



Radiation Safety Associates, Inc.

RADIATION SAFETY OFFICER COURSE OUTLINE

THE ATOM

- Atomic Structure
- Elements
- Isotopes

TYPES OF RADIATION

- Radiation
- Alpha Particles
- Beta Particles
- Gamma and X-rays
- Neutrons
- Units of Radiation Energy

RADIOACTIVITY AND DECAY

- Radioactivity
- Decay
 - Half-life: the rate of radioactive decay
 - Decay constant
- Decay Equation
- Conservation of Mass, Charge, and Energy
- Methods of Radioactive Decay
 - Alpha decay
 - Beta decay
 - Beta minus
 - Positrons
 - Gamma rays
 - X rays
 - Isomeric transition
 - Internal conversion
 - Auger electrons
 - Electron capture
- Chart of the Nuclides
- Decay Data Tables
- Radioactive Series

UNITS OF MEASURE

- Radioactivity
 - The curie
 - Sub-units of the curie
- Radiation
 - Radiation exposure vs. radiation dose
 - Radiation exposure: the roentgen
 - Absorbed dose: the rad
 - Dose equivalent: the rem
 - Dose and dose rate
 - Determination of dose and

- dose rate
- Source Activity vs. Gamma
- Exposure Rate
- CPM vs. DPM
- Specific Activity
- SI Units

RADIATION INTERACTIONS WITH MATTER

- Charged Particle Interactions
 - Ionization
 - Excitation
 - Bremsstrahlung
- Photons
 - Photoelectric effect
 - Compton scattering
 - Pair production
 - Neutron Interactions
 - Fast/slow neutron interactions

BACKGROUND RADIATION

- Introduction
- Cosmic Radiation
- Radioactivity of the Earth
- Radioactivity of Air
- Radioactivity of Water
- Radioactivity in the Human Body
- Artificial (Man-made) Radioactivity
 - Medical and dental exposures
 - Nuclear reactors
 - Transportation
 - Low level waste storage
 - Nuclear reactor accidents
- Summary

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 and density gauges

BIOLOGICAL EFFECTS

- Introduction
- Cell Damage
- Acute and Delayed Effects
- Somatic and Genetic Effects
- Linear or Threshold
- Stochastic and Non-stochastic Effects
- Summary

PERSONAL DOSIMETRY

- Dose Limits
 - Definitions
 - 10 CFR 20 occupational dose limits
 - Pregnant workers
 - Minors
 - Non-radiation workers
 - Violations
 - ALARA
- Personal Dosimetry
 - Badge placement
 - Film badge
 - Thermoluminescent dosimeter (TLD)
 - Pocket ion chambers
 - Chirpers and alarming dosimeters
 - Neutron dieters
 - Control badges
 - Regulatory Guide 8.13

RADIATION DETECTION AND MEASUREMENT

- Gas-filled Detectors
 - Pulse size considerations
 - Ionization chambers
 - Proportional counters
 - Limited proportionality region
 - Geiger-Mueller (GM)
 - Continuous discharge region
- Solid State Detectors
 - Scintillation detectors
 - Semiconductor detectors
 - Detector Applications

- Portable survey meters
- Calibration programs
- Laboratory instruments
- Portal monitors
- Personnel contamination monitors
- Whole body counters
- Basic Radiation Spectroscopy Spectrometer
- Single and multi-channel analyzers

REGULATIONS AND GUIDES

- History of Protective Standards
 - ICRU, ICRP, and NCRP
 - Radiation exposure concerns
 - Basic recommendations
 - Federal policy
 - Regulating agencies
- Other Organizations
- Regulations and Guides
 - 10 CFR 19
 - 10 CFR 20
 - 10 CFR 30
 - 10 CFR 40
 - 10 CFR 70
 - 10 CFR 71
 - 10 CFR 74
- Regulatory guides
 - NUREGs
 - American National Standards Institute (ANSI) Standards
 - Information notices

