UNITED STATES
NUCLEAR REGULATORY COMMISSION
TECHNICAL TRAINING CENTER
OSBORNE OFFICE CENTER, SUITE 200
5700 BRAINERD ROAD
CHATTANOOGA, TN 37411-4017

December 23, 1996

MEMORANDUM TO: Sally Cornell, Training Coordinator, NMSS
Dennis Sollenberger, Training Coordinator, OSP

FROM: Kenneth A. Raglin, Director, TTD, AEOD

SUBJECT: HEALTH PHYSICS FOR URANIUM RECOVERY (F-104)
FEBRUARY 5 - 6, 1997

The subject course is to be held in Room T3B15 at the PDC in Rockville, Maryland from February 5 - 6, 1997. Attached is a list of attendees and a tentative course outline and schedule for persons scheduled to attend. Pre-reading material is also attached and participants are encouraged to review this matrrial in preparation for the course.

Normal office/business attire is appropriate for students attending courses. Students who are normally on the Compressed Work Schedule should be removed from the Compressed Work Schedule during training. Classes are scheduled to run from 8:00AM to 4:00PM beginning Wednesday, February 5.

Please provide your attendees with the above and inform them as to their responsibilities in preparing for this course.

If you have any questions, please call Rod Reed on 423/855-6500.

Attachments: 1. List of Attendees
2. Tentative Course Outline
3. Schedule
4. Pre-reading Material

cc w/atts: R. Reed, TTD
J. Patterson, TTD
C. Cain, RIV
D. Schmidt, NMSS
D. Simpson, ORISE
B. Phillips, ORISE

ENCLOSURE 2

PROPOSED LIST OF ATTENDEES

COURSE TITLE: Health Physics for Uranium Recovery (F-104)

COURSE DATES: February 5 - 6, 1997

INSTRUCTORS: Chuck Cain, Region IV
NMSS Staff
Dave Simpson, ORISE

NMSS

Daniel Gillen
Tae Ahn
Joseph Holonich
Daniel Rom
Duane Schmidt
Harold Lefevre
James Park
Janet Lambert
Michael Layton
Kenneth Hooks
Latif Jamdan
Mohammed Haque
Mike Fliegel
William Ford
Elaine Brummett
Robert Carlson
Charlotte Abrams
Abou-Bakr Ibrahim
Philip Justus
Keith McConnell
Patrick Laplante
Simon Hsiung
James Prikryl

State Programs

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F-104 HEALTH PHYSICS FOR URANIUM RECOVERY TENTATIVE COURSE OUTLINE

Introduction

Open Discussion of Pre-Reading Material - Appendix A (40 minutes)

Module 1.0 Radiological and Chemical Properties of Uranium (2.0 hours)

- Characteristics of Uranium
  - Naturally Occurring Isotopes of Uranium and Abundances
  - Radioactive Equilibrium
  - Uranium Decay Chain
  - Actinium Decay Chain
- Radiological Properties
  - Radiological Properties of Uranium
  - Specific Activity
- Human Response Indicators of Uranium Exposure
- Comparative Hazards and Radiological Versus Toxic Limits
- Radon
  - Characteristics of Radon
  - Radon Generation In and Movement Through Soil
  - Emanation Rate
    - RA-226 Concentrations
    - Soil Permeability
    - Soil Moisture
    - Atmospheric Pressure
    - Wind Speed
    - Technological Enhancement
  - Typical Outdoor Radon and Thoron Concentrations
  - Typical Indoor Radon and Thoron Concentrations
  - Temporal Variation in Radon Levels
  - Spatial Variations in Radon Concentrations
- Radon Progeny
  - Schematic of Radon Decay
  - The Potential Alpha Energy Concentration and the Working Level
  - Typical Working Level Concentration
  - Working Level Month (WLM)
  - Typical Cumulative Exposures

Module 2.0 Contamination Control (1.0 hour)

- Airborne Contamination Hazard
  - Sources of Airborne Material
- Airborne Contamination Control
  - Types of Samplers
  - Air Filters
  - Frequency and Limits of Air Sampling
  - Radon Considerations
- Surface Contamination Hazard
  - Overview of Surface Contamination Control
- Surface Contamination Control

Characterization of Uranium Surface Contamination
Personnel Contamination Hazard
Personnel Contamination Control
Special Precautions for Personnel Contamination Control

Module 3.0 Internal and External Dose Control (2.0 hours)

Primary and Derived Limits
ICRP 26 Dose Limits
Types of Effects
Dose Equivalent
DE (H_T)
Committed DE
CDE ($H_{50,T}$)
Total DE
TDE ($H_{50,T}$)
Effective Dose Equivalent (EDE)
Weighting Factor Definition
ICRP Weighting Factors
Other Organs & Tissues
Total Effective Dose Equivalent (TEDE)
NRC Limits
Examples
Dose Conversion Factors
Annual Limit on Intake (ALI)
Derived Air Concentration (DAC)
DAC-Hours
ALIs for Uranium
ALI vs. Weekly Limit of 10 mg
Things to Remember
Examples
ICRP 30 Models
Intake Routes
Terminology
Pathways
Uranium Biokinetics
Solubility Classes
Site-Specific Models
Excreta Analysis
InVivo Detection of Urine (Lung counts for uranium rather than whole body counts)
Fluorimetry
Quality Assurance for In-house Labs
QA Audits for In-house Labs
Overview of the External Dose Control Hazard
Beta Radiation
Mining and Milling Workplace Examples
Relative Hazard of Beta Versus Gamma Radiation
Sources and Detection of Beta Radiation
Sources and Detection of Gamma Radiation
Comparison of the Relative Hazard of Beta Versus Gamma Radiation
Other Sources of Gamma Radiation
Personal Dosimetry
Appropriate Personal Equipment
Problems with TLD Instrumentation

External Dose Reduction
- Reduction Principles
- Protective Clothing

Module 4.0 Sampling and Measurement at Uranium Mining and Milling Operations (1.0 hour)

- Reasons for Sampling and Measurement
- In-Situ Uranium Solution Mining
  - Flow Diagram for a Uranium In-Situ Leach Mining Operation
  - Environmental Concerns
  - Groundwater Monitoring Program
  - Guidelines for Groundwater Monitoring
  - Example of Surface and Ground Water Monitoring Program at In-Situ Mining Operations
- Uranium Milling
  - 10 CFR 20 "Standards for Protection Against Radiation"
  - 10 CFR 40 "Domestic Licensing of Source Material"
  - Flow Chart for Processing Uranium Ores
- Health Physics Concerns
  - Surveys for Airborne Uranium Ore Dust
  - Airborne Yellowcake
  - Sampling and Measurement
  - Radon-222 and Its Progeny
  - Sampling and Measurement Frequency Requirements
  - External Radiation
  - Measurements for External Radiation
  - Surface Contamination
  - Visual Inspections and Contamination of Skin and Personal Clothing
  - Release of Equipment to Unrestricted Areas
  - Packages for Shipment
  - Ventilation System
  - Contamination on Respirators
  - Summary of Survey Frequencies
- Liquid and Solid Wastes
  - Uncontrolled Release of Tailings
  - Radioactive Element
  - Effluent and Environmental Programs
    - Preoperational Radiological Monitoring Programs for Uranium Mills

Module 5.0 Health Physics Practices for Mining and Milling Operations (2.0 hours)

- Health Physics Role in Routine Activities
- Health Physics Role in Accidents and Emergencies
- Case Studies – Mining and Milling Facilities

Module 6.0 Open Forum or Panel Discussion of Current Issues (3.0 Hours)

To be determined.

Abbreviations, Acronyms, and Glossary

Tentative Schedule

Wednesday, February 5, 1997

8:00 am	–	8:10 am	Introduction of Instructors and Course Schedule
8:10 am	–	8:50 am	Open Discussion – HP Fundamentals
8:50 am	–	9:00 am	Break
9:00 am	–	10:00 am	Radiological and Chemical Properties of Uranium
10:00 am	–	10:10 am	Break
10:10 am	–	11:10 pm	Radiological and Chemical Properties of Uranium (Continued)
11:10 am	–	11:20 am	Break
11:20 am	–	12:00 pm	Contamination Control
12:00 pm	–	1:00 pm	Lunch
1:00 pm	–	1:30 pm	Contamination Control (Continued)
1:30 pm	–	1:40 pm	Break
1:40 pm	–	2:50 pm	Internal and External Dose Control
2:50 pm	–	3:00 pm	Break
3:00 pm	–	4:00 pm	Internal and External Dose Control (Continued)

Thursday, February 6, 1997

8:00 am	–	8:15 am	Questions
8:15 am	–	9:15 am	Sampling and Measurement at Uranium Mining and Milling Operations
9:15 am	–	9:30 am	Break
9:30 am	–	10:30 am	Health Physics Practices
10:30 am	–	10:45 am	Break
10:45 am	–	12:00 pm	Health Physics Practices (Continued)
12:00 pm	–	1:00 pm	Lunch
1:00 pm	–	4:00 pm	Open Forum or Panel Discussion (Current Issues)

INTRODUCTION

This appendix provides basic fundamentals of radiation and terms that are common to the health physics and nuclear industries. Trainees will build from these basics to the more in-depth concepts presented in the other modules of the Health Ph' sics for Uranium Recovery Course.

