn2 cr 99-0006

- **Electronic Dosimeters are special devices that alarm when more dose has been received than expected OR when higher than expected dose rates are encountered.**
- **Dosimetry is normally worn on the front part of the body between the waist and neck. The Thermoluminescence Dosimeter should be located next to the Electronic Dosimeter.**

Screen end4

- **Read your EDs:**
  - **Immediately upon logging in on an RWP**
  - **Periodically while in use**
  - **Upon exiting the area**

CONTAMINATION

Screen obj

OBJECTIVES

CON-01 **Identify and compare the following types of contamination: fixed contamination, loose contamination, and airborne contamination.**

CON-04 **Explain why contamination is controlled.**

CON-05 **Describe the sources and indications of contamination including: spills and leaks, open contaminated systems, maintenance activities.**

Screen obj3
CON-08 **Explain how to monitor personnel and personal items for contamination including the use of:**
- **friskers**
- **personnel contamination monitors**

CON-06 **Describe 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, restrictions concerning non-routine surveyed areas, and engineering controls.**

Screen obj4
CON-09 **State the actions to be taken upon indication of becoming contaminated.**

CON-10 **State the methods for control of contaminated tools, equipment, and materials, including: minimizing materials contaminated, hot tool issue, bagging/surveillance requirements.**

CON-03 **Define hot particles and be able to state: the hazards, methods to identify a hot particle, sources of hot particles, work activities that may result in hot particle contamination, special precautions to be used in an area that may contain hot particles.**

Screen obj5
CON-12 **Identify situations that require immediate exit from a contaminated area (for example, torn PCs, wounds, and wet PCs).**

CON-02 **State the units used to measure contamination.**

CON-07 **State the individual's actions for removing contaminated and non-contaminated materials from contaminated areas and the RCA.**

Screen con1

RADIOACTIVE CONTAMINATION

Sources of Contamination

Contamination is defined as radioactive material where it is not desired.

Screen con2

An area may be contaminated by…

Screen con3

. . . a spill of radioactive liquid.

Screen con4

. . . settling of airborne particulate matter.

. . . maintenance activities performed on a system.

Screen con5

Everyone should know that radioactive contamination emits radiation.

Screen con6

The TWO major sources of radioactive contamination at a nuclear station are:

Screen con7

- **Fission Products.**
- **Activated Corrosion & Wear Products.**

Screen con8

In either case, these products are transported throughout systems that carry reactor water.

Screen con9

Leaks and maintenance operations in these systems may allow radioactive materials to be released and to accumulate on floors and walls. This creates a contamination problem for personnel who have to work in these areas.

Screen tre1

Types of Contamination

CON-01: Identify the following types of contamination: fixed, loose, and airborne.

Radioactive Contamination can be identified as:
loose surface contamination
fixed contamination
airborne contamination

Screen tre1a

LOOSE SURFACE CONTAMINATION

CON-01: Compare the following types of contamination: fixed, loose, and airborne.

Loose surface contamination is radioactive material that is loosely adhered to an object.

Screen tre1b

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 contaminated areas.

Screen tre1c

Just like regular dust or dirt, loose surface contamination can become stirred-up and go airborne.

Screen tre1c2

SER 89-001
OE 2398
DO NOT DELETE

CON-03: Define hot particles and state the hazards, sources of hot particles, and work activities that may result in hot particle contamination.

A highly radioactive form of loose contamination that presents a concern is Hot Particles. These particles can be produced when corrosion or wear products are irradiated during transport through the core by the primary coolant or when fission fragments escape and enter the primary coolant. Disassembly of a plant component with internal contamination or opening a contaminated system may result in hot particle contamination. If a hot particle attaches itself to the body or clothing, it can cause a high localized dose.

Screen tre1c3

SER 89-001
OE 2398
DO NOT DELETE

CON-03: State the methods to identify a hot particle.

When frisking, a hot particle will cause the meter to spike provided the probe is within ½ inch and the survey rate is less than 1-2 inches/ second.

A Personnel Contamination Monitor (PCM) can also be used for detecting hot particles.

To minimize Hot Particle hazards:

- **Review the RWP survey map.**
- **Use PCs without rips or tears.**
- **Carefully frisk upon exit.**

Screen tre1c4

Operating Experience Feedback Report (PS-5198) Braidwood Unit 2

A contract employee was working on the bottom elevation of containment (along the path of steam generator workers).

While the contractor was frisking out with a hand-held detector, he detected a hot spot on a finger of his right hand. The exposure period was estimated at 100 minutes. A shallow dose at 70.6 rad was assigned, averaged over about ½ square inch - in excess of federal limits.

Screen tre1d

FIXED CONTAMINATION

CON-01: Compare the following types of contamination: fixed, loose, and airborne.

Fixed contamination is surface contamination that has become embedded in an object and cannot be removed by normal cleaning techniques.

Screen tre1e

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 some materials and become loose surface contamination.

Screen tre1g

AIRBORNE CONTAMINATION

CON-01: Compare the following types of contamination: fixed, loose, and airborne.

Airborne contamination is radioactive particles or gases suspended in the air. Airborne contamination is hard to contain but EASY TO BREATHE.

Screen quiz1
trn2 cr 99-0083

QUESTION: Contamination that is embedded in an object and cannot be removed by normal cleaning techniques is known as:

loose or fixed or airborne

Screen quiz1b

ANSWER: Contamination which is embedded in an object is known as fixed contamination.

Screen con10
trn2 cr 99-0038

Contamination Units

Since contamination is radioactive, it can be detected through the use of contamination monitors.

Screen con11

However, loose surface contamination is frequently detected by wiping a piece of cloth or paper over a suspected surface area and measuring the radiation being emitted from the "smear".

Screen con12

The area wiped is usually 100 square centimeters (cm^2) which is an area of about 4 inches x 4 inches. The level of radiation emitted is usually expressed as disintegrations per minute (dpm).

Screen con13 & 14

Ultimately, loose surface contamination will be measured in units of dpm/100 cm^2.

CON-02: State the units used to measure contamination.

Screen con15

CON-02: State the units used to measure contamination.

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. Fixed contamination will be measured in units of count per minute (CPM) or mrad/hour as read on an instrument's meter face.

Screen con16

Sources and Indications of Contamination

While in the plant, you may work with many potential sources of contamination. In addition, you must be aware of any possible indications of potential contamination…

Screen con18

Possible Sources of Radioactive Contamination:

CON-05: Describe the sources of contamination including spills and leaks, open contaminated systems, maintenance activities.

▷ **Spills and leaks from a system carrying reactor water.**

Screen con19

Screen con20

Screen con21

- ▷ **Contaminated systems that are opened for maintenance.**
- ▷ **Grinding a pipe with fixed contamination.**
- ▷ **Disassembly of a plant component containing contamination.**

Screen con23

Possible <u>Indications</u> of Radioactive Contamination:

CON-05: Describe the indications of contamination including spills and leaks, open contaminated systems, maintenance activities.

- ▷ **Water leaking from a pump or valve that carries reactor water.**

Screen con24

Screen con25

Screen con26

Screen con27

- ▷ **Components removed from contaminated systems.**
- ▷ **Maintenance on a potentially contaminated system.**
- ▷ **Water standing near a contaminated system.**
- ▷ **Rise in frisker counts or frisker alarm**

Screen con28

Report leaking components inside the RCA to RP.

Screen quiz2
trn2 cr 99-0083

<u>QUESTION</u>: The unit used to measure loose surface contamination is mrem per hour (mrem/hr).

True or False

Screen quiz2c

<u>ANSWER</u>: False. The unit used to measure loose surface contamination is dpm/100 cm^2.

Screen con30

<u>Methods To Prevent Spread Of Contamination</u>

CON-04: Explain why contamination is controlled.

If radioactive contamination were allowed to spread uncontrolled, it would soon be all over everything.

This would result in:

- ▷ **unmonitored radiation dose.**
- ▷ **an increase in radioactive waste.**
- ▷ **decreased productivity.**

Screen con31

Imagine radioactive contamination as being like invisible wet paint that never dried.

Screen con32

Now imagine people walking through the wet, invisible paint day after day. It is not difficult to see that after a while the contamination, just as the paint, would be everywhere, emitting radiation.

Screen con33

Although the spread of contamination could cause some problems as previously noted, it generally causes NO ILL health effects…

Screen con34

The dose received from typical levels of radioactive contamination spread to individuals' skin or clothing is considered INCIDENTAL.

The FEW personnel skin or clothing contamination incidents which occur involve very low levels of radioactive contamination.

Screen con35

METHODS

Stopping or preventing the spread of contamination is not difficult, but requires GOOD WORK PRACTICES.

Screen con36

Some proven methods effective in limiting the spread of radioactive contamination are:

Screen con37

Contamination Prevention

The way to control the spread of radioactive contamination is at the source.

Screen con38

CONTAMINATION PREVENTION OF PERSONNEL AND AREA:

- **Never reach across contaminated area tape/rope boundaries or allow material to lie on or near these boundaries.**

Screen con39

- **Report all full waste or protective clothing containers to RP for pick-up. DO NOT compress or compact with your hands!**

  - Compacting a container full of radioactive materials could cause a puff of airborne contamination to be released into the air.

Screen con40

- **DO NOT walk through puddles of water or piles of debris encountered in the RCA. Report all leaks within the RCA to RADIATION PROTECTION (RP).**

CON-06: Describe methods to prevent contamination of personnel and areas.

Screen con41
trn2 cr 99-0043

- **Keep work area clean.**
- **Minimize the spread of tools and materials over large areas.**
- **Use tools from the Hot Tool Room inside the RCA.**
- **Utilize Step-Off-Pads (SOPs) and the proper techniques when entering and exiting Contaminated Areas and RCAs.**
- **Follow the directions from RP when grinding, drilling, and welding on contaminated material in the RCA.**

CON-10: State the methods for control of contaminated tools, equipment, and materials.

Screen con44

- **Wear protective clothing as assigned in a proper manner.**
  - **fully zip coveralls and secure Velcro**
  - **securely fasten hood flaps**
  - **secure all required areas**
  - **contain long hair within protective clothing**

CON-06: Describe methods to prevent contamination of personnel and areas.

Screen con45

- **Notify RP and obtain appropriate approval prior to breaching any potentially contaminated system.**

  - **Review radiation work permit and ensure you have been briefed before using an RWP.**

Screen con46
trn2 cr 99-0044

- **AVOID CONTACT of exposed body surfaces with contaminated materials. Don't rub up against materials and equipment while in an RCA.**

CON-06: Describe methods to prevent contamination of personnel and areas.

- **Use a protective cover to sit or kneel on in Contaminated Areas.**

Screen con47

- **Contact RP prior to entry into potentially contaminated areas that are not routinely monitored (for example, overhead, 6 feet above floor level).**

- **Work planning and pre-job briefings.**

- **Engineering controls: containments and decontamination.**

Screen con47_a

MORE TIPS ON PREVENTION OF PERSONNEL CONTAMINATION:

- **How to NOT get your face contaminated**

Screen con47_b

CON-06: Describe methods to prevent contamination of personnel and areas.

– ***Always, always* be aware of where your hands are!**
– **Do NOT touch your face, wipe your brow, adjust your safety glasses, fix your hood, scratch your nose… while wearing PCs.**

Screen con47_c

Tip: Use safety glasses straps. Tape your hood closure, if needed.

Screen con47_d

– **Be careful your face does not touch plant equipment, hoods, glove bags, herculite or anything that may be contaminated.**
– **Contain long hair within protective clothing**

Screen con47_e

Tip: Assume EVERYTHING is contaminated once you have put on your PCs.

Screen con47_f

– **Be extra careful when you remove your hood, respirator, or skull cap… otherwise you could lose some hair!**

Screen con47_g

- **How to NOT get your feet contaminated.**

Screen con47_h

– **Avoid stepping in ANY water in the Radiologically Controlled Area (RCA).**

Screen con47_i

Tip: Tell RP about the water. Stay off floor drain covers.

Screen con47_j

– **Do NOT step in water with your booties.**

Screen con47_k

– **Practice your Step-Off-Pad technique BEFORE you get in a Contamination Area.**

Screen con47_l

Tip: Remember, the Step-Off-Pad is CLEAN! Help keep it that way.

Screen con47_m

– **Your personal shoes must only touch the Step-Off-Pad and must NOT come in contact with any part of the Contamination Area.**

Screen con47_n

- **How to NOT get your hands contaminated**

Screen con47_o

– **Be extra careful of activities which can puncture your rubber gloves.**

Screen con47_p

Tip: Watch out for tie wraps and wire. Use work gloves when needed.

Screen con47_q
CON-06: Describe methods to prevent contamination of personnel and areas.

– **Do NOT lean on handrails which are Contamination Area boundaries.**

– **Do NOT reach across Contamination Area barriers with your bare hands.**

– **Be careful what you touch with cotton liners-they offer very little protection from contamination.**

Screen con47_r

– **Outside people-watch how you hold those bags for your co-workers.**

– **You must never touch the inside part of the bag.**

Screen con47_s

- **How to NOT get your body contaminated.**

Screen con47_t

– **Do NOT get your coveralls WET!**

Screen con47_u

CON-06: Describe methods to prevent contamination of personnel and areas.

