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/training/, or contact us at 860.228.0487.