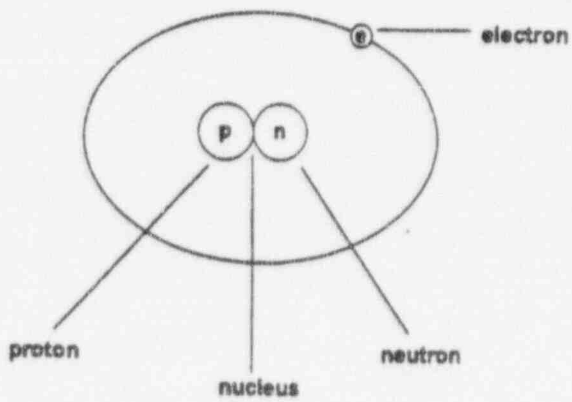
Topics include:

- Atomic Structure
- Definitions of Common Terminology
- Basic Types of Ionizing Radiation
- Radiological Units
- Effects of Radiation on Cells
- Acute and Chronic Radiation Exposure
- Contributions to U.S. Population Dose From Various Radiation Sources
- ALARA Program Concepts
- Radiological Postings

ATOMIC STRUCTURE

The basic unit of matter is the atom. The central portion of the atom is the nucleus, which consists of protons and neutrons. Electrons orbit the nucleus similar to the way planets orbit our sun.

The three basic particles of the atom are protons, neutrons, and electrons.



	Proton	Neutron	Electron
Location	In the nucleus of an atom	In the nucleus of the atom	In orbit around the nucleus of an atom
Charge	Positive	No charge	Negative
Facts	• The number of protons in the nucleus determines the element and atomic number • If the number of protons in an atom changes, the element changes	• Have about the same mass as a proton	• Electrons determine the chemical properties of an atom since they are involved in chemical reactions. • Are very small (about 1/1800 the mass of a proton).

DEFINITIONS

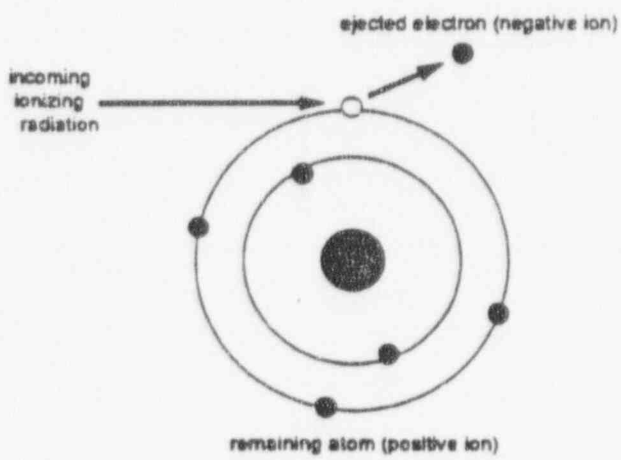
The following terms and definitions are commonly used by health physics professionals involved in mining and milling operations.

Radiation

Energy in the form of particles or waves that can travel through space.

Ionization

The process of removing electrons from atoms. Ionization should not be confused with radiation. If enough energy is supplied to remove electrons from the atom, the remaining atom has a positive (+) charge. The positively charged atom and the negatively charged electron are called an <u>ion pair</u>. Do not confuse ionization with radiation. Radiation is simply energy in motion. As a result of this energy, ionization may occur. Ions (or ion pairs) produced as a result of radiation exposure allow the detection of radiation.



Ionizing Radiation

Energy (particles or rays) emitted from atoms that can cause ionization. The basic types of ionizing radiation are alpha particles, beta particles, gamma rays, x-rays, and neutrons.

Non-ionizing Radiation

Radiation that doesn't have the amount of energy needed to ionize an atom with which it interacts. Examples are: radar waves, microwaves, and visible light. Although the word "radiation" can be used to mean ionizing or non-ionizing radiation, it is most often used to mean ionizing radiation.

Stable and Unstable Atoms

Only certain combinations of neutrons and protons result in stable atoms.

- If there are too many or too few neutrons for a given number of protons, the resulting nucleus will contain too much energy and will not be stable.
- The unstable atom will try to become stable by giving off excess energy in the form of particles or waves (radiation). These unstable atoms are also known as radioactive atoms.

Radioactivity

Unstable (or radioactive) atoms trying to become stable by emitting radiation in the form of particles or energy.

Radioactive Material

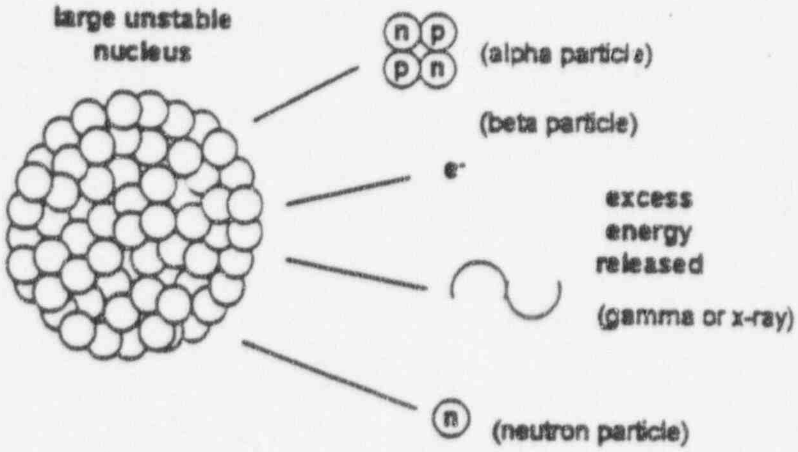
Any material containing unstable radioactive atoms that emit radiation.

Radioactive Contamination

Radioactive material in an unwanted place. (There are certain places where radioactive material is beneficial). It is important to note here that exposure to radiation does not result in contamination of the worker. Radiation is a type of energy and contamination is a material.

Radioactive Decay

Radioactive decay is the process of radioactive atoms releasing radiation over a period of time to try to become stable (non-radioactive). (Also known as disintegration.)



Half-life

Radioactive half-life is the time it takes for one half the radioactive atoms present in a radioactive sample to decay. After seven half-lives the activity of an average radioactive sample will be less than 1% of the original activity.

- radioactive half-life of U-239 is 23.5 minutes
- radioactive half-life of U-238 is 4,510,000,000 years

The amount of activity remaining after some number of half-lives can be calculated by multiplying the original amount of activity by the factor

$$\left(\frac{1}{2}\right)^n$$

where n is the number of half-lives that have elapsed.

THE BASIC TYPES OF IONIZING RADIATION

The basic types of ionizing radiation are alpha particles, beta particles, gamma rays, x-rays, and neutrons.

TYPE	ALPHA	BETA	GAMMA/ X-RAYS	NEUTRON
Physical Characteristics	Particle (+2 charge)	Particle (-1 charge)	Ray, Wave (no charge)	Particle (no charge)
Penetrating Power (Range)	Very Low (1-2" in air)	Limited (10-12' in air, few mm in skin)	High (several hundred feet in air)	High (several hundred feet in air)
Shielding	- <1" of air - Outer layer of dead skin - Clothing	- Glass - Metal foil - Plastic - Safety glasses	- Concrete - Lead - Steel	- Hydrogenous materials: Water Concrete Polyethylene
Biological Hazard	Internal	Internal skin, eyes	Internal/External (whole body)	External (whole body)
Sources	Uranium and Plutonium and most radioisotopes with atomic number >82	Uranium decay products, tritium, carbon-14	Decay products of natural uranium, x-ray machines	- Those used to calibrate instruments such as: Americium-Beryllium and Plutonium-Beryllium - Uranium Hexafluoride (UF_6) cylinders

Alpha Particles

- Physical Characteristics

  The alpha particle has a large mass. Positively charged. Consists of two protons, two neutrons, and no electrons.

- Penetrating Power (Range)

  Deposits a large amount of energy in a short distance of travel.

- Shielding

  Most particles are stopped by a few centimeters of air, a sheet of paper, or the dead layer (outer layer) of skin.

- Biological Hazard

  An internal radiation hazard when inhaled or ingested due to deposition of large amounts of energy.