CAUTION: Wet or sweaty coveralls will usually not prevent contamination from penetrating the fabric and reaching your skin. This is especially true if the contamination levels are fairly high or you heavily rub your coveralls (i.e., knees, elbows, posterior) into a hard surface which is contaminated.

Screen con47_v

– **Do NOT sit down, lay down or kneel in a Contamination Area.**

Screen con47_w

Tip: If your work activity requires you to sit, lay or kneel in a Contamination Area, place some clean material between you and the contamination. Plastic bags, herculite, A-cloth and other similar materials work well.

Screen con47_x

– **Remove your PCs correctly-just like you learned in GET.**

Screen con47_y

Tip: Remember, your shoe covers and outer gloves are the areas of most contamination-BEWARE!

Screen con47_z

- **General Tips:**

Screen con47_za

– **Tell RP promptly if the conditions of your work area change such that you may need additional protective clothing. Water, high contamination, oil, dust-normally triggers additional protective clothing.**

Screen con47_zb

– **Help co-workers. If you see someone having problems, help them or go for help.**

Screen con47_zc

CON-06: Describe methods to prevent contamination of personnel and areas.

– **Use PCM-1Bs or frisk anytime you think you may have done something which may have contaminated you.**

– **Stay away from others when removing your PCs-do not brush against them (and do not let them brush against you).**

– **If you are not happy with the conditions in your work area-tell RP.**

Screen con47_zd

REMEMBER:

- **Most personnel contaminations are preventable.**

Screen con47_ze

- **Most personnel contaminations are due to some type of personnel error (big, small, intentional and inadvertent – sometimes, just not taking proper precautions to not get yourself contaminated).**

Screen rhp

CONTAMINATION PREVENTION RADIOACTIVE HOT PARTICLES:

CON-06: Describe methods to prevent contamination of personnel and areas.
SER 89-001
OE 2398
DO NOT DELETE
CON-03: State special precautions to be used in an area that may contain hot particles.

- **Wearing additional protective clothing is a skin dose reduction method. The additional layer of clothing reduces the possibilities of a radioactive hot particle getting directly on the skin. The extra layer of clothing increases the distance between the particle and the skin providing greater beta protection.**

Screen rhp1

- **Proper disposal of all outer protective clothing worn in areas containing discrete hot particles will greatly help prevent the spread of contamination:**

  - **to others coming in contact with the PCs.**
  - **throughout the laundry.**

  When in close proximity to the skin, these particles can cause very large but very localized skin doses.

Screen quiz3a
trn2 cr 99-0083

QUESTION: Avoiding water spilled under a contaminated component is a method which will aid in limiting the spread of contamination.

True or False

Screen quiz3c

ANSWER: True. Not going near the contaminated water will prevent it from getting tracked around.

Screen con48

PROTECTIVE CLOTHING

Let's take a close look at protective clothing!

Screen con49

Protective clothing (PC) is used to prevent personal contamination, but generally DOES NOT protect against radiation dose. Some type of protective clothing is always required to enter contaminated areas.

Screen con50
trn2 cr 99-0129

The use of protective clothing will be specified by the Radiation Work Permit (RWP).

Screen con51
trn2 cr 99-0129

Contact the RP group if there are any doubts concerning PC requirements.

Screen con52

PC items are obtained WITHIN the RCA, at the designated dress-out areas, and are donned (put on) BEFORE entering the contaminated area. Protective clothing must remain in the RCA since it typically has fixed contamination.

Screen con53
trn2 cr 99-0045

Protective clothing generally consists of:

- ✓ **hoods**
- ✓ **coveralls**
- ✓ **glove liners**
- ✓ **rubber gloves**
- ✓ **shoe covers (booties)**
- ✓ **rubber overshoes**
- ✓ **surgeon caps**
- ✓ **lab coats**
- ✓ **paper or plastic suits.**

Screen con54

There are three levels of "dress" associated with protective clothing.

Screen tre2

_ **Minimal Dress Items**

_ **Standard or Full Dress Items**

_ **Additional Clothing Requirements**

Minimal Dress Items

Screen tre2a

Conditions which allow use of minimal dress protective clothing items must be EVALUATED by RP on a case-by-case basis unless otherwise noted on the Radiation Work Permit.

Screen tre2b

Minimal dress items:

- **surgeons cap**

Screen tre2c
trn2 cr 99-0046

- **lab coat (buttoned/zipped)**

Screen tre2d

- **shoe covers**

Screen tre2e
trn2 cr 99-0046

- **gloves**
- **booties**
- **cotton liners**

Screen tre2h

Standard/Full Dress Items

—— **hood fastened under chin**

—— **coveralls - zipped and/or secured with velcro**

Screen tre2j

—— **1 pair of booties tucked under coveralls**

—— **1 pair of rubber shoe covers over booties**

Screen tre2m
trn2 cr 99-0047

Also:

—— **white cotton glove liners under rubber gloves**

—— **rubber or latex gloves which are secured at the coverall sleeve**

Screen tre2n

Additional Clothing Requirements

Elevated levels of radioactive contamination may require using additional protective clothing. Items include, but are not limited to:

Screen tre2o
trn2 cr 99-0048

▷ **plastics, rainsuits, or paper suits**

Screen tre2p

▷ **double coveralls**

Screen tre2q

▷ **extra gloves or booties**

Screen tre2r

NOTE:

Due to the infrequent use of these items, RP will provide specific instructions and/or assistance on their use.

Screen quiz4
trn2 cr 99-0083

QUESTION: You need to wear full dress protective clothing to inspect a component in a contaminated area. You can complete the job in less time if you wore just minimal dress PC items. What should you do?

a) go ahead and wear just the minimal dress
b) discuss the situation with your supervisor
c) discuss the situation with RADIATION PROTECTION (RP)

Screen quiz4c

ANSWER: C is correct: Conditions allowing use of minimal dress PC MUST be evaluated by RADIATION PROTECTION (RP) on a case-by-case basis.

Screen con55

Donning Standard or Full Dress PC

Let's look at putting on or "donning" the most commonly used protective clothing -- the standard or full set!

An evaluation of the proper method for donning and removal of standard protective clothing is a part of the required practical exercise.

Screen con56

DONNING FULL DRESS PC - NINE STEPS

No personal clothing (except for undergarments, shoes, and socks) should be worn under PCs along with modesty clothing. Stripping down to the undergarments may be offensive to others or embarrassing. There are areas designated to change into modesty clothing. Total nudity is prohibited at all times.

Screen con56_1
trn2 cr 99-0049

Personal items or valuables that could become contaminated should be removed and not taken into the area. Security badges, dosimeters, and other items may be enclosed in a plastic bag, secured or clipped to coverall pockets.

CON-10: State methods for control of contaminated tools, equipment and materials.

Workers may wear their personal hard hats into contamination zones that require hard hats as directed by RP. After donning protective clothing, as required by your RWP, your personal hard hat will be worn on the outside of the protective clothing. Yellow hard hats are ~~no longer~~ provided for use in contamination zones when required by RP. DO NOT touch your personal hard hats while working in a contamination zone. If your personal hard hat becomes contaminated, it will be deconned and returned to you. Protective hard hat covers may be issued for use in highly contaminated areas.

Screen con56a

1. **Inspect all items. Check for holes or rips in gloves, hood, coveralls, shoe covers, shoes; ensure coveralls are a larger size than normally worn. PCs are generally worn over a modesty garment unless a site approved uniform is worn.**

Screen con57

2. **Don coveralls.**

Screen con58

3. **Don booties and secure coveralls over booties utilizing cuff retainers or tape, as needed. Ensure that no gaps are present. Ensure tape, if used, is tabbed.**

Screen con60

4. **Don rubber shoe covers over your booties.**

Screen con61
trn2 cr 99-0050

5. **Place dosimetry and security badge as directed by your site. Close and secure coveralls.**

Screen con62

6. **Don surgeon's cap (if applicable).**

Screen con63

7. **Don cotton glove liners.**

Screen con66

8. **Don rubber gloves, ensuring that the coverall sleeves are well tucked in. Secure using cuff retainers or tape as needed. If tape is used, ensure a tab is left on the end.**

Screen con67

9. **Don and secure cloth hood, front and back. Ensure that long hair is contained within the protective clothing.**

Screen con68
trn2 cr 99-0051

Remember…

1. **Inspect items.**
2. **Don coveralls.**
3. **Don booties and secure.**
4. **Don rubber shoe covers.**
5. **Place dosimetry.**
6. **Don surgeon's cap.**
7. **Don cotton glove liners.**
8. **Don rubber gloves and secure.**
9. **Don hood.**

Screen con69

Removing Standard or Full Dress PC

Now that we have shown how to dress in full protective clothing, let's show how to remove a full set of protective clothing. The proper area to remove protective clothing is at the exit of the contaminated area just prior to the step-off-pad.

Screen con70

Each item of protective clothing should be turned inside out as it is being removed.

This keeps the contaminated outer surface away from you.

It is important to note that items removed must be placed in properly marked receptacles.

Screen con71

The following are the removal guidelines:

1. **Remove all tape and/or elastic retainers. Place tape in trash receptacle and elastic retainers in the clothing/reusable receptacle.**

Screen con72
trn2 cr 99-0052

2. **Remove rubber shoe covers carefully and slowly. Place shoe covers in the proper receptacle.**

Screen con73
trn2 cr 99-0052

3. **Remove rubber gloves inside out. Keep glove liners clean by touching cuff of rubber glove only. The first glove is pulled from the outside and then rolled inside out. The second glove should be pulled off with the clean hand index finger or thumb on the inside of the glove. Place in the proper receptacle.**

Screen con74

4. Grasp your personal hard hat with one hand and remove it (you are still in cotton glove liners). DO NOT lay your hard hat down. While holding your hard hat in one hand, use your free hand to accomplish steps 5&6.

Screen con74a

5. Remove hood - pull open velcro from bottom, lean head back and bring hood around the side of the body without going over the top of the head or shoulder. Place in the proper receptacle.

Screen con75a

6. Then remove surgeon's cap (if applicable) from the back of the head without touching exposed skin surfaces or hair. Never attempt to untie. Place in the proper receptacle.

Screen con76

7. Place your hard hat back on your head.

Screen con76a

8. Remove dosimetry devices from coverall pocket and place on corner of the step-off-pad or tray attached to stanchion if provided.

Screen con77

9. Remove coveralls by carefully reaching inside the coverall flap and unzipping the zipper or separating the velcro. Carefully reach inside the coverall, grasp the inside surface and remove by rolling inside out down to the ankles. Step out of coveralls. Place in the proper receptacle.

Screen con79
trn2 cr 99-0053

10. Back up to the SOP. Remove the booties while stepping out onto the SOP. Be careful not to allow an unprotected street shoe to be placed down in the contaminated area or touch any clean surface with a potentially contaminated surface. As each bootie is removed, place your street shoe on the clean step-off pad. Place the booties in the proper receptacle.

11. Remove cotton glove liners by turning inside out and place in yellow trash container.

Screen con81
trn2 cr 99-0054

12. Proceed to the nearest frisking station and survey your hands (both sides) and feet (bottom sides and top), as a minimum. If your personal hard hat was worn in the contaminated area, it needs to be surveyed also. If nothing is detected, proceed to the nearest PCM for a whole body frisk.

Screen con83

<u>Remember</u>…

1. **Remove tape/velcro or elastic retainers.**
2. **Remove rubber shoe covers.**
3. **Remove rubber gloves.**
4. **Remove personal hard hat (DO NOT lay it down).**
5. **Remove hood.**
6. **Remove surgeon's cap (if applicable).**
7. **Place personal hard hat back on your head.**
8. **Remove dosimetry.**
9. **Remove coveralls.**
10. **Remove booties while stepping out on SOP.**
11. **Remove cotton liners.**
12. **Proceed to the nearest frisker and survey your hands (both sides) and feet (bottom sides and top), as a minimum. If your personal hard hat was worn in the contaminated area, it needs to be surveyed also. If nothing is detected, proceed to the nearest PCM for a whole body frisk.**

Screen quiz5
trn2 cr 99-0083

<u>QUESTION</u>: The first step in donning a set of full protective clothing is to put on the coveralls.

True or False

Screen quiz5c

<u>ANSWER</u>: False. Inspecting all protective clothing is the first step. Donning a protective clothing item with a rip or tear could result in you getting contaminated.

Screen con84
trn2 cr 99-0013

Precautions While Using Protective Clothing

CON-12: Identify situations that require immediate exit from a contaminated area.

You should immediately exit the contaminated area and frisk if:

- **You tear or cut your PCs.**
- **You suffer cuts, abrasions, or other open wounds.**
- **Your PCs become wet or saturated from equipment leaks.**
- **Your ED is lost, damaged, or dose limit alarms.**
- **You observe abnormal conditions in the work area or you suspect you are contaminated.**
- **RP personnel direct you to leave.**

Screen con86

NO personal clothing should be worn under protective clothing with the exception of underwear covered by "modesty clothing" or TVA Nuclear uniforms approved by RP.