EXTERNAL EXPOSURE CONTROL AND SURVEYS

- ALARA
 - 10 CFR 20
 - Current ALARA-related regulatory guides
- Radiation Exposure Control
 - Time
 - Distance
 - Shielding
- Administrative Controls
 - Radiation work permits
- Access Control
 - 10 CFR 20
- Posting and Control
 - 10 CFR 20
- Surveys
 - 10 CFR 20
- Survey Form Contents
- Regulatory Guide 8.21

DISTANCE AND SHIELDING

- Distance
 - Point sources
 - Line sources
 - 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
 - Accuracy and precision
 - Normal probability distribution
 - Standard deviation
 - Confidence levels
 - Minimum detectable count rate (MDCR)
 - Minimum detectable activity (MDA)
 - Changing the MDA
- Survey Frequency and Limits
- Protective Clothing
- Self-Frisk
- Personnel Decontamination
- Skin Dose Assessment
 - Skin dose calculation
 - Documentation
- Survey Documentation
- Posting and Control of Contaminated Areas
- Equipment And Area Decontamination

AIR SAMPLING AND 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 AND DOSE ASSESSMENT

ALARA

- Annual Limit on Intake (ALI)
- Derived Air Concentration
 - Derived air concentration-hour
- Assessing Body Burden
- Bioassay Methods
 - Whole body counting
 - Radiourinalysis
 - Fecal analysis
- Bioassay Programs
- Calculating Internal Dose
- Examples of Dose Calculations
- Removing Internal Contamination
- Required Postings
 - Airborne radioactivity area
- Regulatory Guide 8.20
- Regulatory Guide 8.32

SOURCE HANDLING

TECHNIQUES/RADIOACTIVE

MATERIAL CONTROL AND DISPOSAL

- Definitions
 - Sealed source
 - Source material
 - Special nuclear material
- Regulations and Procedures
 - 10 CFR 20
 - 10 CFR 30
 - 10 CFR 40
 - 10 CFR 70/74
- Exempt vs. Nonexempt Quantities of Radioactive Material
- Responsibilities
- Use and Precautions
- Labeling
- Master Index
- Leak Testing
- Storage Limitations
- Disposal
- Receiving Packages
- Container Labels
- Exemptions from Labeling Requirements
- Disposal of Empty Radioactive Material Containers
- Storage and Control
- Posting
 - Exceptions from Posting Requirements
 - Loss or Theft of Licensed Material
- Industry Events
- Radioactive Waste - Definition
- Radwaste Minimization

- Radwaste Treatment
 - Storage for decay
 - Evaporation
 - Dilution and release
 - Filtration and deionization
 - Incineration
 - Compaction
 - Solidification
- Waste Disposal
 - Disposal facilities
- Packaging
 - Physical form
 - Strong tight containers
 - Type A containers
 - Type B containers
 - Warning labels on packages
 - Contamination limits on packages
 - Radiation limits during transport
 - Vehicle placarding
 - Other methods
- Source Handling Incidents
- NRC Information Notice 88-32
- NRC Information Notice 90 35

LICENSE REQUIREMENTS AND THE RADIATION PROTECTION PROGRAM

- Notice of Expiration
- Application NRC Form 313
- Radiation Protection Program
 - ALARA
 - Procedures
 - Training
 - Document Posting
 - Surveys
 - Legal Aspects
 - Procedural Compliance
 - Fundamentals of excellence
 - Pitfalls
- Ways for Health Physicists to Minimize the Chances of Being Sued

EMERGENCY PLANNING

- Introduction
- The Emergency Plan
- Emergency Response
- Organization
- Characterization of Installation and Facilities
- Licensed Activities
- Emergency Plan Implementation
- Response Actions
 - Assessment Actions
 - Protective Access
 - Corrective Actions
- Facilities and Equipment
- Off-site Agreements and Support
- Re-entry and Recovery
- Maintaining Emergency
- Preparedness
- Notifications

AUDITS

- Introduction
- In-house Audits
- Who Should Audit?
- What Should Be Audited?
- Performing An Audit
 - Audit Preparation
 - Audit Performance
- Audit Follow-Up
- Suggested Audit Finding Format
- Closing Out Previous Audits
- Dealing With Findings
- Handling a Regulatory Audit
- Other Regulatory Action
- General Comments

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.