- Sources

  Uranium and Plutonium and most radioisotopes with atomic number >82

Beta Particles

- Physical Characteristics

  A small mass negatively charged.

- Penetrating Power (Range)

  A limited penetrating ability

- Shielding

  Most particles are shielded by plastic, glass, metal foil, or safety glasses

- Biological Hazard

  If ingested or inhaled, can be an internal hazard. Externally, beta particles are potentially hazardous to the skin and eyes

- Sources

  Uranium decay products, tritium, carbon-14

Gamma Rays/X-Rays

- Physical Characteristics

  A wave that has neither mass nor electrical charge. Gamma rays originate within the nucleus of an atom. X-rays originate from the electron field.

- Penetrating Power (Range)

  Because gamma/x-ray radiation has no charge and no mass, it has a very high penetrating power.

  Several hundred feet in the air

- Shielding

  Best shielded by dense materials, such as concrete, lead, or steel.

- Biological Hazard

  Can result in radiation exposure to the whole body.

- Sources

  Decay products of natural uranium, x-ray machines

Neutrons

- Physical Characteristics

  No electrical charge, mass about the same as a proton

- Penetrating Power (Range)

  Because of the lack of a charge, have a relatively high penetrating ability and are difficult to stop

  A direct interaction occurs as the result of a collision between a neutron and a nucleus. A charged particle or other ionizing radiation may be emitted during these interactions.

  Several hundred feet in the air

- Shielding

  Best shielded by materials with a highly hydrogen content, such as water or plastic.

- Biological Hazard

  Whole body hazard due to high penetrating ability.

- Sources

  Those used to calibrate instruments such as Americium-Beryllium and Plutonium-Beryllium

  Uranium Hexafluoride (UF_6) cylinders

RADIOLOGICAL UNITS

Radiation

Per 10 CFR 20.1004, the following are units of radiation dose:

- **Gray (Gy)** is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1Joule/ kilogram (100 rads).
- **Rad** is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

- **Rem** is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

- **Sievert** is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).

Contamination Units

The units most commonly used to measure contamination are disintegrations per minute, disintegrations per second, and counts per minute.

- **Disintegrations per minute (dpm)** describes the number of atoms disintegrating (decaying) each minute in a radioactive source.

- **Disintegrations per second (dps)** describes the number of atoms disintegrating each second in a radioactive source.

- **Counts per minute (cpm)** represents the number of radiations detected per minute by a radiation detection instrument. Cpm can be converted to dpm by using a conversion factor for the radiation instrument you are using.

Radioactivity Units

Per 10 CFR 20.1005, Units of Radioactivity are:

- One becquerel=1 disintegration per second (s^{-1}).

- One curie=3.7×10^{10} disintegrations per second= 3.7×10^{10} becquerels=2.22×10^{12} disintegrations per minute.

Activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

EFFECTS OF RADIATION ON CELLS

Ionizing radiation can potentially affect the normal operation of cells.

The method by which radiation causes damage to any material is by ionization of atoms in the material. Some radiation damage is repaired by the cell. Some effects of radiation may not be observed immediately following exposure.

ACUTE AND CHRONIC RADIATION EXPOSURE

Potential biological effects depend on how much and how fast a radiation exposure is received. Radiation doses can be grouped into two categories: acute dose and chronic dose.

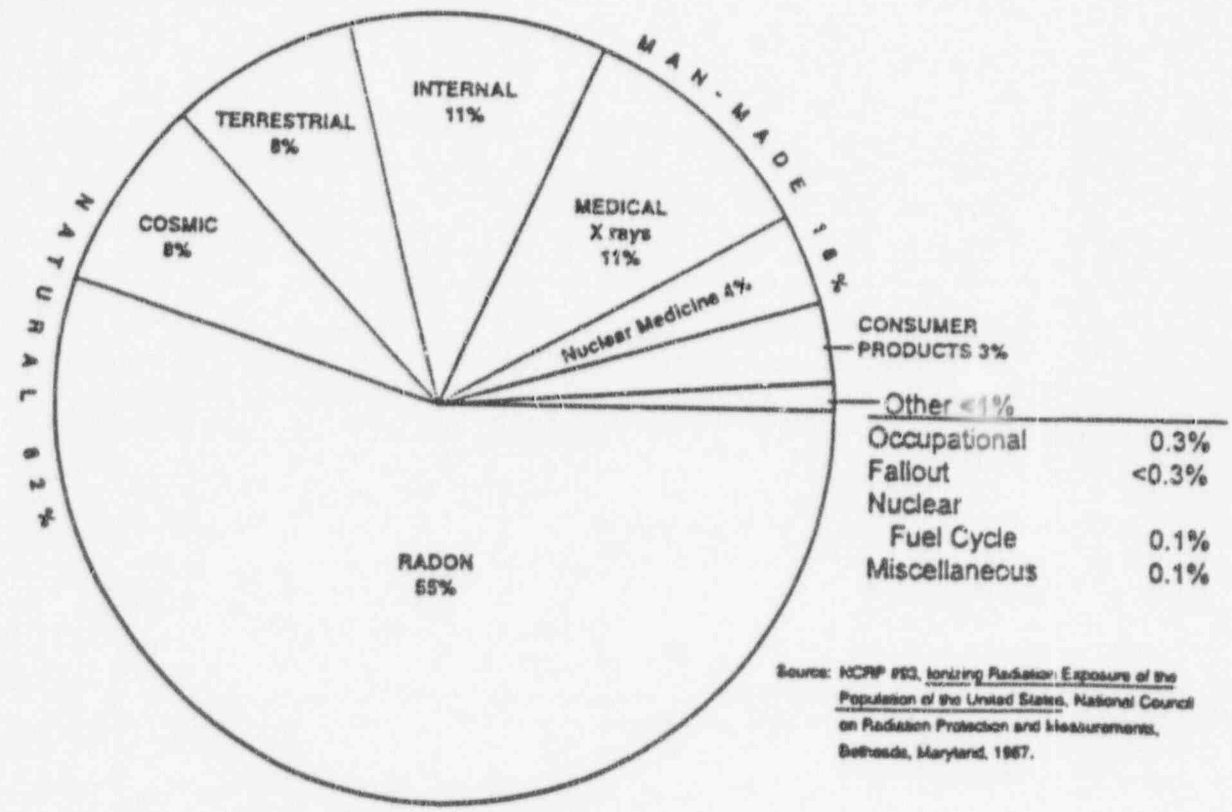
Acute Radiation Exposure

Large doses of radiation received in a short period of time are called acute doses. An acute effect is a physical reaction due to cell damage. This damage is caused by a large radiation dose received in a short period of time. Acute exposures are generally associated with radiological incidents.

Chronic Radiation Exposure

A chronic radiation dose is typically a small amount of radiation received over a long period of time. A typical example of a chronic dose is the dose we receive from occupational exposure.

CONTRIBUTIONS TO U.S. POPULATION DOSE FROM VARIOUS RADIATION SOURCES



Source: NCRP #93, Ionizing Radiation Exposure of the Population of the United States, National Council on Radiation Protection and Measurements, Bethesda, Maryland, 1987.

ALARA PROGRAM

ALARA stands for As Low As Reasonably Achievable.

ALARA is an approach to radiological control whereby exposures (individual and collective) to the workforce and to the general public are managed and controlled to be at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit below the applicable controlling limits.

This concept includes reducing both internal and external exposure to ionizing radiation. The ALARA concept is an integral part of all site activities that involve the use of radioactive materials.

The implementation of the ALARA concept is the responsibility of all employees.

The main goal of the ALARA program is to reduce exposure when reasonable by minimizing the time spent within a field of radiation, maximizing the distance from a source of radiation, using shielding whenever possible, and/or using proper protective clothing.

Basic Exposure Reduction Concepts

Time

Reducing the amount of time spent within a field of radiation will lower the dose received by the workers.

- Pre-plan and discuss the task thoroughly prior to entering the area. Use only the number of workers actually required to do the job.
- Have all necessary tools before entering the area.
- Use mock-ups and practice runs that duplicate work conditions.

Distance

Methods for maintaining distance from sources of radiation include the following:

- Stay as far away as possible from the source of radiation.
- During work delays, move to lower dose rate areas.
- Use remote handling devices when required.

Shielding

Shielding reduces the amount of radiation dose to the worker. Different materials are used to shield a worker form different types of radiation. Many materials, such as vehicle, a mound of dirt, or a piece of heavy equipment between the worker and the source of radiation, can reduce the exposure level during field activities.

Radiological Postings

Radiological postings are used to alert personnel to the presence of radiation and radioactive materials.