Screen con87

If conditions which cause excessive sweating are anticipated, obtain sweat bands and/or retaining devices for glasses to minimize sweat in the eyes or the need to push glasses back onto the nose or face. Don't adjust safety glasses in contaminated areas due to the probability of facial and internal contamination resulting.

Screen con88

If PCs become torn or are rendered ineffective:
STOP - LEAVE - CHECK

Screen con89
Stop **work.**
Screen con90
Leave **the contaminated area.**
Screen con91
Check **yourself for contamination.**

Screen con92

NOTE:
Contact RP if you are contaminated!

Screen con92a

FRISKING

Process by which radiation workers monitor themselves for radioactive contamination on their skin or clothing. Frisking stations are set up near the exit of Contaminated Areas and Radiologically Controlled Areas.

Screen con92b

- **When exiting a c-zone, proceed to the nearest frisker.**

Screen con92c
trn2 cr 99-0055

- **Survey your hands (both sides) and feet (bottom, sides and top), as a minimum.**
- **If nothing is detected, then proceed to the nearest PCM for a whole body frisk.**
- **The whole body frisk must be completed prior to donning personal clothing.**

Screen con92d

- **If contamination is detected, contact RP immediately.**
- **When exiting the RCA, another whole body frisk must be performed using the PCM.**

Screen frsk

Frisker

Prior to frisking ensure:

- **Frisker is on.**
- **AC power is supplied.**
- **Response switch is in slow position.**
- **Proper scale selected (x1).**

Screen frsk1
trn2 cr 99-0008

- **Volume is up.**
- **Background reading < 300 cpm.**
- **Listen for any audible response.**

Screen frsk2

CONDUCTING YOUR FRISK

CON-08: Explain how to monitor personnel and personal items for contamination including the use of friskers and personnel contamination monitors.

First, without picking up the probe, frisk the hand you are going to use to hold the probe while frisking the rest of your body.

Screen frsk3

The purpose of passing your hand over the probe is to ensure that your hand is not contaminated when you pick up the probe.

- **If you were to pick up the probe with a contaminated hand, you would contaminate the handle of the probe and pass contamination on to others who follow after you.**

Screen frsk4

- **Then, pass the probe over the other portions of body to be monitored in a slow and deliberate manner, about 1 to 2 inches per second, being sure to cover all parts of your body, including the top of the shoes. The probe should not exceed ½" away from the surface being monitored.**

Screen frsk5

Contamination Detection

If you notice a significant increase in count rate (at least 100 cpm above background) slowly move the probe back to locate the exact location of the contamination. If the reading still indicates contamination then notify RP.

If the alarm sounds reset the alarm, check the area again, and if the alarm sounds again notify RP.

Screen frsk6

When you have finished frisking yourself, leave the probe in a face up position or in a holder if one is provided facing outward. It is important to leave the probe in this manner so the next person can frisk his or her hand before picking up the probe.

Screen pcm

Personal Contamination Monitors (PCMs)

CON-08: Explain how to monitor personnel and personal items for contamination including the use of friskers and personnel contamination monitors.

To use the PCM-1B monitor:

- **First enter the right side of your body into the monitor and insert your right hand into the slot and place right foot on the detector area.**
- **Watch the red flashing light - If the count rate is below the alarm level, the PCM will chime and display the message, "Right side OK, insert left arm."**

Screen pcm2

- **Now enter the left side of your body, inserting your left hand and foot.**
- **Watch the red flashing light - when the light stops, the PCM will chime and the LED on top of the machine will read, "Count complete - You may pass", if no levels were exceeded.**

Screen pcm3

- **Premature arm withdrawal will cause the PCM to alarm and display the message, "Count Incomplete ** Recount."**
- **If the alarm sounds and the message reads "Contaminated," then contact RP and remain in the area.**

Pcm3_a

The PCM-2 is similar in use to the PCM-1B previously discussed. The monitor generally will check one side of your body at a time.

To use the PCM-2 monitor:

Pcm3_b

1. **Ensure the monitor is ready for use. The monitor is ready for use when three green bars are illuminated on outside upper left portion of the monitor. If three red bars are illuminated, the monitor is not ready for use.**

Pcm3_c

2. **Assume position 1 by stepping face forward into the monitor, positioning your feet so as to activate the sensors (this generally means they will be somewhat spread apart), inserting right arm in the slot to the right, and turning your head to the right.**

Pcm3_d

3. **The screen will indicate the monitor is counting position 1 and will beep as it counts down. Once the beeps stop, a brief chirp will sound and the screen will say "face out, turn head to right".**

Pcm3_e

4. **Assume counting position 2 by turning your back to the monitor, position feet to activate the sensors, insert left arm in slot, and head again turned to the right.**

Pcm3_f

5. **Again, the monitor will beep as it counts down and when the beeps stop a brief chirp will sound and the screen will indicate "All OK, Exit".**

Pcm3_g

6. **Should the alarm sound while you are checking for contamination, remain in the area and notify RP immediately.**

Pcm3_h

If you ever have any questions regarding the use of any RP equipment, ask RP for assistance.

Pcm 3a

Portal Monitors (PM)

Portal monitors are also designed to monitor workers for contamination. Workers are required to pause briefly upon entering the PM, wait for a chime indicating that no contamination was detected, then proceed through the monitor.

Screen pcm4
trn2 cr 99-0058

CON-09: State the actions to be taken upon indication of becoming contaminated.

Alarming Friskers

If the instrument you are using sounds an alarm while you are checking for contamination, remain in the area and notify RADIATION PROTECTION (RP) immediately!

DO NOT LEAVE THE AREA!

Screen pcm5

DECONTAMINATION

- **Decontamination is the process of removing radioactive material from where it is not wanted.**
- **The purpose of decontamination is to prevent radioactive material from entering the body or spreading contamination into other areas.**
- **All skin decontamination MUST be performed under the direction of RADIATION PROTECTION (RP)!**
- **Decontamination is usually accomplished by washing with soap and water.**

Screen con93

REMOVING MATERIAL FROM CONTAMINATED AREAS & THE RCA

Screen con94
trn2 cr 99-0056
CON-10: State methods for control of contaminated tools, equipment, and materials.
Screen con96
CON-10:State methods for control of contaminated tools, equipment, and materials..
Screen con97
CON-10: State methods for control of contaminated tools, equipment, and materials.

All radioactive material containers must be identified with a label or tag bearing the radiation tri-blade and the words "Caution Radioactive Material". In addition, magenta spray paint is often used to identify tools and equipment with fixed contamination.

RADIATION PROTECTION (RP) may direct workers to bag material and have it escorted to a different location for radiological surveying and tagging by a RADIATION PROTECTION (RP) technician.

Placing these items in a bag or container will lessen the spread of contamination.

Screen con98

CON-07: State the individual's actions for removing contaminated and non-contaminated materials from contaminated areas and the RCA.

Removing Material from the Radiologically Controlled Area

▷ **Have all tools and equipment monitored by RADIATION PROTECTION (RP) for contamination prior to removal from the RCA.**

New Screen con98a

Material to be released for unrestricted use that has been in the RCA, but **NOT** in contamination areas, shall be monitored as specified below.

New Screencon98b

The following table indicates the items that individuals may wear through a personnel contamination monitor or may place in a small article monitor (SAM) for release from the RCA.

Personnel Contamination Monitor
[Only if being worn] Personnel Clothing, Shoes, Watches, Jewelry, Eye Glasses, Hearing Aids, Ear Plugs, Hard Hat, Safety Glasses, Cell Phone, Pager, Flashlight and other similar personal devices.
Lanyards - Typical items worn on lanyard may remain attached.
Security Officer Weapons and the other Security Officer Specific Equipment.
Small Personal Items in pockets (coins, wallet, keys, pens, pencils, etc.)
SAM
Gloves, paperwork and notebooks (less than 1 inch thick), radios, flashlights and items listed above not being worn.

New Screencon98c

As directed by RP, personnel exiting the RCA will be expected to remove all materials from their pockets to verify no items, other than those listed in the table above, are inadvertently brought through the Personal Contamination Monitors.

New Screecon98d

Only qualified RP personnel can release the following from the RCA.

- Personal items that have been in a contaminated area
- All tools and equipment
- Trash/packaging material
- Other items not included in the table above

New Creeencon98e

Criteria for SAM Use

- Inspect item prior to survey to ensure no radioactive material labels or purple paint is present. Do **NOT** place any item designated as radioactive material in a SAM. Radioactive Material **CANNOT** be released from the RCA.
- No items that will not physically fit into the SAM without exerting pressure on the sides of the unit.
- No paperwork or notebooks 1 inch thick or greater
- No items with loose surface contamination
- No items with self shielding greater than 1/4 inch metal
- No items weighing greater than 40 pounds
- No liquids or aggregate materials

Screen con100

▷ **All items removed from a Contaminated Area shall be bagged and secured and taken to RP (generally at the Green Tag Table), or have RP survey at the step-off-pad.**

Con_a

CONTROL OF RADIOACTIVE MATERIAL

CON-10: State methods for control of radioactive material.

Recent events have occurred at a TVA Nuclear plant where radioactive material has been discovered outside the boundaries of the Radiologically Controlled Area (RCA). Specific examples are:

Con_b

- a magenta painted tool with fixed radioactive contamination was discovered in the plant clean tool room

Con_c

- an air mover box fan with fixed contamination identified with a radioactive materials tag was discovered in the control bay

Con_d

- a magenta painted screwdriver with fixed contamination was found in the control bay.

Con_e

- a worker removed an electronic dosimeter clamshell that was marked as radioactive material from the RCA

Con_f

- an oil sample marked as "Radioactive Oil Sample" was discovered in the Maintenance Building

Con_g

The most disturbing part of these recent events is that each item was clearly marked as radioactive material, either through the use of a Radioactive Material tag, magenta paint markings or with Radioactive Material tape.

Con_h

Remember:

Con_i

- **The purpose of the RCA is to ensure that controls are in place to use and handle radioactive material in a safe manner.**

- **When radioactive material is improperly removed from the RCA those controls are no longer effective in ensuring safe handling of the material.**

Con_k

Methods of Identification

Con_l

Radioactive material is identified in several different ways:

Con_m

- Radioactive Material tag contains universal tri-blade symbol.

Con_n

- Magenta (purple) paint – used to identify tools or other items with radioactive material embedded in the surface (fixed contamination).

Con_o

- Radioactive Material tape (magenta and yellow tape with universal tri-blade symbol).

Con_p

NOTE: ITEMS IDENTIFIED IN THIS MANNER ARE NOT TO BE REMOVED FROM THE RCA WITHOUT RP ASSISTANCE!!

Con_q **All un-marked items must be checked for contamination prior to removing them from the RCA:**

- How?
  - RP personnel check the item(s)
  - Approved hand carried items checked in the SAM

NOTE: Items that have been in a contaminated area (c-zone) must be checked by RP for contamination. They cannot be cleared by plant workers using the SAM.

Con_r **CONSEQUENCES OF INEFFECTIVE RADIOACTIVE MATERIAL CONTROL**

- NRC violations - Loss of control of radioactive material is a serious matter that would result in violations.
- Security issues involving radioactive material - The public relies on every employee at TVA Nuclear Plants to maintain the highest level of vigilance in controlling radioactive material.

Con_s ***"DOING THE RIGHT THING"***

- Employees will be held accountable for doing the right thing.

Con_t Examples of ***NOT*** "doing the right thing".

- Placing magenta marked tools into the SAM
- Attempting to exit the RCA with hand tools, gloves, etc., in pockets
- Removing any item marked as radioactive material from the RCA (Radioactive material tag, magenta paint markings, Radioactive material tape, etc.)
- Persons who fail to follow the rules for control of radioactive material will subject themselves to disciplinary action in accordance with plant policy.

Con_u **ERROR REDUCTION**

- You should always have a moment of uneasiness prior to entering and exiting the RCA.
- Self-check - ensure your intended actions for complying with radiological controls are correct.
- Peer check – ask your peers to check your actions.
- From a radiation safety perspective, it is imperative that each of us be vigilant in ensuring that radioactive material is properly controlled.

EXAMPLES OF ITEMS THAT SHOULD *NOT* BE REMOVED FROM THE RCA

Figure 1: Magenta Painted Tool

Figure 2: Radioactive Sample Label

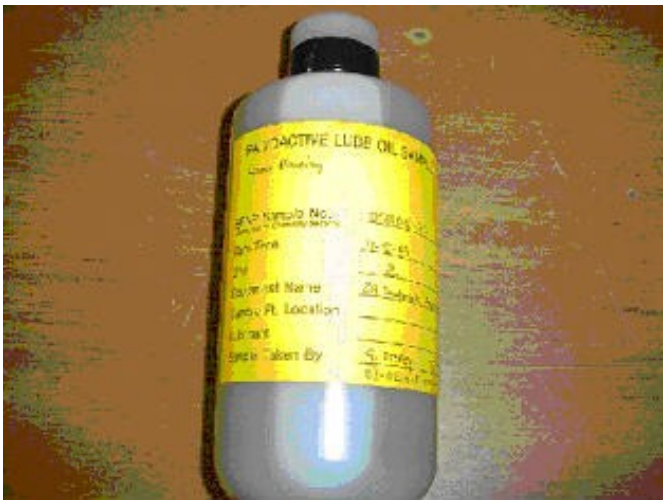


Figure 3: Radioactive Material Tag

Figure 4: Radioactive Material Bag

Screen quiz7
trn2 cr 99-0083

QUESTION: While using a wrench to tighten the packing on a contaminated valve, you slip and rip a hole in your protective clothing glove. You should stop work, and:

? change your PC glove and continue with the task.
? patch the hole with tape and notify your supervisor.
? leave the area and check yourself for contamination.

