



# Radiation Safety Associates, Inc.

## HEALTH PHYSICS TECHNICIAN LEVEL I -- BASIC

### COURSE OUTLINE

#### **MATH REVIEW**

- Basic algebra review
- Using the scientific calculator
- Significant digits
- Zeros
- Rounding numbers
- Determining the significant digits or decimal places to record
- Averaging a series of numbers
- Consistency of units
- Exponential functions
- Multiplication
- Division
- Power functions
- Radicals
- Logarithms
- Linear graphs
- Procedures for graphing
- Slope
- Logarithmic graphs
- Logarithmic vs. linear graphing
- Bar graphs
- Interpolation & extrapolation
- Nomographs

#### **RADIOACTIVITY & DECAY**

- Radioactivity
- Decay
- Half-life: the rate of radioactive decay
- Decay constant
- Decay equation
- Chart of the Nuclides
- Decay Data Tables
- Radioactive Series
- Properties
- Artificially occurring series
- Other radionuclides
- Decay chains
- Methods of radioactive decay
- Alpha decay
- Beta decay
- Beta minus
- Positrons
- Auger electrons

- Electron capture
- Internal conversion
- Gamma rays
- X rays
- Isomeric transition
- Conservation of mass, charge, & energy
- Specific activity

#### **RADIATION INTERACTIONS WITH MATTER**

- Charged particle interactions
- Ionization
- Excitation
- Bremsstrahlung
- Photons
- Photoelectric effect
- Compton scattering
- Pair production
- Neutron interactions
- Fast neutron interactions
- Slow neutron interactions

#### **UNITS OF MEASURE**

- Radioactivity
- Radiation
- Radiation exposure vs. radiation dose
- Radiation exposure: the roentgen
- Absorbed dose: the rad
- The rem
- Dose & dose rate
- Determination of dose & dose rate
- Source Activity Vs. Gamma Exposure Rate
- SI Units

#### **RADIATION DETECTION & MEASUREMENT**

- Gas-filled detectors
- Pulse size considerations
- Ionization chambers
- Proportional counters
- Limited proportionality region
- Geiger-Mueller (GM)
- Continuous discharge region

- Scintillation detectors
- Liquid scintillation detectors
- Solid scintillation devices
- Photomultiplier tubes
- Semiconductor detectors
- Detector applications
- Portable survey meters
- Laboratory instruments
- Portal monitors
- Personnel contamination monitors
- Whole body counters
- Basic radiation spectroscopy
- Processing
- Spectrometer
- Single channel analyzer
- Multi-channel analyzers
- Energy calibration
- Channel coefficient
- Detector efficiency
- Efficiency calibration

#### **BIOLOGICAL EFFECTS OF RADIATION**

- Radiosensitivity & radioresistance
- Dose Response
- Stochastic & nonstochastic effects

#### **REGULATIONS & GUIDES**

- History of protective standards
- ICRU, ICRP, & NCRP
- Radiation exposure concerns
- Basic recommendations
- Federal policy
- Regulating agencies
- Other organizations
- Regulations & guides
- 10 CFR 19, "Notices, Instructions & Reports to Workers: Inspection & Investigations"
- 10 CFR 20, "Standards for Protection against Radiation"

Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material"  
10 CFR 70, "Domestic Licensing of Special Nuclear Material"  
10 CFR 71, "Packaging & Transportation of Radioactive Material"  
10 CFR 74, "Material Control & Accounting of Special Nuclear Material"  
Regulatory Guides  
NUREGs  
American National Standards Institute (ANSI) Standards  
Information Notices

## **EXTERNAL EXPOSURE CONTROL & SURVEYS**

### **ALARA**

Current 10 CFR 20  
Revised 10 CFR 20  
Current ALARA-related regulatory guides  
Surveys  
Current 10 CFR 20  
Revised 10 CFR 20  
Current survey-related regulatory guides  
Survey form contents  
Posting & Control  
Current 10 CFR 20  
Revised 10 CFR 20  
Administrative Controls  
Radiation Exposure Control

### **DISTANCE & SHIELDING**

Distance  
Point sources  
Line & plane sources  
Shielding  
Beta  
Gamma  
Neutron

## **CONTAMINATION CONTROL**

Radiation vs. contamination  
Survey methods  
Loose contamination  
Total contamination  
Wipe test evaluation  
Statistical considerations in a Counting program  
Standard deviation  
Confidence levels  
Minimum detectable count rate (MDCR)  
Application of MDCR  
Minimum detectable activity (MDA)  
Survey frequency & limits  
Protective clothing  
Self-frisk  
Personnel decontamination  
Survey evaluation  
Posting & control of contaminated areas  
Equipment & area decontamination

## **AIR SAMPLING & EVALUATION**

Types of airborne contaminants  
Sample collection  
Air sample accuracy  
Total sample volume  
Efficiency of collection medium  
Counting efficiency  
Representative sample  
Calculation of airborne concentrations  
Lower Limit of Detection (LLD)

## **INTERNAL EXPOSURE CONTROL & DOSE ASSESSMENT**

ALARA  
Annual limit on intake (ALI)  
Derived air concentration  
Maximum permissible concentration  
Assessing body burden  
Whole body counting  
Radiourinalysis  
Fecal analysis  
Bioassay Programs  
Calculating Internal Dose  
Removing Internal Contamination  
Internal Exposure Control  
Required Postings  
Rope boundaries  
Airborne radioactivity area

## **SOURCE HANDLING TECHNIQUES**

Regulations & procedures  
10 CFR 20  
10 CFR 30  
10 CFR 70  
10 CFR 74  
Definitions  
Sealed source  
Special nuclear material  
Procedural compliance  
Fundamentals of excellence  
Pitfalls  
Industry events  
Responsibilities  
Exempt vs. Nonexempt  
Quantities of Radioactive Material  
Master index  
Use & precautions  
Lost sources  
Labeling  
Loss  
Disposal  
Leak testing  
Storage limitations  
SNM receipt & movement

## **RADIOACTIVE MATERIAL CONTROL & DISPOSAL**

- Receiving packages
- Type A quantity or less
- Greater than type A quantity
- Container labels
- Exemptions from labeling  
Requirements
- Disposal of empty radioactive  
material containers
- Storage & control
- Posting
- Exceptions from posting  
requirements
- Loss or theft of licensed  
material
- Definition
- Radwaste Minimization
- Radwaste Treatment
- Storage for decay
- Evaporation
- Dilution & release
- Filtration & deionization
- Incineration
- Compaction
- Solidification
- Waste Disposal
- Packaging
- Physical form
- Type A containers
- Type B containers
- Warning labels on packages
- Contamination limits on  
packages
- Radiation limits during  
transport
- Vehicle placarding
- Other methods

## **APPLICATIONS**

- X Ray machines
- Production
- Filtering
- Medical radionuclides
- Diagnosis
- Therapy (radiation oncology)
- Linear accelerators
- Nuclear reactors
- Boiling water reactor
- Pressurized water reactor
- Nuclear fuel
- Safety
- Radiation sterilization
- Other industrial sources
- Isotopic neutron sources
- Oil well logging
- Level & density gauges

## **REFERENCES**

## **GLOSSARY**

Course offered at our Hebron, Connecticut facility in rotation with other radiation safety courses. For more information, see our website at <http://www.radpro.com/calendar.html>, or contact us at 860.228.0487.