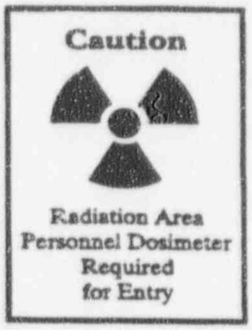
Areas controlled for radiological purposes will be designated with a magenta (or black) standard three-bladed radiological warning symbol on a yellow background. Additionally, yellow and magenta ropes, tapes, chains, or other barriers will be used to denote the boundaries.

- The barriers will be clearly visible from every side. Entrance points to those areas will have signs (or equivalent) stating the entry requirements, such as "Personnel Dosimeters, Radiation Work Permit (RWP) and Respirator Required." Additionally, the radiation dose rate, contamination level, and/or airborne radioactivity concentration will be included on or near each posting, as applicable.

- Before entering an area controlled for radiological purposes, read all of the signs. Since radiological conditions may change, the signs are also changed to reflect the new conditions. So, a sign or posting that you saw yesterday may be replaced with a new one tomorrow.

- In some cases, more than one radiological hazard may be present in the area and will be posted as such (e.g., Radiation Area, Contamination Area, Airborne Radioactivity Area.)

The following is an example of a radiological posting.



SUMMARY

A familiarity with basic health physics terminology and concepts is necessary for communicating with health physics professionals involved in mining and milling operations.

INSTRUCTIONS TO STUDENTS

ACCEPTANCE: This is to advise you that those individuals in Enclosure 1 have been accepted for participation in the training course (F-104), "Health Physics for Uranium Recovery." This course is scheduled to be presented February 5-6, 1997 at the NRC Headquarters training center, Room T3B15, Rockville, MD.

COURSE: The course starts at 8:00 a.m. on Wednesday, February 5, 1997 and will end at approximately 4:00 p.m. Thursday, February 6, 1997.

LODGING: The following hotels are near the Twinbrooke Metro station one stop on the red line from the White Flint NRC complex. Participants must make their own lodging arrangements. Individuals should request a State or government employee rate at the hotels.

Ramada Inn	Double Tree Hotel
1775 Rockville Pike	1750 Rockville Pike
Rockville, MD	Rockville, MD
(310) 881-2300	(301) 468-1100
(800) 255-1775	(800) 222-8733

TRAVEL AND EXPENSES FOR STUDENTS TRAVELING AT NRC EXPENSE:

For those States that have requested that NRC continue funding their travel to training and have received notice in writing that NRC will continue to fund reasonable training and travel expenses for fiscal year 1997, they should follow the instructions below for Federal travel orders:

TRAVEL: If you travel by air, you must call Carlson Wagonlit Travel, (202) 554-1850, to make your flight reservations. You must use Carlson or you may not be reimbursed for your plane ticket. Your tickets will be mailed to you about a week before the course begins. If you travel by car, you will be reimbursed at a rate of $0.31 per mile, with the total payment not to exceed the minimum government airfare. For those participants that fly, taxi or courtesy van service will take you to the hotel.

The Nuclear Regulatory Commission has received approval from the General Services Administration to allow State employees who are able to obtain a special discount (i.e., a lower fare than is available from Carlson Wagonlit Travel) through their State travel agency to purchase airline tickets themselves and be reimbursed via their travel voucher. In order to use your own State travel agency, it must be confirmed that Carlson Wagonlit Travel is not able to obtain that same class ticket for the same price. Before purchasing your own ticket, please contact Brenda Usilton at (301) 414-2348 in order to assure the proper procedures are followed.

EXPENSES: State participants traveling on Federal orders will be reimbursed for expenses in accordance with Federal travel regulations. A voucher will be provided to you at the course. Receipts are necessary to claim any expenses of $25.00 or more. Telephone calls will not be reimbursed by NRC. The per diem rate for the Washington, DC area is $42.00 for meals and miscellaneous expenses. The maximum lodging rate including taxes is $124.00 per day.

Any questions about, or changes in, travel should be directed to Ms. Brenda Usilton at (301) 415-2348. Any questions on the course should be made to Dennis Sollenberger at (301) 415-2819.

ENCLOSURE 3

Please FAX the following information to Brenda Usilton at (301) 415-3502 by 5 pm (EDT) January 23, 1997

Course or Workshop: Health Physics for Uranium Recovery (F-104)

Dates: February 5 - 6, 1997

Travel: February 4 - 6 or 7, 1997

Location: Professional Development Center, Room T3B15
NRC Headquarters, 11545 Rockville Pike
Rockville, MD

NAME: ______________________________

BUSINESS ADDRESS: ______________________________

____

____

WORK PHONE NUMBER: ______________________________

SS#: ______-_____-_______

Departure City (airport): ______________________________

Date of Departure (if not Feb 04): ______________________________
Please provide reason: ______________________________

Date of Return (if not Feb 6): ______________________________
Please provide reason: ______________________________

Cost of Airfare (from Carlson Travel): ______________________________

If you are driving indicate roundtrip miles: ______________________________

Lodging Arrangements Made: (Yes) (No) ______________________________

ENCLOSURE 3

FAX INFORMATION

U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF STATE PROGRAMS

OFFICE OF STATE PROGRAMS FAX: (301) 415-3502

NUMBER OF PAGES: 24 including this page

DATE: JANUARY 17, 1997

TO: DONALD SIMPSON, CO

MINOR HIBBS, TNRCC
ALICE ROGERS, TNRCC
GEORGE FITZGERALD, TNRCC
DALE KOHLER, TNRCC

WOODROW W. CAMPBELL, UT

DOROTHY STOFFEL, WA

FROM: PAUL LOHAUS, DEPUTY DIRECTOR
OFFICE OF STATE PROGRAMS

SUBJECT: SP-97-002
ACCEPTANCE TO HEALTH PHYSICS FOR
URANIUM RECOVERY COURSE (F-104)

VERIFICATION - 415-3340

< TRANSACTION REPORT >

01-17-1997(FRI) 17:54

[TRANSMIT]

NO.	DATE	TIME	DESTINATION STATION	PG.	DURATION	MODE	RESULT
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			Dorothy Stoffel	24	0°09'11"		

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01-17-1997(FRI) 17:37

[BROADCAST]

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30560		17:26	801 533 4097	24	0°10'49"	NORM.E	OK
				72	0°28'28"		

JAN 17 1997

ALL AGREEMENT STATES
MASSACHUSETTS, OHIO, OKLAHOMA, PENNSYLVANIA

TRANSMITTAL OF STATE AGREEMENTS PROGRAM INFORMATION (SP-97-002)

Your attention is invited to the attached correspondence which contains:

INCIDENT AND EVENT INFORMATION.........

PROGRAM MANAGEMENT INFORMATION...

TRAINING COURSE INFORMATION.............XX ACCEPTANCE TO THE HEALTH PHYSICS FOR URANIUM RECOVERY COURSE (F-104)

TECHNICAL INFORMATION.......................

OTHER...

Supplementary Information: Enclosure 1 is the list of students from the States selected to attend the February 5-6, 1997, Health Physics for Uranium Recovery course (F-104). Enclosure 2 is information on the course and some pre-reading material that all participants should read prior to attending the course. Please provide the list of students, other course information, and the travel instructions (Enclosure 3) to each individual from your program that is on the list. Those traveling at State expense should be encouraged to follow the instructions and make the appropriate travel and lodging arrangements as soon as possible. Those traveling at NRC expense should follow the specific additional instructions in Enclosure 3. Please refer to the All Agreement States Letter (SP-95-006) "Timeliness of Travel Orders" for further information on timing and travel arrangements for attendance at training courses.

If you have any questions regarding this correspondence, please contact me or the individual named below.

POINT OF CONTACT: Dennis M. Sollenberger
TELEPHONE: (301) 415-2819
FAX: (301) 415-3502
INTERNET: DMS4@NRC.GOV

Original Signed By:
PAUL H. LOHAUS

Paul H. Lohaus, Deputy Director
Office of State Programs

Enclosures:
As stated

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TTD)		

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 17, 1997

ALL AGREEMENT STATES
MASSACHUSETTS, OHIO, OKLAHOMA, PENNSYLVANIA

TRANSMITTAL OF STATE AGREEMENTS PROGRAM INFORMATION (SP-97-002)

Your attention is invited to the attached correspondence which contains:

INCIDENT AND EVENT INFORMATION.........

PROGRAM MANAGEMENT INFORMATION...

TRAINING COURSE INFORMATION............XX ACCEPTANCE TO THE HEALTH PHYSICS FOR URANIUM RECOVERY COURSE (F-104)

TECHNICAL INFORMATION........................

OTHER..