Screen quiz7c

ANSWER: leave the area and check yourself for contamination. Your protective clothing is no longer "protecting" you. Stop work, leave the area, and check yourself for contamination.

Screen quiz8
trn2 cr 99-0083

QUESTION: Prior to removing the wrench from the contaminated area, you may be required to place the tool in a bag.

True or False

Screen quiz8c

ANSWER: True. You would probably bag or contain the wrench to lessen the spread of contamination when removing the tool from the area.

Screen sum1

SUMMARY

▷ **Radioactive contamination can be identified as loose surface, fixed, or airborne contamination.**

▷ **Loose surface contamination can be easily transferred from one surface to another.**

▷ **Surface contamination that has become embedded in or on an object and cannot be removed by normal cleaning techniques is known as fixed contamination.**

Screen sum2

▷ **Radioactive particles or gases suspended in the air are known as airborne contamination. Airborne contamination is hard to contain but easy to breathe.**

▷ **Controlling the spread of contamination will minimize unmonitored radiation dose, decrease radioactive waste, and increase productivity.**

▷ **Protective clothing (PCs) is used to protect the worker from radioactive contamination.**

Screen sum3

▷ **Under routine conditions, some type of protective clothing is usually required to enter a contaminated area.**

▷ **All items exiting the Radiologically Controlled Area must be checked for contamination.**

INTERNAL EXPOSURE

Screen intsum1

OBJECTIVES

IDO-01

State the four pathways that radioactive materials can enter the body: inhalation, ingestion, absorption, open wounds/injuries.

IDO-02

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

IDO-03

State the process by which radioactive material is eliminated from the body.

Screen intsum2
IDO-04

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

IDO-05
IDO-06

Define derived air concentration (DAC), annual limit on intake (ALI), committed effective dose equivalent (CEDE), and state the relationship among DAC, ALI, CEDE, and TEDE.

Screen intsum3
IDO-07
trn2 cr 99-0059

Recognize plant conditions which may increase the potential for airborne radioactivity including:

- **brushing or sweeping**
- **fans blowing in dusty areas**
- **steam leaks**
- **sanding or grinding**
- **wet contaminated areas that are drying out**
- **breaching contaminated systems**

Screen int1

METHODS OF INTERNAL EXPOSURE

IDO-01: State the four pathways for radioactive material to enter the body.

There are FOUR ways radioactive material can enter the body:

Screen int2

1. INHALATION - **Prevented by the issuance of respirators, if the wearing of respirators is ALARA.**

Screen int3

2. INGESTION - **Prevented by good housekeeping and good work practices such as no eating, drinking, smoking, chewing, or dipping in the RCA.**

Screen int4

3. ABSORBTION - **Prevented by wearing protective clothing.**

Screen int5

4. OPEN WOUNDS - **Prevented by covering all wounds prior to entering the RCA and all injuries received inside the RCA are promptly reported to RP.**

Screen int5a

Methods used to prevent internal exposure…

Methods used to prevent external contamination (i.e. good housekeeping practices and not touching yourself with contaminated items) work very well in preventing internal exposure.

Screen int5b

Specific methods used to prevent an uptake of radioactive material consist of:

- **stir the air as little as possible while working in contaminated areas.**
- **ensure power tool exhaust does not blow on contaminated surfaces.**
- **use permanent or temporary ventilation systems to filter radioactive material from the air.**
- **use containment devices such as glove bags or tents to stop significant airborne contamination.**
- **use of respirators if ALARA.**

Screen int6

METHODS TO REDUCE INTERNAL DEPOSITION

The amount of radioactive material deposited in the body should be limited as much as possible since radioactive material deposited internally can become lodged within an organ and give a radiation dose to both the organ and whole body.

Screen int7

Let's look at methods you can use to help reduce the amount of internal contamination.

IDO-02: State the methods used to limit the internal deposition of radioactive materials.

Screen int8

Not EATING, DRINKING, SMOKING, or CHEWING within RCAs can reduce the amount of radioactive material deposited in the body.

Screen int9

ENGINEERING CONTROLS can also limit internal dose by establishing conditions that improve the radiological environment for workers.

Screen int10

ENGINEERING CONTROLS could include such things as installing ventilation systems with temporary filters, isolating potentially radioactive steam leaks, or shifting ventilation flow paths.

Screen int11

Using RESPIRATORS and other protective equipment can be effective in reducing the amount of material deposited in the body.

Screen int12

However, it may take longer to complete a task wearing a respirator; therefore, the total effective dose equivalent (TEDE) must be considered prior to wearing a respirator.

Screen int14

NOTE:
Breathing airborne radioactivity at typical levels found in a nuclear power plant DOES NOT pose a hazard to your health.

Screen intq1
trn2 cr 99-0083

QUESTION: Breathing in airborne radioactive contamination is one way radioactive material can enter the body.

True or False

Screen intq1c

ANSWER: True. Breathing in, or inhalation, will allow radioactive material to enter the body.

Screen intq2 trn2 cr 99-0083

QUESTION: Which of the following protective equipment would be effective in reducing the amount of radioactive material deposited in the body?

Safety glasses or Hearing protection or Respirator

Screen intq2c

ANSWER: Respirator. Respirators are effective in reducing the amount of material deposited in the body. However, respirator use for radiological work must be evaluated by RP.

Screen int15

ELIMINATION OF INTERNAL DEPOSITIONS

IDO-03: State the process by which radioactive material is eliminated from the body.

Once radioactive material enters the body, there are TWO processes that will cause it to be eliminated:

Screen intre1

biological processes and radioactive decay.

Screen intre1a

BIOLOGICAL PROCESSES **will naturally cause many types of internal deposition to be eliminated from the body.**

Screen intre1b

RADIOACTIVE DECAY **will occur to those radioactive isotopes that remain within the body.**

The decay process will make these isotopes less radioactive as time goes on.

Screen intre1c

The amount of time required for an isotope to decay to one-half of its initial activity (that is, its radioactive half-life) is entirely dependent on the isotope.

This can vary from seconds to many years.

Screen int16

MEASURING INTERNAL ACTIVITY

The body contains naturally occurring radioactivity such as potassium.

Screen int17

IDO-04: Recognize the methods used to determine the amount of radioactive material deposited in the body.

The internal dose we worry about is from the internal deposition of radioactive material.

Screen int18

This internal radioactivity is measured by WHOLE BODY COUNTS or BIOASSAYS.

Screen int19

As a radiation worker, you may be required to have a WHOLE BODY COUNT **prior to initially entering the radiologically controlled area.**

Screen int20

The WHOLE BODY COUNT detects gamma-emitting radioactivity within the body.

Screen int21
trn2 cr 99-0060

Periodically, another whole body count may be performed.

Another whole body count may be performed when there is indication of an internal uptake of radioactive material or upon termination.

Screen int22

BIOASSAYS **may also be used to determine internal radioactivity levels. A bioassay is an evaluation of a waste sample taken from the body.**

Screen int23

Bioassays can be more effective in determining WHERE the internal deposition is located in the body as well as HOW MUCH is present.

Screen intq3

QUESTION: One method of measuring how much internal radioactivity is present in your body is by performing a:

? Whole body count
? Frisk using a hand-held frisker
? Survey using an electronic dosimeter

Screen intq3a

ANSWER: Whole Body Count. A whole body count measures the level of radioactivity inside the body.

Screen int24

INHALATION through the nose and mouth is the most common cause of internal dose.

Screen int25

The amount of dose received is directly related to the RADIOACTIVITY LEVEL of the air breathed and the DURATION OF TIME in the environment.

Screen int26

The amount of internal dose you are permitted to receive is LIMITED by FEDERAL LAW.

Screen int27

IMPORTANT TERMS

IDO-05: Define derived air concentration (DAC), annual limit on intake (ALI), and committed effective dose equivalent (CEDE).

Screen intre2

Committed Effective Dose Equivalent (CEDE) **- The amount of assigned internal dose that relates organ dose to the whole body.**

Screen intre2a
trn2 cr 99-0061
trn2 cr 99-0062

Annual Limit on Intake (ALI) **- The concentration of radioactive material you would have to breathe to receive 5 rem committed effective dose equivalent or 50 rem to any organ.**

Screen intre2b

Derived Air Concentration (DAC) **- The concentration of radioactive material in air that would result in a dose of one ALI if breathed for 2000 hours in one year.**

Screen int28

Relating DAC, CEDE, ALI, and TEDE

IDO-06: State the relationships among DAC, ALI, CEDE, and TEDE.

Let's explore how these terms relate to each other.

Screen int29

Since the ALI is based on 5 rem (5000 mrem) in 2000 hours/year, then a DAC-hour is equal to 2.5 mrem of internal dose:

Screen int30

5000 mrem/2000 hrs = 2.5 mrem per DAC-hr

Screen int31

The following example will show how these terms are related to internal exposure and the use of respirators:

Screen int32

EXAMPLE:

A worker is tasked with repairing a door.

The area has a dose rate of 24 mrem/hr and also has some airborne radioactivity.

From experience, the worker knows it will take 2 hours and 20 minutes (2.33 hours) to make the repair with a respirator or 2 hours without a respirator.

If the job is done without a respirator, the worker will receive 2 DAC-hours internal exposure.

Screen int33

FACTS:

- **area dose rate = 24 mrem/hr**
- **some airborne radioactivity present**
- **working WITH a respirator = 2.33 hours**
- **working WITHOUT a respirator = 2 hours**
- **working WITHOUT a respirator = 2 DAC-hrs internal exposure**

Screen int35

QUESTION: **If the worker wears a respirator, what will the total dose be?**

Screen int36

ANSWER: **(24 mrem/hr) (2.33 hrs) = 56 mrem.**

The total dose will be 56 mrem…

Screen int37

QUESTION: **If the worker does not wear a respirator, what will the total dose be?**

Screen int38

ANSWER: **(24 mrem/hr) x (2 hrs) = 48 mrem**
(2 DAC-hrs) x (2.5 mrem/DAC-hr) = 5 mrem

48 mrem + 5 mrem = 53 mrem

The total dose will be 53 mrem….

Screen int39

CONCLUSION:

By NOT wearing a respirator to complete this task, the worker will receive LESS total effective dose equivalent (TEDE).

Screen int40

All jobs in the RCA must be evaluated by RP to determine if using respirators will or will not reduce total dose (TEDE).

Screen intq4
trn2 cr 99-0083

QUESTION: One DAC-hour is equal to:

15 mrem or 50 mrem or 1 mrem or 2.5 mrem

Screen intq4d

ANSWER: 2.5 mrem. One DAC-hour is equal to 2.5 mrem.

Screen intq5
trn2 cr 99-0083

QUESTION: Whenever airborne radioactive contamination is present in an area, a respirator will always be used.

True or False

Screen intq5b

ANSWER: False. As demonstrated in the earlier example, there may be times when using a respirator in an airborne radioactive area may actually increase a worker's total dose! Therefore, respirators will not always be used in these areas.

Screen int41

INCREASING AIRBORNE RADIOACTIVITY

IDO-07: Recognize plant conditions that may increase the potential for airborne radioactivity.

Be aware of certain activities inside RCAs that may increase the amount of airborne radioactivity…

Screen int42

- **Brushing or sweeping.**

Screen int43

- **Fans blowing in dusty areas.**

Screen int44

- **Steam leaks.**

Screen int45

- **Sanding, grinding, or welding on a contaminated pipe.**

Screen int46

- **A wet contaminated area that is drying out.**

Screen int46a

- **Poor housekeeping and improper work techniques.**

Screen int47
trn2 cr 99-0057

Be alert to the types of conditions that can increase the airborne radioactivity levels and your TEDE.

Check with a RP technician BEFORE attempting any of these activities.

Screen intend1

SUMMARY

- **The four primary methods which allow radioactive material to enter the body are: inhalation, ingestion, absorption, and through open wounds.**
- **Some ways to reduce the amount of internal contamination are: not to eat, drink, smoke, or chew within RCAs; use of engineering controls; use of respirators.**

Screen intend2

- **The two primary processes by which radioactive material is eliminated from the body are radioactive decay and biological elimination.**
- **Whole body counts and bioassays are techniques used to measure radioactivity within the body.**
- **Committed Effective Dose Equivalent is defined as the amount of assigned internal dose that relates organ dose to the whole body.**

Screen intend3
trn2 cr 99-0062

- **Annual Limit on Intake is defined as the concentration of radioactive material you would have to breathe to receive 5 rem committed effective dose equivalent or 50 rem to any organ.**
- **Derived Air Concentration is defined as the concentration of radioactive material in the air that would result in an accumulation of 1 ALI if breathed for 2000 hours in one year.**

Screen intend4

- **Be alert to the types of conditions that can increase the airborne activity levels and your total dose.**

RADIATION WORK PERMIT

Screen obj1

OBJECTIVES

RWP-01

State the function of an RWP.

