Radiation Safety course outline (40 hours)

Personnel Monitoring

a. Wearing of monitoring badges
b. Reading of pocket dosimeters
c. Recording of daily dosimeter readings
d. "Off-scale" dosimeter-action required
e. Permissible exposure limits

Survey Instruments

a. Types of radiation instruments
b. Reading and interpreting meter indications
c. Calibration frequency
d. Calibration expiration-action
e. Battery check-importance

Leak Testing of Sealed Radioactive Sources

a. Requirements for leak testing
b. Purpose of leak testing
c. Performance of leak testing

Radiation Survey Reports

a. Description of report format
b. Requirements for completion

Radiographic Work Practices

a. Establishment of restricted areas
b. Posting and surveillance of restricted areas
c. Use of time, distance, and shielding to reduce personnel radiation exposure
d. Applicable regulatory requirements for surveys, posting, and control of radiation and high- radiation areas

Exposure Devices

a. Daily inspection and maintenance
b. Radiation exposure limits for gamma-ray exposure devices
c. Labeling
d. Use
e. Use of collimators to reduce personnel exposure

Emergency Procedures

a. Vehicle accidents with radioactive sources
b. Fire involving sealed sources
c. "Source out" - failure to return to safe shielded conditions
d. Emergency call list

Storage and Shipment of Exposure Devices

a. Vehicle storage
b. Storage vault - permanent
c. Shipping instructions - sources
d. Receiving instructions - radioactive material

State and Federal Regulations

a. Nuclear Regulatory Commission (NRC) and agreement states - authority
b. License reciprocity
c. Radioactive materials license requirements for industrial radiography
d. Qualification requirements for radiographic personnel
e. Regulations for the control of radiation (state or NRC as applicable)
f. Department of Transportation regulations for radiographic-source shipment
g. Regulatory requirements for X-ray machines (state and federal as applicable)

Fundamental Properties of Matter

a. Elements and atoms
b. Radiation protection - why?
c. Basic math review: exponents, square root, etc.
d. Atomic particles - properties of protons, electrons, and neutrons
e. Atomic structure
f. Atomic number and weight
g. Isotope vs. radioisotope

Radiation Safety course outline (40 hours)

Radioactive Materials

a. Production
   (1) Neutron activation
   (2) Nuclear fission
b. Stable vs. unstable (radioactive) atoms
c. Curie - the unit of activity
d. Half-life of radioactive materials
e. Plotting of radioactive decay
f. Specific activity - curies/gram

Types of Radiation

a. Particulate radiation - properties: alpha, beta, neutron
b. Electromagnetic radiation - X-ray, gamma- ray
c. X-ray production
d. Gamma-ray production
e. Gamma-ray energy
f Energy characteristics of common radioisotope sources
g. Energy characteristics of X-ray machines

Interaction of Radiation with Matter

a. Ionization
b. Radiation interaction with matter
   (1) Photoelectric effect
   (2) Compton scattering
   (3) Pair production
c. Unit of radiation exposure - the roentgen
d. Emissivity of commonly used radiographic sources
e. Emissivity of X-ray exposure devices
f. Attenuation of electromagnetic radiation - shielding
g. Half-value layers; tenth-value layers
h. Inverse-square law

Biological Effects of Radiation

a. "Natural" background radiation
b. Unit of radiation dose - rem
c. Difference between radiation and contamination
d. Allowable personnel-exposure limits
e. Theory of allowable dose
f. Radiation damage - repair concept
g. Symptoms of radiation injury
h. Acute radiation exposure and somatic injury
i. Personnel monitoring for tracking exposure
j. Organ radio-sensitivity

Radiation Detection

a. Pocket dosimeter
b. Difference between dose and dose rate
c. Survey instruments
   (1) Geiger-Muller tube
   (2) Ionization chambers
   (3) Scintillation chambers, counters
d. Film badge - radiation detector
e. TLDs (Thermo-Luminescent Dosimeters)
f. Calibration

Exposure Devices and Radiation Sources

a. Radioisotope sources
   (1) Sealed-source design and fabrication
   (2) Gamma-ray sources
   (3) Neutron sources
b. Radioisotope exposure device characteristics
c. Electronic radiation sources - 500 keV and less, low-energy
   (1) Generator - high-voltage rectifiers
   (2) X-ray tube design and fabrication
   (3) X-ray control circuits
   (4) Accelerating potential
   (5) Target material and configuration
   (6) Heat dissipation
d. Electronic radiation sources - medium- and high-energy
   (1) Resonance transformer
   (2) Van de Graaff accelerator
   (3) Linac
   (4) Betatron
   (5) Roentgen output
   (6) Equipment design and fabrication

Practical demonstrations and structured daily exercises

Summary / Final review

End of Course Test and review