Supplementary Information: Enclosure 1 is the list of students from the States selected to attend the February 5-6, 1997, Health Physics for Uranium Recovery course (F-104). Enclosure 2 is information on the course and some pre-reading material that all participants should read prior to attending the course. Please provide the list of students, other course information, and the travel instructions (Enclosure 3) to each individual from your program that is on the list. Those traveling at State expense should be encouraged to follow the instructions and make the appropriate travel and lodging arrangements as soon as possible. Those traveling at NRC expense should follow the specific additional instructions in Enclosure 3. Please refer to the All Agreement States Letter (SP-95-006) "Timeliness of Travel Orders" for further information on timing and travel arrangements for attendance at training courses.

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Paul H. Lohaus, Deputy Director
Office of State Programs

Enclosures:
As stated

AGREEMENT STATE STUDENT LIST FOR THE
HEALTH PHYSICS FOR URANIUM RECOVERY COURSE (F-104)

COLORADO	Donald Simpson (Traveling at State Expense) Colorado Department of Health HWWM-RP-B2 4300 Cherry Creek Drive South Denver, CO 80222-1530
TEXAS - TNRCC	Alice Rogers (Traveling at NRC Expense) TX Natural Resource Conservation Commission UIC, Uranium and Radioactive Waste Section P.O. Box 13087, MC-131 Austin, TX 78711-3087
	George FitzGerald (Traveling at NRC Expense) TX Natural Resource Conservation Commission UIC, Uranium and Radioactive Waste Section P.O. Box 13087, MC-131 Austin, TX 78711-3087
	Dale Kohler (Traveling at State Expense) TX Natural Resource Conservation Commission UIC, Uranium and Radioactive Waste Section P.O. Box 13087, MC-131 Austin, TX 78711-3087
	Minor Hibbs (Traveling at State Expense) TX Natural Resource Conservation Commission Industrial & Hazardous Waste Division P.O. Box 13087, MC-131 Austin, TX 78711-3087
UTAH	Woodrow W. Campbell (Traveling at State Expense) Utah Division of Radiation Control 168 North 1950 West Salt Lake City, UT 84114-4850
WASHINGTON	Dorothy Stoffel (Traveling at State Expense) Washington Department of Health 1500 W. 4th Ave., Suite 305 Spokane, WA 99204

ENCLOSURE 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
TECHNICAL TRAINING CENTER
OSBORNE OFFICE CENTER, SUITE 200
5700 BRAINERD ROAD
CHATTANOOGA, TN 37411-4017

December 23, 1996

MEMORANDUM TO: Sally Cornell, Training Coordinator, NMSS
Dennis Sollenberger, Training Coordinator, OSP

FROM: Kenneth A. Raglin, Director, TTD, AEOD

SUBJECT: HEALTH PHYSICS FOR URANIUM RECOVERY (F-104)
FEBRUARY 5 - 6, 1997

The subject course is to be held in Room T3B15 at the PDC in Rockville, Maryland from February 5 - 6, 1997. Attached is a list of attendees and a tentative course outline and schedule for persons scheduled to attend. Pre-reading material is also attached and participants are encouraged to review this material in preparation for the course.

Normal office/business attire is appropriate for students attending courses. Students who are normally on the Compressed Work Schedule should be removed from the Compressed Work Schedule during training. Classes are scheduled to run from 8:00AM to 4:00PM beginning Wednesday, February 5.

Please provide your attendees with the above and inform them as to their responsibilities in preparing for this course.

If you have any questions, please call Rod Reed on 423/855-6500.

Attachments:
1. List of Attendees
2. Tentative Course Outline
3. Schedule
4. Pre-reading Material

cc w/atts:
R. Reed, TTD
J. Patterson, TTD
C. Cain, RIV
D. Schmidt, NMSS
D. Simpson, ORISE
B. Phillips, ORISE

ENCLOSURE 2

PROPOSED LIST OF ATTENDEES

COURSE TITLE: Health Physics for Uranium Recovery (F-104)

COURSE DATES: February 5 - 6, 1997

INSTRUCTORS: Chuck Cain, Region IV
NMSS Staff
Dave Simpson, ORISE

NMSS

Daniel Gillen
Tae Ahn
Joseph Holonich
Daniel Rom
Duane Schmidt
Harold Lefevre
James Park
Janet Lambert
Michael Layton
Kenneth Hooks
Latif Jamdan
Mohammed Haque
Mike Fliegel
William Ford
Elaine Brummett
Robert Carlson
Charlotte Abrams
Abou-Bakr Ibrahim
Philip Justus
Keith McConnell
Patrick Laplante
Simon Hsiung
James Prikryl

State Programs

10

F-104 HEALTH PHYSICS FOR URANIUM RECOVERY
TENTATIVE COURSE OUTLINE

Introduction

Open Discussion of Pre-Reading Material - Appendix A (40 minutes)

Module 1.0 Radiological and Chemical Properties of Uranium (2.0 hours)

- Characteristics of Uranium
  - Naturally Occurring Isotopes of Uranium and Abundances
  - Radioactive Equilibrium
  - Uranium Decay Chain
  - Actinium Decay Chain
- Radiological Properties
  - Radiological Properties of Uranium
  - Specific Activity
- Human Response Indicators of Uranium Exposure
- Comparative Hazards and Radiological Versus Toxic Limits
- Radon
  - Characteristics of Radon
  - Radon Generation In and Movement Through Soil
  - Emanation Rate
    - RA-226 Concentrations
    - Soil Permeability
    - Soil Moisture
    - Atmospheric Pressure
    - Wind Speed
    - Technological Enhancement
  - Typical Outdoor Radon and Thoron Concentrations
  - Typical Indoor Radon and Thoron Concentrations
  - Temporal Variation in Radon Levels
  - Spatial Variations in Radon Concentrations
- Radon Progeny
  - Schematic of Radon Decay
  - The Potential Alpha Energy Concentration and the Working Level
  - Typical Working Level Concentration
  - Working Level Month (WLM)
  - Typical Cumulative Exposures

Module 2.0 Contamination Control (1.0 hour)

- Airborne Contamination Hazard
  - Sources of Airborne Material
- Airborne Contamination Control
  - Types of Samplers
  - Air Filters
  - Frequency and Limits of Air Sampling
  - Radon Considerations
- Surface Contamination Hazard
  - Overview of Surface Contamination Control
- Surface Contamination Control

        - Characterization of Uranium Surface Contamination
    - Personnel Contamination Hazard
    - Personnel Contamination Control
        - Special Precautions for Personnel Contamination Control

Module 3.0 Internal and External Dose Control (2.0 hours)

- Primary and Derived Limits
- ICRP 26 Dose Limits
- Types of Effects
- Dose Equivalent
    - DE (H_T)
- Committed DE
    - CDE ($H_{50,T}$)
- Total DE
    - TDE ($H_{50,T}$)
- Effective Dose Equivalent (EDE)
- Weighting Factor Definition
- ICRP Weighting Factors
- Other Organs & Tissues
- Total Effective Dose Equivalent (TEDE)
- NRC Limits
- Examples
- Dose Conversion Factors
- Annual Limit on Intake (ALI)
- Derived Air Concentration (DAC)
- DAC-Hours
- ALIs for Uranium
- ALI vs. Weekly Limit of 10 mg
- Things to Remember
- Examples

ICRP 30 Models
- Intake Routes
- Terminology
- Pathways

Uranium Biokinetics
- Solubility Classes
- Site-Specific Models

Excreta Analysis
- InVivo Detection of Urine (Lung counts for uranium other than whole body counts)
- Fluorimetry
- Quality Assurance for In-house Labs
- QA Audits for In-house Labs

Overview of the External Dose Control Hazard
- Beta Radiation
- Mining and Milling Workplace Examples
- Relative Hazard of Beta Versus Gamma Radiation

Sources and Detection of Beta Radiation

Sources and Detection of Gamma Radiation
- Comparison of the Relative Hazard of Beta Versus Gamma Radiation
- Other Sources of Gamma Radiation

Personal Dosimetry
- Appropriate Personal Equipment
- Problems with TLD Instrumentation

External Dose Reduction
- Reduction Principles
- Protective Clothing

Module 4.0 Sampling and Measurement at Uranium Mining and Milling Operations (1.0 hour)

- Reasons for Sampling and Measurement
- In-Situ Uranium Solution Mining
  - Flow Diagram for a Uranium In-Situ Leach Mining Operation
  - Environmental Concerns
  - Groundwater Monitoring Program
  - Guidelines for Groundwater Monitoring
  - Example of Surface and Ground Water Monitoring Program at In-Situ Mining Operations
- Uranium Milling
  - 10 CFR 20 "Standards for Protection Against Radiation"
  - 10 CFR 40 "Domestic Licensing of Source Material"
  - Flow Chart for Processing Uranium Ores
- Health Physics Concerns
  - Surveys for Airborne Uranium Ore Dust
  - Airborne Yellowcake
  - Sampling and Measurement
  - Radon-222 and its Progeny
  - Sampling and Measurement Frequency Requirements
  - External Radiation
  - Measurements for External Radiation
  - Surface Contamination
  - Visual Inspections and Contamination of Skin and Personal Clothing
  - Release of Equipment to Unrestricted Areas
  - Packages for Shipment
  - Ventilation System
  - Contamination on Respirators
  - Summary of Survey Frequencies
- Liquid and Solid Wastes
  - Uncontrolled Release of Tailings
  - Radioactive Element
  - Effluent and Environmental Programs
    - Preoperational Radiological Monitoring Programs for Uranium Mills

Module 5.0 Health Physics Practices for Mining and Milling Operations (2.0 hours)

- Health Physics Role in Routine Activities
- Health Physics Role in Accidents and Emergencies
- Case Studies -- Mining and Milling Facilities

Module 6.0 Open Forum or Panel Discussion of Current Issues (3.0 Hours)

To be determined.