RWP-06

State the types of RWPs

RWP-03

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

RWP-04

State the responsibility for complying with RWP requirements.

RWP-05

Extract information from a survey map.

Screen obj2
RWP-02

State the required actions to be taken if the work scope or radiological conditions change so that they are not within the scope of an RWP.

Screen rwp1
trn2 cr 99-0129

Functions of an RWP

A radiation work permit (RWP) contains details concerning a radiological area that will help you minimize dose and reduce the likelihood of becoming contaminated or spreading radioactive contamination.

Screen rwp2
trn2 cr 99-0129

As a radiation worker, the RWP is one of the most important tools available to you in helping to achieve your ALARA goals.

Screen rwp3

Authorization to use Radiation Work Permit must be obtained from RP. RWPs provide two major functions…

Screen rwp4b

RWP-01: State the function of an RWP.

- **Requirements: Lists radiological requirements necessary for you to work in the area.**
- **Information: Provides information to enable radiation workers to perform their work in radiologically safe manner.**

Screen rwp8
trn2 cr 99-0129

Conditions Requiring An RWP

- **Any entry into a Radiologically Controlled Area.**

Screen quiz1
trn2 cr 99-0083

QUESTION: One of the functions of an RWP is to provide information on radiation workers' rights and responsibilities.

True or False

Screen quiz1c

ANSWER: False. RWPs provide: radiological requirements and information concerning radiological conditions and hazards; NOT information on your rights and responsibilities.

Screen rwp10_1
trn2 cr 99-0129

Types of RWPs

RWP-06

A General RWP is used for day to day routine inspections, maintenance and surveillance.

A Specific RWP is used for specific jobs/tasks.

Screen rwp10_2
trn2 cr 99-0129

A General RWP is required for access to the RCA. Additionally, during outages, individuals may be required to log into the HIS-20 "island terminal" for the job/task Specific RWP.

Screen rwp10_3
trn2 cr 99-0129

For example, a worker will be performing refueling activities which require a Specific RWP. He must log in on a General RWP to obtain access to the RCA. He will proceed to a HIS-20 "island terminal" near the job location and log in on the Specific RWP. HIS-20 will automatically log him off the General RWP. After completing his job, he must log off the Specific RWP and log back onto the General RWP.

Remember that an RWP is required when you are in the RCA.

Screen rwp10
trn2 cr 99-0129

EXTRACTING INFORMATION FROM AN RWP

RWP-03: Extract information from an RWP.

An RWP contains information that will help you stay radiologically safe by providing details such as clothing requirements, dosimetry requirements, and other special information that will help with the job.

trn2 cr 99-0129

An example RWP and survey map will be provided for use during the practical exercise. The ability to extract information from the RWP and survey map will be a part of the practical exercise.

Screen rwp11_1
trn2 cr 99-0129
trn2 cr 99-0063

RWPs are identified by a permit number consisting of 8 characters and will contain all or part of the following information. Any information that does not apply will not be printed on the RWP.

Screen rwp11_2
trn2 cr 99-0064
trn2 cr 99-0129

Heading: Contains the permit number and briefing frequency.

Screen rwp11
trn2 cr 99-0064
trn2 cr 99-0065
trn2 cr 99-0066
trn2 cr 99-0129

General Description: The important information in this section for the general employee is the RP Coverage (none, intermittent, or continuous), work area description, and dose alarm/dose rate alarm setpoints for EDs. RP will also brief individuals on the ALARA Review Number, if required.

Screen rwp12
trn2 cr 99-0064
trn2 cr 99-0129

Description of Work to be Performed: Task to be performed. Workers must not deviate from stated task.

Screen rwp13
trn2 cr 99-0064
trn2 cr 99-0129

Radiological Conditions of Work Area: Radiation and contamination levels from an initial survey may be annotated. Latest radiological conditions shall be reviewed prior to each entry.

Screen rwp14
trn2 cr 99-0064
trn2 cr 99-0129

Anti-Contamination Clothing Requirements: The protective clothing requirement(s) that must be adhered to exactly. The type of protective clothing corresponds to the Work Steps on the RWP.

Screen rwp14_1
trn2 cr 99-0064
trn2 cr 99-0129

Dosimetry Requirements: Dosimetry requirements are found in this section. For example electronic dosimeter, TLD, multibadge, or extremity badging.

Screen rwp14_2
trn2 cr 99-0064
trn2 cr 99-0129

Respiratory Protection Requirements: The type of respirator required will be noted in this section.

Screen rwp14_3
trn2 cr 99-0064
trn2 cr 99-0129

Briefing Requirements: Types could include pre-job, post-job, or mid-job.

Screen rwp14_4
trn2 cr 99-0064
trn2 cr 99-0129

Training Requirements: Additional training beyond General Employee Training. For example, Steam Generator jumper.

Screen rwp14_5
trn2 cr 99-0064
trn2 cr 99-0129

EQUIS: This code identifies a component of the plant.

Screen rwp14_6
trn2 cr 99-0064
trn2 cr 99-0129

ALARA Tracking Codes: Codes used by RP to track dose for various plant evolutions.

Screen rwp14_7
trn2 cr 99-0064
trn2 cr 99-0129

Work Steps: A description of the work step(s). Remember that protective clothing requirements correspond to the work step(s).

Screen rwp14_8
trn2 cr 99-0064
trn2 cr 99-0129

Types of Communication: Communication devices utilized, such as radios or headsets.

Screen rwp14_9

Worker Instructions: Information to the worker with regard to the use of the RWP. For example, review survey map prior to entry.

Screen rwp14_10
trn2 cr 99-0064
trn2 cr 99-0129

Special Instructions: References any special issues or concerns, and the RP coverage required.

Screen rwp14_11
trn2 cr 99-0064
trn2 cr 99-0129

Approval: Notes individuals who prepared and approved the RWP.

<YOUR SITE NAME> Unit: 1
<Your Site Address 1> Permit Number: 99009997
<Your Site Address 2>
Revision Number: 1
Page: 73

RADIOLOGICAL WORK PERMIT
UNIT 1 CONTAINMENT
BRIEFING REQUIRED QUARTERLY

GENERAL DESCRIPTION

Status:	ACTIVE	Start Date:	21-MAY-1999	End Date:	:30-JUN-1999
Type:	SPECIFIC	Map id:	Outage: N	Name:	
Task:	SPECIAL PLANT MAINTENANCE			PSE:	N
HP Coverage:	INTERMITTENT			Authorization Type:	ALL
ALARA Review Number:	99002		Primary Work Doc:		
Person-mrem Estimate:	600		Person-Hrs Estimate:		15
Dose Alarm:	100:			Dose Rate Alarm:	200
DAC-hrs Tracked:	Y				
Work Area Description:	U-1 REACTOR BUILDING ALL ELEVATIONS				

DESCRIPTION OF WORK TO BE PERFORMIED

Inspect/Replace Pump A Impeller

RADIOLOGICAL CONDITIONS OF WORK AREA

RAD LEVELS: Survey No.: 990215 by: W. SIMPKINS on: 20-FEB-1999
Survey Information:
Internal to 500,000 dpm/100cm2
External to 15,000 dpm/100cm2
Dose rates 20-40 mrem/hour general area
Comment:

ANTI-CONTAMINATION CLOTHING REQUIRMENTS

1	GLOVES, RUBBER, ONE PAIR	1	SHOE COVERS, ONE PAIR
1,2	BOOTIES, ONE PAIR	1,2	CLOTH INSERTS
1,2	HOOD	1,2	MODESTY CLOTHING
1,2	SURGEON'S CAP	1,2	SECURE GLOVES/BOOTIES
1,2	COVERALLS, ONE PAIR	2	GLOVES, PUBBER, TWO PAIR
2	SHOE COVERS, TWO PAIR	2	RAIN SUIT

DOSIMETRY REQUIREMENTS

ELECTRONIC DOSIMETER	TLD

RESPIRATORY PROTECTION REQUIREMENTS

Respiratory Protection: REQUIRED
Respirator Types:

ULTRATWIN	MSA FULL FACE TWIN CARTRIDGE

BRIEFING REQUIREMIENTS

PRE JOB BRIEFING	

<YOUR SITE NAME>
<Your Site Address 1>
<Your Site Address 2>

Unit: 1
Permit Number: 99009997
Revision Number: 1
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RADIOLOGICAL WORK PERMIT
UNIT 1 CONTAINMENT
BRIEFING REQUIRED QUARTERLY

TRAINING REQUIREMENTS

ADVANCED RADWORKER

EQUIS

PMP200A		

ALARA TRACKING CODES

REPLACE		

Work Steps

1 UNBOLT PUMP HOUSING
2 REMOVE HOUSING/IMPELLER

TYPES OF COMMUNICATION

NONE

Worker Instructions

1 REVIEW SURVEY MAP PRIOR TO ENTRY
2 THIS WORK INVOLVES BREACHING A PRIMARY SYSTEM. BE AWARE THAT FOREIGN MATERIAL MAY BE ENCOUNTERED. IF THIS OCCURS, DO NOT TOUCH THE MATERIAL CONTACT RADIATION PROTECTION (RP) TO SURVEY THE MATERIAL
3 NOTIFY RADIATION PROTECTION (RP) OF ANY UNUSUAL RADIOLOGICAL CONDITIONS (FOR EXAMPLE, WATER, LEAKS, PADIATION MONITOR ALARMS)
4 UTILIZE LOW DOSE WAITING AREAS AND AVOID POSTED HOT SPOTS.
5 TVA SUPPLIED CLOTHING MAY BE USED INSTEAD OF MODESTY CLOTHING

Special Instructions

1 NOTIFY PADCON PRIOR TO BREACHING PUMP HOUSING HP Coverage: INTERMITTENT GRAB AIR SAMPLE
2 RADIATION PROTECTION (RP) SHALL SURVEY THE IMPELLER FOR THE PRESENCE OF HOT PARTICLES. HP Coverage: INTERMITTENT

APPROVAL

Prepared By: MAPALMER Approved By: Approved By: Final Approval: MAPALMER

End of RWP

Screen rwp16

RWP PRECAUTIONS

RWP-02: State the required actions to be taken if the work scope or radiological conditions change so that they are not within the scope of an RWP.

If it becomes necessary to exceed the scope of the RWP to perform work, or if work conditions DEVIATE from those described on the RWP…

Screen rwp17

STOP WORK and CONTACT RADIATION PROTECTION (RP)!

Screen rwp18

RADIATION PROTECTION (RP) will re-evaluate the radiological conditions on the job site and either:

Screen rwp19

⇨ **terminate the old RWP and create a new RWP.**

Screen rwp20

⇨ **revise the original RWP.**

Screen rwp21

It is important to check your secondary dosimetry often since radiological conditions can change unexpectedly.

If you determine that conditions have changed inform your co-workers, leave the area, and contact RADIATION PROTECTION (RP).

Screen rwp22

Radiation Work Permits will be TERMINATED when the work is complete or if conditions have changed and the requirements of the RWP cannot be reconciled to those changes.

Screen rwp23

Remember, ALL WORK within an RCA must be authorized by RADIATION PROTECTION (RP).

Screen quiz2
trn2 cr 99-0083

QUESTION: The radiological conditions at a job site where you have been assigned to clean up a spill are much worse than the RWP specified. You should:

? Continue work and tell RADIATION PROTECTION (RP).
? Stop work and contact RADIATION PROTECTION (RP).
? Clean up the spill then call your boss.

Screen quiz2b

ANSWER: Stop work and contact RADIATION PROTECTION (RP). If work conditions deviate from those described on the RWP, stop work and contact RADIATION PROTECTION (RP).

Screen rwp24

RWP USE

Workers can only be logged in on one RWP at a time! A hard copy is normally maintained by RP.

Screen rwp25
trn2 cr 99-0129

You must thoroughly READ and UNDERSTAND the RWP before logging on to the Access Control system.

Screen rwp26
trn2 cr 99-0129

RWP access is documented in the Health Physics Information System (HIS-20). Access Control is an electronic method of logging in under an RWP.

Screen rwp27
trn2 cr 99-0129

Access Control interfaces with your ED. When inserted into the reader, the ED will have all alarm setpoints programmed.

Screen rwp28

All requirements in the RWP are included for a reason - to protect TVA Nuclear workers from receiving unnecessary dose.

RWP-04: State the responsibility for complying with RWP requirements.

It is important for you to follow all requirements.

Screen rwp30

RWP COMPLIANCE

Not complying with the RWP requirements 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.

Screen rwp31

SURVEY MAPS

As mentioned earlier, most radiation work permits reference survey maps.

Screen rwp32

A survey map contains a drawing of the area that was surveyed and provides detailed radiological information such as local dose rates, contamination levels, radiological boundaries/postings, etc.

Screen rwp38
trn2 cr 99-0067
trn2 cr 99-0068
trn2 cr 99-0069

RWP-05: Extract information from a survey map.

new screen
See Figure 5 for radiological survey map example.

