

Radiation Safety Course Outline (40hr)

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

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

It is recommended that the trainee receive instruction in this course prior to any Radiography.