Abbreviations, Acronyms, and Glossary

Tentative Schedule

Wednesday, February 5, 1997

8:00 am	–	8:10 am	Introduction of Instructors and Course Schedule
8:10 am	–	8:50 am	Open Discussion – HP Fundamentals
8:50 am	–	9:00 am	Break
9:00 am	–	10:00 am	Radiological and Chemical Properties of Uranium
10:00 am	–	10:10 am	Break
10:10 am	–	11:10 pm	Radiological and Chemical Properties of Uranium (Continued)
11:10 am	–	11:20 am	Break
11:20 am	–	12:00 pm	Contamination Control
12:00 pm	–	1:00 pm	Lunch
1:00 pm	–	1:30 pm	Contamination Control (Continued)
1:30 pm	–	1:40 pm	Break
1:40 pm	–	2:50 pm	Internal and External Dose Control
2:50 pm	–	3:00 pm	Break
3:00 pm	–	4:00 pm	Internal and External Dose Control (Continued)

Thursday, February 6, 1997

8:00 am	–	8:15 am	Questions
8:15 am	–	9:15 am	Sampling and Measurement at Uranium Mining and Milling Operations
9:15 am	–	9:30 am	Break
9:30 am	–	10:30 am	Health Physics Practices
10:30 am	–	10:45 am	Break
10:45 am	–	12:00 pm	Health Physics Practices (Continued)
12:00 pm	–	1:00 pm	Lunch
1:00 pm	–	4:00 pm	Open Forum or Panel Discussion (Current Issues)

INTRODUCTION

This appendix provides basic fundamentals of radiation and terms that are common to the health physics and nuclear industries. Trainees will build from these basics to the more in-depth concepts presented in the other modules of the Health Physics for Uranium Recovery Course.

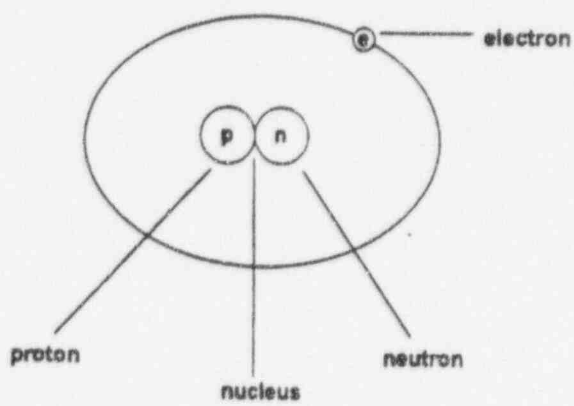
Topics include:

- Atomic Structure
- Definitions of Common Terminology
- Basic Types of Ionizing Radiation
- Radiological Units
- Effects of Radiation on Cells
- Acute and Chronic Radiation Exposure
- Contributions to U.S. Population Dose From Various Radiation Sources
- ALARA Program Concepts
- Radiological Postings

ATOMIC STRUCTURE

The basic unit of matter is the atom. The central portion of the atom is the nucleus, which consists of protons and neutrons. Electrons orbit the nucleus similar to the way planets orbit our sun.

The three basic particles of the atom are protons, neutrons, and electrons.



	Proton	Neutron	Electron
Location	In the nucleus of an atom	In the nucleus of the atom	In orbit around the nucleus of an atom
Charge	Positive	No charge	Negative
Facts	• The number of protons in the nucleus determines the element and atomic number • If the number of protons in an atom changes, the element changes	• Have about the same mass as a proton	• Electrons determine the chemical properties of an atom since they are involved in chemical reactions. • Are very small (about 1/1800 the mass of a proton).

DEFINITIONS

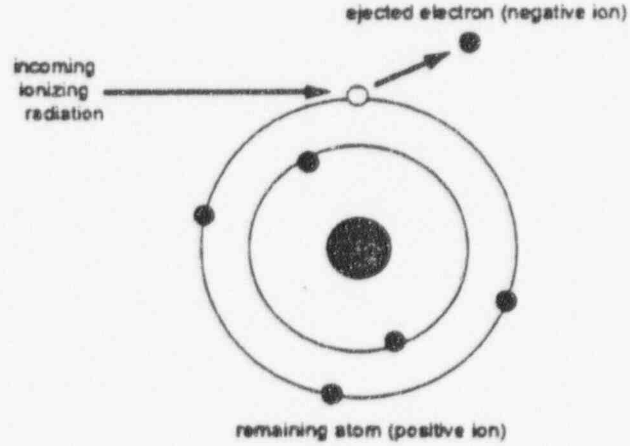
The following terms and definitions are commonly used by health physics professionals involved in mining and milling operations.

Radiation

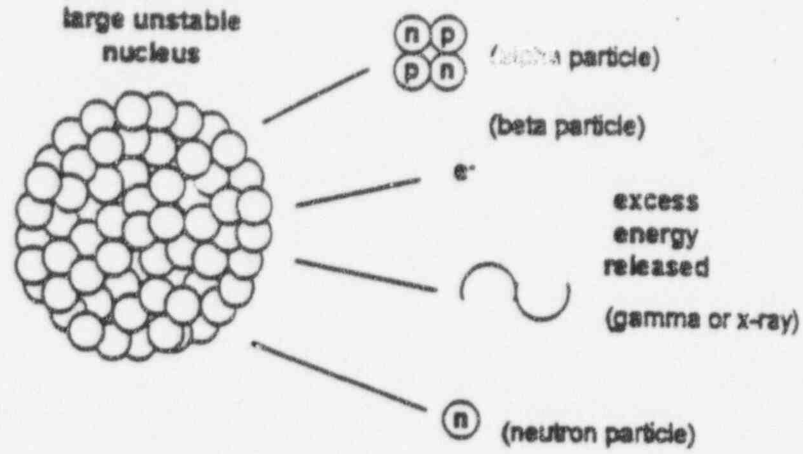
Energy in the form of particles or waves that can travel through space.

Ionization

The process of removing electrons from atoms. Ionization should not be confused with radiation. If enough energy is supplied to remove electrons from the atom, the remaining atom has a positive (+) charge. The positively charged atom and the negatively charged electron are called an ion pair. Do not confuse ionization with radiation. Radiation is simply energy in motion. As a result of this energy, ionization may occur. Ions (or ion pairs) produced as a result of radiation exposure allow the detection of radiation.



Ionizing Radiation	Energy (particles or rays) emitted from atoms that can cause ionization. The basic types of ionizing radiation are alpha particles, beta particles, gamma rays, x-rays, and neutrons.
Non-ionizing Radiation	Radiation that doesn't have the amount of energy needed to ionize an atom with which it interacts. Examples are: radar waves, microwaves, and visible light. Although the word "radiation" can be used to mean ionizing or non-ionizing radiation, it is most often used to mean ionizing radiation.
Stable and Unstable Atoms	Only certain combinations of neutrons and protons result in stable atoms. • If there are too many or too few neutrons for a given number of protons, the resulting nucleus will contain too much energy and will not be stable. • The unstable atom will try to become stable by giving off excess energy in the form of particles or waves (radiation). These unstable atoms are also known as radioactive atoms.
Radioactivity	Unstable (or radioactive) atoms trying to become stable by emitting radiation in the form of particles or energy.
Radioactive Material	Any material containing unstable radioactive atoms that emit radiation.
Radioactive Contamination	Radioactive material in an unwanted place. (There are certain places where radioactive material is beneficial). It is important to note here that exposure to radiation does not result in contamination of the worker. Radiation is a type of <u>energy</u> and contamination is a <u>material</u>.
Radioactive Decay	Radioactive decay is the process of radioactive atoms releasing radiation over a period of time to try to become stable (non-radioactive). (Also known as disintegration.)



Half-life

Radioactive half-life is the time it takes for one half the radioactive atoms present in a radioactive sample to decay. After seven half-lives the activity of an average radioactive sample will be less than 1% of the original activity.