Different types of information on the survey maps are noted through the use of symbols and/or designators (may vary from site to site):

- **Postings/barriers/areas are shown often by a solid line.**
- **Smear location is shown by a number in a circle and level of contamination is in units of dpm/100cm^2.**
- **Dose rates are shown in units of mrem/hr unless otherwise noted. When three numbers are displayed together, either in a box or separated by slash marks, the first number is the contact dose rate, the second number is the whole body (30 cm) dose rate and the third number is the general area (1 meter) dose rate.**
- **Single numbers which are underlined or in boxes indicate general area dose rates.**
- **Air sample location is shown by a number inside a triangle**
- **Boxes with lines through them and numbers inside indicate a masslinn (in cpm)**
- **The designations HS (Hot Spot), AWA (ALARA Waiting Area), and SOP (Step-Off-Pad) may be used to designate these areas on survey maps.**

Screen rwp39

Survey maps are another tool that shows you, in detail, the radiological condition of certain work areas. Consider them when conducting pre-job briefs.

Screen quiz3
trn2 cr 99-0083

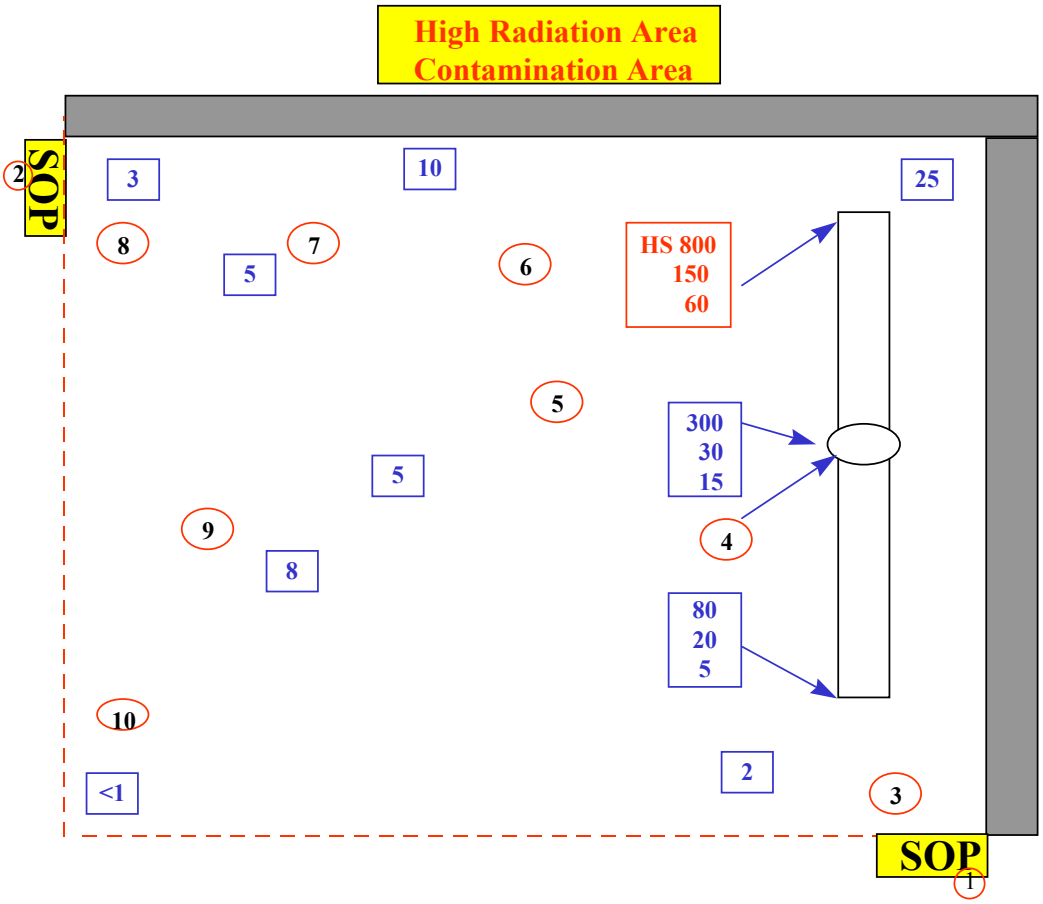
QUESTION: This document shows, in detail, local dose rates and contamination levels in a particular work area:

Survey Map or Radiation Work Permit or Radiological Posting

Screen quiz3a

ANSWER: Survey Map. Survey maps contain drawings of the area that was surveyed and provides detailed radiological information.

Radiological Survey Map Example



Example:

⑥ **Smear locations are indicated by a number inside a circle. The contamination level for each smear is given in a table on the map. Units for contamination is dpm/100cm^2**

Examples:

300 30 15	5

Dose rates are numbers in boxes. The number in the box is the dose rate in mrem/hr. Three numbers in the same box indicate a contact dose rate (top), a whole body dose rate (middle), and a general area dose rate (bottom) associated with a particular point of interest, such as a valve, elbow, pump, etc. One number in a box indicates the general area dose rate.

Example table which shows the contamination levels found for each of the smear locations.

Summary of Highest Readings		Summary of Highest Readings	
Smears		Smears	
1) < 1,000	dpm/100cm^2	6) 40,000	dpm/100cm^2
2) < 1,000	dpm/100cm^2	7) 30,000	dpm/100cm^2
3) 6,000	dpm/100cm^2	8) 4,000	dpm/100cm^2
4) 50,000	dpm/100cm^2	9) 10,000	dpm/100cm^2
5) 45,000	dpm/100cm^2	10) 3,000	dpm/100cm^2

Screen rwp40

CHANGES IN CONDITIONS

Let's review what actions you would take in response to any changing radiological conditions.

Screen rwp41

Radiological conditions can change rapidly in a nuclear plant. These changes may not be apparent since the cause of the change may not even be in the same building!

Dose rates can change with reactor power level, equipment status changes, movement of shielding, and other reasons. Therefore, it is important to monitor dose!

Screen rwp44

If the radiological conditions are different than expected, or if the conditions change unexpectedly:

WARN or inform others who may be in the area…

Screen rwp45

…EXIT the area…

Screen rwp46

…CONTACT RP.

Screen rwp47

Also, be sure to contact RP prior to proceeding if the job scope changes. This will help in preventing the spread of contamination or receiving unexpected dose.

Changes in job scope can include:

Screen rwp48

- **Moving components that were not originally in the job scope.**

Screen rwp49

- **Opening a potentially contaminated system.**

Screen rwp50

- **Removing lead shielding.**

Screen sum1

SUMMARY

⇨ **RWPs: list radiological requirements needed to do work, and provide information regarding radiological conditions and hazards in the work area.**

⇨ **Respiratory needs, protective clothing, and the type of dosimetry needed will be specified on a RWP.**

⇨ **Not complying with the RWP requirements may result in a radiological event, increased dose, spread of contamination, or other radiological problems.**

Screen sum2

⇨ **A survey map contains a drawing of the area that was checked by RP. It provides detailed radiological information such as local dose rates, contamination levels, radiological boundaries/posting, etc.**

⇨ **If the radiological conditions are different than expected, or if conditions change unexpectedly, INFORM others that may be in the area, EXIT the area, and CONTACT RP.**

POSTINGS AND RADIOLOGICAL ALARMS

Screen obj

OBJECTIVES

POS-1
POS-2

Define and recognize the requirements associated with work in the following radiological areas and/or postings: radiologically controlled area, radiation area, high radiation area, locked high radiation area, very high radiation area, contaminated area, airborne radioactivity area, radioactive materials area, hot particle area, radiography area, and hot spots.

POS-3

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

Screen obj2
RAL-1
RAL-2
RAL-3

Identify the radiological alarms used in the plant and state the proper response to these alarms including the potential consequences of ignoring them.

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

CON-11

Screen post1

TYPES OF POSTINGS

NCO860174003
DO NOT DELETE

Several different radiological conditions may exist in our plant. Areas established to provide radiological protection to our workers are known as Radiologically Controlled Areas (RCAs).

POS-01: Define and recognize a Radiologically Controlled Area.

Screen post2

Within an RCA are areas that may have elevated radiation, airborne, and contamination levels.

Screen post3
trn2 cr 99-0070
NCO860174003
DO NOT DELETE

Each area is posted according to the specific hazards via a sign having a magenta or black tri-blade symbol on a yellow background.

Screen post 3a - New

Workers can not reach over raised or elevated barriers (ropes, ribbons, wall, etc.). Uncommon activities (overhead crane operators, scaffolding work, etc.) which may cross over an elevated barrier should be discussed with RP and be evaluated on a case-by-case basis to determine the specific radiological controls.

Screen post 3b - New

Rad tape is used to indicate radiological precautions as necessary in an area. Postings should provide directions. If there are questions concerning the specific radiological precautions associated with rad tape in a specific area, call RP.

Entry requirements for the RCA include:

- ☐ **Entry and exit to the RCA shall only be via access points authorized by RP.**
- ☐ **A TLD and ED, is required for any entry to the RCA unless otherwise directed by RP. The ED must be placed in the turnstile reader prior to entry at those RCA entry points equipped with turnstiles.**

☐ **Report to RP prior to entry into the Protected Area if you have received medical isotopes regardless of how much time has passed since the treatment and returning to work. This reporting requirement applies even if medical professionals assure you the treatment will not be a concern upon returning to work. Do not wear your TLD after receiving a medical isotope treatment until authorized by Radiation Protection.**

☐ **Radiation Worker Training must be current.**

☐ **RWP.**

Screen TCPTI

Rules to Follow within an RCA

DO NOT:

∅ **Eat, drink, smoke, or chew while in an RCA.**

∅ **Carry ingestible items such as tobacco products, food, medicine, cough drops, etc. into the RCA. Essential medicine must be approved by RP.**

∅ **Reposition or remove shielding without approval.**

∅ **Reach across radiological barriers or remove, reposition, or deface postings or temporary barriers.**

∅ **Reach over raised or elevated barriers (ropes, wall, etc.)**

∅ **Breach containers, systems, or components without RP approval.**

Screen TCPTJ

∅ **Walk through standing water.**

∅ **Lean on equipment.**

∅ **Bring any unnecessary items into the RCA.**

∅ **Step on floor drains, especially yellow and/or magenta.**

∅ **Wear hand carried items (gloves, paperwork, notebooks etc.) through PCMs for release monitoring. They must be released using the SAMs or monitored by qualified RP personnel.**

∅ **Block radiological postings or areas such as step-off-pads or low dose waiting areas.**

Screen TCPTK
tnr2 cr 99-0071

DO:

☺ **Leave the area and notify RP if an Area Radiation Monitor (ARM) or Continuous Air Monitor (CAM) alarms.**

☺ **Stop work and notify RP if you are unsure of the radiological consequences of the actions you are about to take or if there is a radiological problem or concern.**

☺ **Read your secondary dosimetry at intervals proportional with the dose rates in the area occupied.**

☺ **Notify RP prior to performing work in the RCA.**

Screen TCPTL

☺ **Notify RP personnel and emergency personnel if an injury occurs while in the RCA.**

☺ **Notify RP if work is to be performed in the overhead (6 feet above floor level).**

☺ **Notify RP of any unusual conditions such as**

- ⇒ **open, ripped, untagged, or unattended yellow bags.**
- ⇒ **fallen RP signs or ropes.**
- ⇒ **lost or damaged dosimetry.**
- ⇒ **dusty or hazy air, steam leaks, or alarming friskers.**
- ⇒ **changes in radiological conditions.**

Screen TCPTM

☺ **Follow good housekeeping practices.**

☺ **Monitor yourself for contamination if contamination is suspected.**

☺ **Be aware of changing radiological conditions: make sure your activities do not create radiological problems for others and be alert that activities of others may change the radiological conditions where you are.**

Screen TCPTN

SER 88-037
SER 88-034
SER 88-006
SOER **01-1**
LER Q5, 237/86052
DO NOT DELETE

Screen TCPTN1

☺ **Know that the potential exists for very high personnel radiation exposures. There have been many instances in the nuclear power industry in which workers were exposed to excessive radiation levels due primarily to personnel error. Examples are:**

1) **entering areas of high radiation for "just a moment".**
2) **climbing over barrier walls rather than checking to verify proper locations.**
3) **ignoring alarming dosimeters.**
4) **Failing to check secondary dosimeter readings periodically.**
5) **Failure to maintain high radiation area barriers or locked doors.**
6) **Ignoring alarming monitors.**

Screen TCPTO

☺ **Monitor yourself for contamination prior to exiting the RCA. This is normally done through using both a portal monitor and a personal contamination monitor.**

☺ **Have tools and equipment monitored for contamination by RP prior to removal from the RCA. Approved hand carried items may be monitored by the workers through the use of SAMs.**

Screen TCPTOa

☺ **Realize that RP has the authority and responsibility to stop work or prevent the initiation of a job, test, or work activity when in their judgment the radiological conditions warrant such actions.**

☺ **Dispose of waste properly.**

Screen TCPTO1

A noble gas is a gas that doesn't react with other elements. This includes helium, argon, krypton, xenon, and radon. Some noble gases (and natural products) tend to be statically attracted to the synthetic materials (clothing) and may be detected by the personnel contamination monitor. It is recommended that you minimize the wearing of these materials into the RCA.

Screen TCPTP

All floor drains located inside radiologically controlled areas are considered potentially contaminated. Employees must not handle floor drain covers or insert drain lines into floor drains without first contacting RP. Failure to do so may result in personnel contamination.

Tools indicated as having fixed radioactive contamination will not be released from the RCA.

Screen TCPTQ

RP may use radiological hold tags to mark equipment that may present a radiological hazard when operated, such as vacuum cleaners with expired DOP test. If a radiological hold tag is on a piece of equipment employees intend to operate or repair, it is imperative to contact RP prior to any action to prevent a potential contamination or radiation incident.

Screen TCPTR

Special permission is required to carry items such as furniture, cabinets, etc. into the RCA.

Screen post6

POSTED AREAS

Screen TCPTV

Radioactive Materials Area

POS-01: Define and recognize a Radioactive Materials Area.

Any area or room in which radioactive material is used, stored, or transferred. In addition to the yellow and magenta colors and tri-blades, the word CAUTION or DANGER will appear on posting.

Screen TCPTW
trn2 cr 99-0072

All radioactive materials shall be stored in designated radioactive material storage area or room with the posting "Caution, Radioactive Material." All radioactive material shall be labeled with a "Caution, Radioactive Material" tag.

You must notify RP prior to placement or removal of radioactive material from a radioactive material storage area.
Unlabeled radioactive material shall not be left unattended.
If you find a radiological material container which is torn, unsealed, unlabeled, or unattended, call RP.

Screen TCPTX

All items which have been used in a contaminated area or potentially contaminated system are considered contaminated until surveyed and released by RP.

These items shall be placed in a sealed yellow container/bag containing the radioactive material symbol.
Containers with radioactive liquids require special care. RP may perform surveys during the movement. These items should be transported in a rigid device such as a bucket, drum or cart if there is potential for the primary container to be damaged and leak.

Screen TCPTY

Radioactive material which is being transported from one RCA to another through a clean area will normally be escorted by RP, except when properly bagged hand tools or protective clothing, certain chemistry samples, and materials are transported by other authorized persons.

You must maintain control of radioactive material in your possession while frisking or getting undressed upon exiting a contamination zone.
Ensure you place the radioactive material away from other personnel.

Screen post9

Radiation Area

POS-01: Define and recognize a Radiation Area.

An accessible area in which a person could receive a deep dose in excess of 5 mrem in one hour (5 mrem/hr) at 30 centimeters (about 1 foot) from the source.

The word "caution" will appear on the radiological posting.

Screen post10

Entry requirements are the same for Radiologically Controlled Area (RCA) entry.

Screen post11
trn2 cr 99-0004

High Radiation Area

POS-01: Define and recognize a High Radiation Area.

An accessible area in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour (100 mrem/hr) at 30 centimeters (about 1 foot) from the radiation source or 30 centimeters from any surface that the radiation penetrates.

Screen post12

The word "caution" or "danger" will appear on the standard radiological posting.

Screen post13

Entry requirements for a High Radiation Area:

Screen post14
Screen post15

- **All RCA entrance requirements apply.**
- **Either a dose warning device, dose rate meter, or RP coverage. Any entry into a high radiation area without one of these items will subject the individual and TVA Nuclear to an NRC violation!!!!**

Screen post17

Notify the RP group prior to ANY entry into a High Radiation Area.

Screen post18

Any entry into a High Radiation Area WITHOUT the ability to keep track of dose rates is a serious violation of plant procedure and may cause an overexposure.

Locked High Radiation Area

Screen post19
Define and recognize a Locked High Radiation Area

Areas where dose rates are greater than 1000 mrem/hr at 30 cm from the source shall be posted as a Locked High Radiation Area and locked (with a key controlled by RP).

- **If the area can not be locked, a continuous attendant (door watch) must be present. The door watch will be briefed in Locked High Radiation Area door watch requirements.**

Screen post19a

- **If it becomes necessary to lock areas that do not have a permanent enclosure, a temporary enclosure may be installed around the area and locked with a High Radiation Area padlock.**

New Screen post19b

- In individual areas where no enclosure exists and where no enclosure can reasonably be constructed around the area, the area does not have to be locked or continuously guarded, but barricaded, conspicuously posted and a clearly visible flashing light shall be activated as a warning device.

- **Electronic surveillance may also be used to prevent unauthorized entries.**

Screen quiz1
trn2 cr 99-0083

QUESTION: The room you are working in has a dose rate of 50 mrem/hr. It should be posted as a high radiation area.

True or False

Screen quiz1c

ANSWER: False. The room should be posted as a radiation area. A High Radiation Area has dose rates in excess of 100 mrem/hr.

Screen quiz2
trn2 cr 99-0083

QUESTION: Which of the following items would be required in order to enter a High Radiation Area?

Electronic dosimeter or Respirator or Protective clothing

Screen quiz2a

ANSWER: Electronic dosimeter. You need the ability to keep track of dose rates while in a High Radiation Area. The ED will do this for you.

Screen post21
trn2 cr 99-0005
trn2 cr 99-0089

Very High Radiation Area

POS-01: Define and recognize a Very High Radiation Area.

An accessible area in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour (> 500 Rad/hr) at 1 meter (about 3 feet) from a radiation source or 1 meter from any surface that the radiation penetrates.

Screen post22
trn2 cr 99-0005

The words "GRAVE DANGER" will appear on the standard radiological posting.

Screen post23

Entry requirements are stringently controlled due to the danger of LIFE-THREATENING OVEREXPOSURE TO INDIVIDUALS.

Screen post24

Access to very high radiation areas can only be approved using an RWP authorized by the RADIATION PROTECTION (RP) Superintendent or his designee.

Screen post25

Some potential VERY HIGH RADIATION AREAS at Browns Ferry are:

- **Drywell (normal power operations).**
- **Spent fuel storage area (divers).**
- **Upper drywell/vessel (refueling operations).**
- **Unshielded spent fuel pool gate (fuel transfer).**

Screen post25a

- **RWCU backwash receiver tank room.**
- **Cleanup demineralizer valve room.**
- **TIP room (during TIP operations).**
- **Radiography, X-ray machines (temporary equipment).**

Screen post26
trn2 cr 99-0074

Examples of potential VERY HIGH RADIATION AREAS at SQN & WBN are:

- **Spent Resin Tank Room.**
- **Lower Containment, inside polar crane wall during operation.**
- **Tritiated Drain Tank Room.**
- **Letdown Heat Exchanger.**

Screen post27

- **Steam Generator (inside).**
- **Keyway (at power).**
- **Radiography, X-ray machines (temporary equipment).**

Screen quiz3
trn2 cr 99-0083

QUESTION: In addition to the standard colors and symbol, what word or words will appear on a Very High Radiation Area Posting?

Caution or Danger or Grave Danger

Screen quiz3c

ANSWER: Grave Danger. Because of the life-threatening dose rates found in these areas, all Very High Radiation Area postings carry the words "grave danger."

Screen TCPTS

Contaminated Area

POS-01: Define and recognize a Contaminated Area.

Any room or area containing loose surface contamination in excess of the levels for a clean surface area. In addition to the conventional colors and tri-blade, the word CAUTION will appear on the posting.

CON-11: State the methods used to designate contaminated areas including postings and step-off pads.

Entry requirements:

- **All RCA entry requirements apply.**
- **Protective clothing.**

Screen TCPTT

Precautions include:

- ∇ **Enter and Exit area via the step-off-pad.**
- ∇ **Avoid contact of exposed body surfaces with contaminated material.**
- ∇ **Notification of RADIATION PROTECTION (RP) is required prior to all entries into contaminated areas.**

Screen TCPTU
trn2 cr 99-0076

- ∇ **Try not to "stir-up" loose contamination, you may cause it to become airborne.**
- ∇ **If you suspect skin contamination, exit immediately and monitor yourself for contamination.**
- ∇ **Cover/bandage all wounds.**

Screen TCPTUa
trn2 cr 99-0077

Step-Off Pads

Step-off pads are used with these contaminated areas. Step-off pads are the clean portion of a contaminated area boundary which denotes the entrance/exit location.

Screen post31

Airborne Radioactivity Area

POS-01: Define and recognize an Airborne Radioactive Area.

An area in any room or enclosure with an airborne concentration exceeding 30 percent of the limits in 10CFR20.

Screen post32

The word "caution" or "danger" will appear on the standard radiological posting.

Screen post33

Entry requirements are the same for RCA entry.

Normally, some type of protective clothing and possibly a respirator will be required. Note that additional training is required prior to respirator use.

Screen post34

If your work requires entry into these areas, contact RADIATION PROTECTION (RP).

Screen post35

Hot Particle Area

POS-02: Define and recognize a Hot Particle Area.

An area in which particles are strongly suspected or have been detected, the word "caution" will appear on the posting.

Screen post37

Entry requirements are the same as for a contaminated area however, additional protective clothing may be required and multiple step-off- pads will be used.

Pre-job discussions with the RP technician providing coverage may be conducted to address the hazards.

Screen post39

Radiography in Progress

Recall radiography is the testing of pipes or welds with radioactive sources.

Screen post40
trn2 cr 99-0016
trn2 cr 99-0080

Any area postings indicating RADIOGRAPHY IN PROGRESS MUST NOT be entered by workers unless permission is granted by the radiographer and RP responsible for the area.

Screen TCPTA

The Efforts of all Plant Workers are Required to Ensure Safe Radiography

A worker at Browns Ferry recently crossed a radiography barrier and entered a radiography area without permission. Because the radioactive source was locked in the shielded position, the worker's unauthorized entry did not result in any exposure.

Screen TCPTA1

It is important for all plant workers to understand the significant potential radiation hazards associated with radiography operations. These operations use intense radiation fields from radioactive sources to produce good quality radiographs of components being tested. The operation is similar to X-raying.

Screen TCPTB

Exposure to a radiography source's high dose rates can cause serious injury. Individuals have suffered skin burns, lost limbs, and even death from such exposures. The NRC has issued several Information Notices about radiography-related events in the industry, each emphasizing the importance of having rigorous controls over the operations.

Screen TCPTC

Radiographers are required to zone off the area. Barriers are typically yellow and magenta rope with signs that read:
"- CAUTION
-- RADIATION AREA
-- NO ENTRY
-- RADIOGRAPHY IN PROGRESS"
or equivalent

Screen TCPTD
trn2 cr 99-0079
trn2 cr 99-0016

Sometimes flashing lights are also placed at the barriers to enhance their visibility. Workers must NEVER cross a radiography barrier without permission from the radiographers and RP. This is for personal safety obviously.

Screen TCPTE

If an employee has an urgent need to enter a radiography area, call RP first. In the event of a high priority task, radiography can be shut down and access to the area approved. Otherwise, the work will have to wait until radiography is complete and the barriers are removed.

Screen TCPTF

A significant amount of radiography is performed at various times at the site. It is imperative that all plant workers maintain a high level of awareness when radiography is in progress and obey all radiography barriers and postings.

Screen Post41
trn2 cr 99-0078

Failure to follow these precautions can lead to a serious OVEREXPOSURE!

Screen post42

ADDITIONAL POSTED AREAS

Screen post43
trn2 cr 99-0082

Hot Spots

POS-02: Define and recognize a Hot Spot.

A hot spot is a small area with a contact dose rate significantly higher than the surrounding dose rates.

Screen post44

Hot spots are typically found in areas where radioactive material may accumulate, such as piping elbows, low-points in drains, and valve bodies.

Screen post45

Low Dose Areas

Certain areas of the plant are sometimes posted as low dose zones/areas or ALARA Zones. These are the lowest dose areas within the general work 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.

Screen post46

MOVEMENT OF POSTINGS

Radiological postings serve an important purpose: they warn station personnel of radiological hazards in the plant. Violation of these postings could affect the well-being of you and your coworkers.

Screen post47

Violation, movement, or removal of any radiological posting will not be tolerated.

RAL-03: State the potential consequences of violating, moving, or altering a radiological posting.

Any of these actions can result in a radiological hazard, increased dose to personnel, regulatory fines, and disciplinary action.

Screen post48

RADIOLOGICAL ALARMS AND RESPONSES

Many areas of the plant are monitored for unusual levels of radioactivity. If radiological conditions deviate from normal, alarms will be sounded.

Screen post49

Radiological Monitors

RAL-01: Identify the radiological alarms used in the plant.

The TWO most common radiological monitors are: Continuous Air Monitor (CAM) and Area Radiation Monitor (ARM).

Screen post50

Continuous Air Monitors

∇ **Located throughout the plant.**

Screen post51

∇ **Used to detect airborne radioactivity.**

Screen post52

∇ **Will alarm if airborne radioactivity levels are abnormally high.**

Screen post52a

∇ **If CAM is alarming, exit the area, notify RP, and monitor yourself for contamination.**

Screen post54

Area Radiation Monitor

∇ **These devices are located in areas of the station which could experience sudden fluctuations in dose rates.**

Screen post55

∇ **Set to alarm when dose rates are abnormally high.**

Screen post55a

∇ **If the alarm is sounding, exit the area and notify RP.**

Screen post57

If either a Continuous Air Monitor or Area Radiation Monitor alarms:

RAL-02: State the proper response to these alarms.