- radioactive half-life of U-239 is 23.5 minutes
- radioactive half-life of U-238 is 4,510,000,000 years

The amount of activity remaining after some number of half-lives can be calculated by multiplying the original amount of activity by the factor

$$\left(\frac{1}{2}\right)^n$$

where n is the number of half-lives that have elapsed.

THE BASIC TYPES OF IONIZING RADIATION

The basic types of ionizing radiation are alpha particles, beta particles, gamma rays, x-rays, and neutrons.

TYPE	ALPHA	BETA	GAMMA/ X-RAYS	NEUTRON
Physical Characteristics	Particle (+2 charge)	Particle (-1 charge)	Ray, Wave (no charge)	Particle (no charge)
Penetrating Power (Range)	Very Low (1-2" in air)	Limited (10-12' in air, few mm in skin)	High (several hundred feet in air)	High (several hundred feet in air)
Shielding	- <1" of air - Outer layer of dead skin - Clothing	- Glass - Metal foil - Plastic - Safety glasses	- Concrete - Lead - Steel	- Hydrogenous materials: Water Concrete Polyethylene
Biological Hazard	Internal	Internal skin, eyes	Internal/External (whole body)	External (whole body)
Sources	Uranium and Plutonium and most radioisotopes with atomic number >82	Uranium decay products, tritium, carbon-14	Decay products of natural uranium, x-ray machines	- Those used to calibrate instruments such as: Americium-Beryllium and Plutonium-Beryllium - Uranium Hexafluoride (UF_6) cylinders

Alpha Particles

- Physical Characteristics

  The alpha particle has a large mass. Positively charged. Consists of two protons, two neutrons, and no electrons.

- Penetrating Power (Range)

  Deposits a large amount of energy in a short distance of travel.

- Shielding

  Most particles are stopped by a few centimeters of air, a sheet of paper, or the dead layer (outer layer) of skin.

- Biological Hazard

  An internal radiation hazard when inhaled or ingested due to deposition of large amounts of energy.

- Sources

  Uranium and Plutonium and most radioisotopes with atomic number >82

Beta Particles

- Physical Characteristics

  A small mass negatively charged.

- Penetrating Power (Range)

  A limited penetrating ability

- Shielding

  Most particles are shielded by plastic, glass, metal foil, or safety glasses

- Biological Hazard

  If ingested or inhaled, can be an internal hazard. Externally, beta particles are potentially hazardous to the skin and eyes

- Sources

  Uranium decay products, tritium, carbon-14

Gamma Rays/X-Rays

- Physical Characteristics

  A wave that has neither mass nor electrical charge. Gamma rays originate within the nucleus of an atom. X-rays originate from the electron field.

- Penetrating Power (Range)

  Because gamma/x-ray radiation has no charge and no mass, it has a very high penetrating power.

  Several hundred feet in the air

- Shielding

  Best shielded by dense materials, such as concrete, lead, or steel.

- Biological Hazard

  Can result in radiation exposure to the whole body.

- Sources

  Decay products of natural uranium, x-ray machines

Neutrons

- Physical Characteristics

  No electrical charge, mass about the same as a proton

- Penetrating Power (Range)

  Because of the lack of a charge, have a relatively high penetrating ability and are difficult to stop

  A direct interaction occurs as the result of a collision between a neutron and a nucleus. A charged particle or other ionizing radiation may be emitted during these interactions.

  Several hundred feet in the air

- Shielding

  Best shielded by materials with a highly hydrogen content, such as water or plastic.

- Biological Hazard

  Whole body hazard due to high penetrating ability.

- Sources

  Those used to calibrate instruments such as Americium-Beryllium and Plutonium-Beryllium

  Uranium Hexafluoride (UF_6) cylinders

RADIOLOGICAL UNITS

Radiation

Per 10 CFR 20.1004, the following are units of radiation dose:

- **Gray (Gy)** is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1Joule/ kilogram (100 rads).

- **Rad** is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

- **Rem** is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).
- **Sievert** is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).

Contamination Units

The units most commonly used to measure contamination are disintegrations per minute, disintegrations per second, and counts per minute.

- **Disintegrations per minute (dpm)** describes the number of atoms disintegrating (decaying) each minute in a radioactive source.
- **Disintegrations per second (dps)** describes the number of atoms disintegrating each second in a radioactive source.
- **Counts per minute (cpm)** represents the number of radiations detected per minute by a radiation detection instrument. Cpm can be converted to dpm by using a conversion factor for the radiation instrument you are using.

Radioactivity Units

Per 10 CFR 20.1005, Units of Radioactivity are:

- One becquerel=1 disintegration per second (s^{-1}).
- One curie=3.7×10^{10} disintegrations per second= 3.7×10^{10} becquerels=2.22×10^{12} disintegrations per minute.

Activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

EFFECTS OF RADIATION ON CELLS

Ionizing radiation can potentially affect the normal operation of cells.

The method by which radiation causes damage to any material is by ionization of atoms in the material. Some radiation damage is repaired by the cell. Some effects of radiation may not be observed immediately following exposure.

ACUTE AND CHRONIC RADIATION EXPOSURE

Potential biological effects depend on how much and how fast a radiation exposure is received. Radiation doses can be grouped into two categories: acute dose and chronic dose.

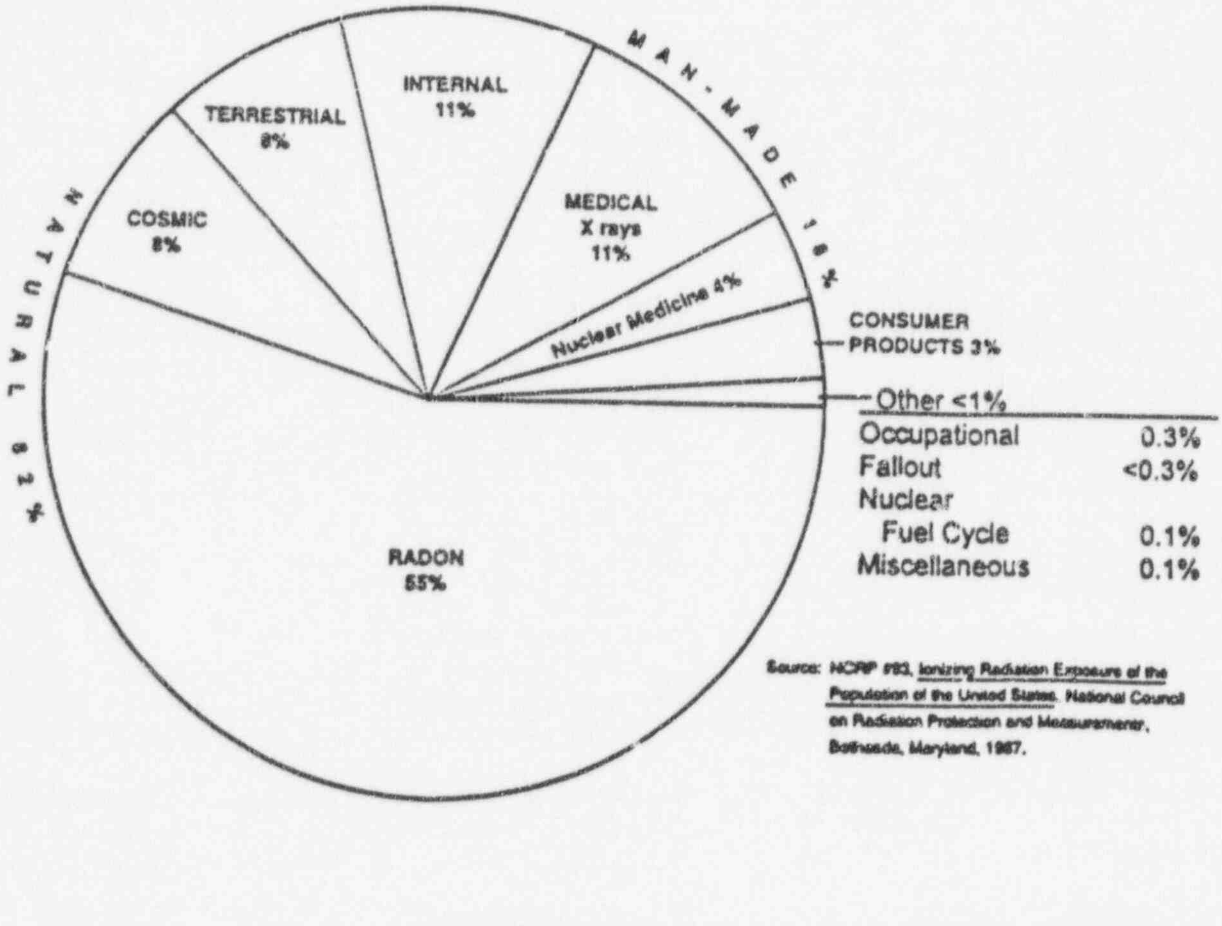
Acute Radiation Exposure

Large doses of radiation received in a short period of time are called acute doses. An acute effect is a physical reaction due to cell damage. This damage is caused by a large radiation dose received in a short period of time. Acute exposures are generally associated with radiological incidents.

Chronic Radiation Exposure

A chronic radiation dose is typically a small amount of radiation received over a long period of time. A typical example of a chronic dose is the dose we receive from occupational exposure.

CONTRIBUTIONS TO U.S. POPULATION DOSE FROM VARIOUS RADIATION SOURCES



ALARA PROGRAM

ALARA stands for As Low As Reasonably Achievable.

ALARA is an approach to radiological control whereby exposures (individual and collective) to the workforce and to the general public are managed and controlled to be at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit below the applicable controlling limits.

This concept includes reducing both internal and external exposure to ionizing radiation. The ALARA concept is an integral part of all site activities that involve the use of radioactive materials.

The implementation of the ALARA concept is the responsibility of all employees.

The main goal of the ALARA program is to reduce exposure when reasonable by minimizing the time spent within a field of radiation, maximizing the distance from a source of radiation, using shielding whenever possible, and/or using proper protective clothing.

Basic Exposure Reduction Concepts

Time

Reducing the amount of time spent within a field of radiation will lower the dose received by the workers.

- Pre-plan and discuss the task thoroughly prior to entering the area. Use only the number of workers actually required to do the job.
- Have all necessary tools before entering the area.
- Use mock-ups and practice runs that duplicate work conditions.

Distance

Methods for maintaining distance from sources of radiation include the following:

- Stay as far away as possible from the source of radiation.
- During work delays, move to lower dose rate areas.
- Use remote handling devices when required.

Shielding

Shielding reduces the amount of radiation dose to the worker. Different materials are used to shield a worker form different types of radiation. Many materials, such as vehicle, a mound of dirt, or a piece of heavy equipment between the worker and the source of radiation, can reduce the exposure level during field activities.

Radiological Postings

Radiological postings are used to alert personnel to the presence of radiation and radioactive materials.

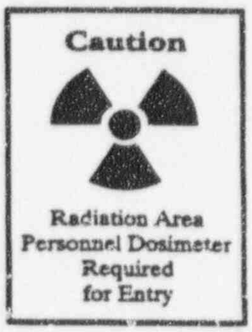
Areas controlled for radiological purposes will be designated with a magenta (or black) standard three-bladed radiological warning symbol on a yellow background. Additionally, yellow and magenta ropes, tapes, chains, or other barriers will be used to denote the boundaries.

- The barriers will be clearly visible from every side. Entrance points to those areas will have signs (or equivalent) stating the entry requirements, such as "Personnel Dosimeters, Radiation Work Permit (RWP) and Respirator Required." Additionally, the radiation dose rate, contamination level, and/or airborne radioactivity concentration will be included on or near each posting, as applicable.

- Before entering an area controlled for radiological purposes, read all of the signs. Since radiological conditions may change, the signs are also changed to reflect the new conditions. So, a sign or posting that you saw yesterday may be replaced with a new one tomorrow.

- in some cases, more than one radiological hazard may be present in the area and will be posted as such (e.g., Radiation Area, Contamination Area, Airborne Radioactivity Area.)

The following is an exampie of a radiological posting.



SUMMARY

A familiarity with basic health physics terminology and concepts is necessary for communicating with health physics professionals involved in mining and milling operations.

INSTRUCTIONS TO STUDENTS

ACCEPTANCE: This is to advise you that those individuals in Enclosure 1 have been accepted for participation in the training course (F-104), "Health Physics for Uranium Recovery." This course is scheduled to be presented February 5-6, 1997 at the NRC Headquarters training center, Room T3B15, Rockville, MD.

COURSE: The course starts at 8:00 a.m. on Wednesday, February 5, 1997 and will end at approximately 4:00 p.m. Thursday, February 6, 1997.

LODGING: The following hotels are near the Twinbrooke Metro station one stop on the red line from the White Flint NRC complex. Participants must make their own lodging arrangements. Individuals should request a State or government employee rate at the hotels.

Ramada Inn	Double Tree Hotel
1775 Rockville Pike	1750 Rockville Pike
Rockville, MD	Rockville, MD
(310) 881-2300	(301) 468-1100
(800) 255-1775	(800) 222-8733

TRAVEL AND EXPENSES FOR STUDENTS TRAVELING AT NRC EXPENSE:

For those States that have requested that NRC continue funding their travel to training and have received notice in writing that NRC will continue to fund reasonable training and travel expenses for fiscal year 1997, they should follow the instructions below for Federal travel orders:

TRAVEL: If you travel by air, you must call Carlson Wagonlit Travel, (202) 554-1850, to make your flight reservations. You must use Carlson or you may not be reimbursed for your plane ticket. Your tickets will be mailed to you about a week before the course begins. If you travel by car, you will be reimbursed at a rate of $0.31 per mile, with the total payment not to exceed the minimum government airfare. For those participants that fly, taxi or courtesy van service will take you to the hotel.

The Nuclear Regulatory Commission has received approval from the General Services Administration to allow State employees who are able to obtain a special discount (i.e., a lower fare than is available from Carlson Wagonlit Travel) through their State travel agency to purchase airline tickets themselves and be reimbursed via their travel voucher. In order to use your own State travel agency, it must be confirmed that Carlson Wagonlit Travel is not able to obtain that same class ticket for the same price. Before purchasing your own ticket, please contact Brenda Usilton at (301) 414-2348 in order to assure the proper procedures are followed.

EXPENSES: State participants traveling on Federal orders will be reimbursed for expenses in accordance with Federal travel regulations. A voucher will be provided to you at the course. Receipts are necessary to claim any expenses of $25.00 or more. Telephone calls will not be reimbursed by NRC. The per diem rate for the Washington, DC area is $42.00 for meals and miscellaneous expenses. The maximum lodging rate including taxes is $124.00 per day.

Any questions about, or changes in, travel should be directed to Ms. Brenda Usilton at (301) 415-2348. Any questions on the course should be made to Dennis Sollenberger at (301) 415-2819.

ENCLOSURE 3

Please FAX the following information to Brenda Usilton at (301) 415-3502 by 5 pm (EDT) January 23, 1997

Course or Workshop: Health Physics for Uranium Recovery (F-104)

Dates: February 5 - 6, 1997

Travel: February 4 - 6 or 7, 1997

Location: Professional Development Center, Room T3B15
NRC Headquarters, 11545 Rockville Pike
Rockville, MD

NAME: ______________________________

BUSINESS ADDRESS: ______________________________

____

____

WORK PHONE NUMBER: ______________________________

SS#: _____-____-______

Departure City (airport): ______________________________

Date of Departure (if not Feb 04): ______________________________
Please provide reason: ______________________________

Date of Return (if not Feb 6): ______________________________
Please provide reason: ______________________________

Cost of Airfare (from Carlson Travel): ______________________________

If you are driving indicate roundtrip miles: ______________________________

Lodging Arrangements Made: (Yes) (No) ______________________________

ENCLOSURE 3

FAX INFORMATION

U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF STATE PROGRAMS

OFFICE OF STATE PROGRAMS FAX: (301) 415-3502

NUMBER OF PAGES: 24 including this pa e

DATE: JANUARY 17, 1997

TO: DONALD SIMPSON, CO

MINOR HIBBS, TNRCC
ALICE ROGERS, TNRCC
GEORGE FITZGERALD, TNRCC
DALE KOHLER, TNRCC

WOODROW W. CAMPBELL, UT

DOROTHY STOFFEL, WA

FROM: PAUL LOHAUS, DEPUTY DIRECTOR
OFFICE OF STATE PROGRAMS

SUBJECT: SP-97-002
ACCEPTANCE TO HEALTH PHYSICS FOR URANIUM RECOVERY COURSE (F-104)

VERIFICATION - 415-3340

< TRANSACTION REPORT >

01-17-1997(FRI) 17:54

[TRANSMIT]

NO.	DATE	TIME	DESTINATION STATION	PG.	DURATION	MODE	RESULT
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			Dorothy Stoffel	24	0°09'11"		

< TRANSACTION REPORT >

01-17-1997(FRI) 17:37

[BROADCAST]

NO.	DATE	TIME	DESTINATION STATION	PG.	DURATION	MODE	RESULT
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30559		17:15	512 239 6383	24	0°08'53"	NORM.E	OK
30560		17:26	801 533 4097	24	0°10'49"	NORM.E	OK
				72	0°28'28"		