- **Secure the work and leave the area**

Screen post58

- **Notify RP**

Screen post59

THESE ALARMS COULD BE THE FIRST INDICATION OF A SERIOUS RADIOLOGICAL PROBLEM.

DO NOT EXIT IN THE DIRECTION OF THE ALARM!

Screen post60

Ignoring Alarms

RAL-03: State the potential consequences of ignoring the radiological alarms.

Improper response or ignoring a radiological alarm can increase your radiation dose and, consequently, health risk. Any individuals who purposefully ignore a radiological alarm are subject to disciplinary action.

Screen quiz4
trn2 cr 99-0083

QUESTION: If an Area Radiation Monitor alarm sounds in your work space, silence the alarm and check your ED.

True or False

Screen quiz4c

ANSWER: False. You would leave the area immediately and notify RP.

Screen sum1

SUMMARY

⇒ **Areas established to provide radiological protection to our workers are known as Radiologically Controlled Areas (RCAs).**

⇒ **An area in which radioactive material is used, stored, or transferred describes a Radioactive Materials Area.**

⇒ **An accessible area in which a person could receive a deep dose in excess of 5 millirem in one hour (5 mrem/hr) at 30 centimeters from the source describes a Radiation Area.**

Screen sum2
trn2 cr 99-0015

⇒ **An accessible area in which a person could receive a deep dose in excess of 100 mrem in one hour (100 mrem/hr) at 30 centimeters from the source describes a High Radiation Area.**

⇒ **An accessible area in which a person could receive a deep dose in excess of 500 rad in one hour (>500 rad/hr) at one meter from the source describes a Very High Radiation Area.**

Screen sum3
trn2 cr 99-0081

⇒ **An area in which the airborne concentration exceeds 30 percent of the limits in 10CFR20 describes an Airborne Radioactivity Area.**

⇒ **An area in which hot particles are strongly suspected or have been detected describes a hot particle area.**

Screen sum4
trn2 cr 99-0082
trn2 cr 99-0016

⇒ **Any area postings indicating radiography is in progress MUST NOT be entered by workers unless permission is granted by the radiographer and RP responsible for the area.**

⇒ **A "hot spot" is an area whose contact dose rate is significantly higher than the surrounding dose rates.**

Screen sum5

⇒ **Make use of low dose areas/zones when not actively working a task to keep your dose ALARA.**

⇒ **If any radiological monitors alarm, leave the area immediately, and notify RP.**

RADIOACTIVE WASTE

Screen wastobj

OBJECTIVES

WAS-01
WAS-02

Define "radioactive waste" and contrast the disposal costs of radioactive versus non-radioactive waste.

WAS-03

State the general methods for minimizing the generation of radioactive waste.

Explain why it is important to separate:

WAS-04
WAS-05
WAS-06

- **radioactive and non-radioactive waste**
- **wet and dry radioactive material**
- **radioactive and hazardous waste.**

Screen RadWast

DEFINITION

WAS-01: Define radioactive waste.

Radioactive waste is defined as material which has become radioactive or contaminated and is no longer of any practical use.

Screen RadWast2

Examples of potential radioactive waste are:

Screen RadWast3

- **used PCs that are no longer serviceable.**
- **used tape, gloves, and plastic bags from contaminated areas.**

Screen RadWast4

- **packing material inadvertently brought into the RCA.**

Screen Cost
trn2 cr 99-0075

WASTE COST AND REDUCTION

WAS-02: Contrast the disposal costs of radioactive versus non-radioactive waste.

The cost to dispose of low-level radioactive waste is very expensive and therefore has an economic impact on TVA Nuclear.

Reducing low-level radioactive waste (LLRW) improves our economic position and reduces the amount of radioactive material needing disposal.

It costs about $4 per pound to dispose of radioactive waste. This compares to approximately a nickel per pound for normal non-radioactive waste.

Screen Cost2

In addition, due to the decreasing number of disposal sites, storage and burial costs are continually increasing.

Screen LLRW

TECHNIQUES TVA NUCLEAR UTILIZES TO REDUCE LOW LEVEL RADIOACTIVE WASTE (LLRW)

Screen TCRWA

The techniques TVA Nuclear utilizes to reduce Radioactive Waste are:

WAS-03: State the general methods for minimizing the generation of radioactive waste.

- **Reduce**
- **Reuse**
- **Segregate**
- **Be Smart Save Money and Reduce Trash**

Screen TCRWB

REDUCE

- ◊ **Paper, plastics, consumables, tools and cardboard packing taken into Radiological Control Area (RCA).**
- ◊ **Spread of contamination by use of containment devices, wrapping tools used in contaminated areas.**
- ◊ **Length of wire, rope cable taken into RCA.**
- ◊ **Contamination areas by reporting system leaks as soon as possible and decontamination of work area/tools/equipment.**

Screen TCRWC

REUSE

- ◊ **Tools, flashlights, hoses, extension cords, ladders, equipment from Hot Tool Room.**
- ◊ **Cloth tool bags, material that is easy to decontaminate.**
- ◊ **Scaffold material in RCA.**
- ◊ **Report or repair leaking components and have spill of radioactive liquid cleaned up quickly.**

Screen TCRWD

SEGREGATE

- ◊ **Potentially clean items from radioactive contaminated items – clean trash in green receptacles – contaminated trash in yellow receptacles.**
- ◊ **Reusable protective clothing in purple receptacles.**
- ◊ **Wet/moist items from dry items – The burial site will issue a violation for wet waste.**

Screen TCRWE

Be Smart Save Money and Reduce Trash

- ◊ **Include radwaste minimization in work planning, pre-job briefs, mid-shift briefings and post job briefings.**
- ◊ **Remove packing materials such as boxes, padding and packing from ear plugs, side shields…etc. before entering RCA.**
- ◊ **Survey procedures, work packages, cardboard boxes, gloves at RCA exit.**

Screen TCRWF

◊ **Do not pour any chemicals, oil or other solvents into a plant drainage system without approval of plant chemistry personnel. Doing so will exhaust the filtering ability prematurely and generate unnecessary radwaste.**

◊ **Make Radwaste Reduction suggestions in the ALARA suggestion program.**

◊ **Use good judgment and common sense to reduce radioactive waste generation.**

◊ **Reduce TVA Nuclear's Radioactive Waste and contribute to our Winning Performance.**

Screen TCRWG
Screen Rwquiz
trn2 cr 99-0083

QUESTION: Removing unnecessary packing materials before entering any contaminated areas will help reduce radioactive waste.

True or False

Screen RwquizC

ANSWER: True. Remember to bring only those items into these areas that you will really need to do the job.

Screen Seprt

KEEPING WASTES SEPARATE

Keeping different types of waste separate from each other will reduce excess generation and cost. Let's look at three scenarios involving mixed waste.

Screen Seprt2

∇ **Radioactive Waste from Nonradioactive Waste**

∇ **Wet Radioactive Waste from Dry Radioactive Waste**

∇ **Hazardous Waste from Radioactive Waste**

Screen Nonrad

Keeping Radioactive Waste Separate from Nonradioactive Waste

When putting waste into the trash, keep radioactive waste separate from non-radioactive trash.

Screen Nonrad2

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 time and manpower and it almost always increases the amount of low level radioactive waste.

WAS-04: Explain why it is important to separate contaminated and non-contaminated waste.

Screen Nonrad3
Screen Nonrad3a
Screen Nonrad3b

Place contaminated trash in the properly marked containers…
…put clean trash in the "Green Is Clean" program containers.
DO NOT put Protective Clothing (PCs) into the "Green Is Clean" containers.

Screen WetDry

Keeping Wet Radioactive Waste Separate from Dry Radioactive Waste

Keep wet radioactive waste separate from dry low level radioactive waste.

Screen WetDry2

WAS-05: Explain why it is important to separate wet and dry contaminated material.

If liquid and dry radioactive waste 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 radioactive waste.

Screen WetDry3

Additionally, most radioactive waste disposal sites will refuse to accept waste that is mixed. Therefore, if wet and dry waste are mixed, they will have to be separated and dried before disposal can occur.

Screen Hazard

WAS-06: Explain why it is important to separate contaminated and hazardous waste.

Keeping Hazardous Waste Separate from Radioactive Waste

Do not put any chemicals into LLRW trash! If mixed, it becomes even more difficult to get rid of due to the additional restrictions that apply to chemical and hazardous waste disposal.

Screen Rwquiz2 trn2 cr 99-0083

QUESTION: Reducing the amount of low level radioactive waste generated will NOT reduce:

Cost or Dose received or Reactor power

Screen Rwquiz2C

ANSWER: Reactor power. The only one of these that reducing radwaste will not reduce is reactor plant power.

Screen wastsum

SUMMARY

⇒ **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 contaminated area; and packing material inadvertently brought into the RCA.**

⇒ **Compared to non-radioactive waste, the cost to dispose of radioactive waste is much higher.**

Screen wastsum2

⇒ **Use good judgment and think ahead - bring only those items into the RCA that you will need. This really reduces generation of radioactive waste.**

⇒ **When discarding, keep radioactive waste separate from non-radioactive materials.**

⇒ **Keep wet waste separate from the dry low level radioactive waste.**

⇒ **Do not mix chemicals or hazardous material with radioactive waste.**

PRACTICAL EXERCISE

Upon successful completion of the initial training examination on the previous objectives in this lesson, students must demonstrate the ability to wear protective clothing, enter a contaminated area, remove personal items and exit the area properly. As a part of this exercise, students will acknowledge their ability to hear ED alarms and be reminded of their responsibility should they not be able to hear the alarms. The following steps will be evaluated using a RADIATION PROTECTION (RP) DRESSOUT EXERCISE VERIFICATION form. Using an RWP, students should be able to:

- **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 rates and contamination levels.**
- **properly document the entry.**
- **don protective clothing specified by the RWP.**
- **properly wear dosimetry with protective clothing.**
- **meet the requirements on signs and postings within the radiological area to be entered.**
- **read a self-reading dosimeter while wearing protective clothing.**
- **minimize dose and the spread of contamination.**
- **properly remove personal items from the contaminated area.**
- **properly remove protective clothing when exiting the contaminated area.**
- **perform required monitoring for contamination.**
- **properly documenting the exit.**

RADIATION PROTECTION (RP) DRESSOUT EXERCISE VERIFICATION

NAME _____ SSN _____ INITIAL TRAINING _____ RETRAINING _____		Point Value	1st Attempt	2nd Attempt
PRE JOB	Inspected protective clothing	1		
	Familiar with RWP requirements and precautions	3		
	Familiar with radiological conditions	3		
	Properly dressed (as required by the RWP)	5		
	Dosimetry worn correctly	3		
	Cuff retainers or tape utilized correctly	3		
	Signed in on the RWP correctly	2		
DURING JOB	Checked dosimeter while in work area	2		
	Correct responses to given situations (e.g. irregular dosimeter readings, abnormal radiological conditions, alarms, transferring items out of c-zone)	5		
	Skin surfaces not touched (NOTE: DURING ANY ATTEMPT THE SECOND TIME EYEGLASSES OR ANY UNPROTECTED SURFACES ARE TOUCHED WILL RESULT IN AN AUTOMATIC FAILURE OF THAT ATTEMPT.)	5		
POST JOB CRITERIA	NOTE: Proper removal includes placing articles in proper receptacle			
	Tape or cuff retainers removed properly	3		
	Shoe covers removed properly	3		
	Rubber gloves removed properly	3		
	Hood removed properly	3		
	Surgeon's cap removed properly	3		
	Dosimetry removed and handled properly	3		
	Coveralls removed properly	3		
	Booties removed properly	3		
	Glove inserts removed properly	3		
	Step-Off-Pad (SOP) used properly	6		
	Personnel has dosimetry when leaving Step-Off-Pad (SOP)	3		
	Demonstrated knowledge of proper frisker checks (power, volume, selector/response switches, background) and any corrective actions	5		
	Surveyed hands properly prior to touching probe	2		
	Surveyed dosimetry properly	2		
	Demonstrated survey technique that would ensure no body area missed	5		
	Demonstrated adequate body survey rate (1 - 2 inches per second)	3		
	Probe within acceptable distance (1/2 inch) from surface during survey	3		
	Proper action taken if contamination found on body, dosimetry or frisker	4		
	Replaced frisker probe in proper position	1		
	Signed out on RWP correctly	2		
	Proper response to whole body frisker alarm	1		
	Proper utilization of ED Reader	2		
	Barriers breached	2		
		SCORE		
COMMENTS				

My signature verifies that I was instructed on the proper performance of items performed unsatisfactorily and had an opportunity to ask questions about this performance exercise. Also, I understand by my failure of this exam that I am restricted from entering any area regulated for the purpose of radiological protection.

restricted from entering any area regulated for the purpose of radiological protection.

1st Attempt STUDENT _____

Date ___ INSTRUCTOR _____

2nd Attempt STUDENT _____

Date ___ INSTRUCTOR _____