



40-Hour Radiation Safety Officer Training For Industrial Gauge Users

SYLLABUS

PRESENTED BY:

Applied Environmental Consulting, Inc.

COURSE OVERVIEW

History of Radiation
Fundamentals of Radiation
Radioactivity Measurements
Half-Life
Interaction with Matter and Biological Effects
Dose and Dose Risks
Radiation Protection Techniques
Radiation Detection and Instrumentation
Regulatory Authorities
Ensuring Compliance
Radiation Safety Officer Duties
Types of Gauges
How Gauges Function
Tasks to be performed with gauges
How to Relocate a Fixed Gauge
Use and limitations of the Radiation Work Permit (RWP)
Transportation of Gauges

MATH REVIEW

How to use the Math Primer
Basic Math
Algebra Review
Scientific Notation
Exponents and Logarithms
Using Your Calculator
Radiation Math
Radioactivity
Half-Life
Time, Distance and Shielding
Radiation Work Permit (RWP)

LESSON 1: HISTORY OF RADIATION DISCOVERY, HISTORICAL EVENTS & EMERGENCE OF REGULATORY AGENCIES

TOPIC 1	The Beginning
TOPIC 2	Discovery of Radiation Henri Becquerel Wilhelm Roentgen Madam Curie (Plus others)
TOPIC 3	Development of Nuclear Technology Manhattan Project Albert Einstein Enrique Fermi Development of the Nautilus Development of the Atomic Energy Act

LESSON 2: RADIATION FUNDAMENTALS

TOPIC 1	Energy Spectrum Ionization Non-Ionizing
TOPIC 2	Atomic Structure Nuclear Proton Neutron: Extra-nuclear Electron: Classification
TOPIC 3	Atomic Number Atomic Weight Unstable Atoms & Emissions Characteristics of Radioactive Materials Unstable Detectable Spontaneous Emission Emission from nucleus of atoms Photons: Gamma Particles: Alpha, Beta, Neutron Emissions from outer shells of atoms

Photons: X-ray

LESSON 3: RADIOACTIVITY AND HALF-LIFE

TOPIC 1	Units for Disintegrations Radioactivity Disintegration Disintegration per Unit Time (dps, dpm) Curie Becquerel Total Activity Specific Activity/Activity Concentration Background vs. Contamination
PRACTICAL EXERCISE: Problems TOPIC 2	Half-Life Carbon-14 Dating Short/Long Half-Lives Half-life Formula
	PRACTICAL EXERCISE: Problems

LESSON 4: INTERACTION OF RADIATION WITH MATTER

TOPIC 1	Energy Disposition in Air Interactions Ionizations Excitation Energy Deposition in Air Roentgen Exposure Rates
TOPIC 2	Energy Disposition in Matter RAD Gray Relative Biological Effectiveness (RBE) Linear Energy Transfer (LET)
TOPIC 3	Energy Disposition in the Body REM Sievert Dose rates

PRACTICAL EXERCISE: Problems

LESSON 5: RADIATION IN BIOLOGY

TOPIC 1	Sources of Dose External Internal Man-made and Natural
TOPIC 2	Types of Dose Acute Fractionated Chronic
TOPIC 3	Types of Dose Effects Somatic Genetic Teratogenic
TOPIC 4	Variable in Dose Effects Amount of Dose Critical Organ Type of Radiation Individual Biological Variations Radio sensitivity and Radio resistance
TOPIC 5	Types of biological effects in The Cell Types of Biological Variations Radio sensitivity and Radio resistance
TOPIC 6	Types of Risks Definition Comparisons with other types of risks
TOPIC 7	Causes of dose Stochastic Non-Stochastic

LESSON 6: RADIATION PROTECTION

TOPIC 1	Time Principles of Exposure Control Time
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	PRACTICAL EXERCISE: Problems
TOPIC 2	Distance (Inverse Square Law)
	PRACTICAL EXERCISE: Problems
TOPIC 3	Shielding HVL and TVL
	PRACTICAL EXERCISE: Problems
TOPIC 4	As Low As Reasonably Achievable (ALARA)
TOPIC 5	Administrative Controls and Levels Administrative Controls Establishing administrative limits Engineering (Mechanical) Controls Signs, labels and postings
TOPIC 6	Radiation Dose Limits Radiation Workers Members of the Public (MOP) study
TOPIC 7	Monitoring External dose Personnel Monitoring Devices OSLDs/TLDs/Film Badges Pocket Dosimeters
TOPIC 8	Monitoring Internal Dose Bioassays Direct and in vitro
TOPIC 9	Active Monitors (reading real time) Pocket Ion Chamber

LESSON 7: PORTABLE SURVEY METERS

TOPIC 1	Types Geiger-Mueller (GM) Scintillator Comparing instrumentation for hazards: BIOLOGICAL, CHEMICAL and NUCLEAR
TOPIC 2	Reading Results CPM vs. DPM Scales and displays Radiation Levels
TOPIC 3	Efficiency and Calibration Efficiency Calibration
TOPIC 4	Operating a Survey Meter

Battery check/Calibration check/Check source
 Establish Background
 cpm vs. mR/hour
 High to Low scales
 End window
 LAG Time (GM)
 Use & Care

LESSON 8: IMPLEMENTING A RADIATION PROTECTION PROGRAM

TOPIC 1	Establish a Radiation Protection Manual (RPM)
TOPIC 2	Scope of Authorized Work
TOPIC 3	Role of Personnel Radiation Safety Officer (RSO) Advanced Authorized User (40-hour) Authorized User (less than 40-hour, usually 8-hour) Ancillary workers
TOPIC 4	ALARA philosophy emphasized Time, Distance and Shielding
TOPIC 5	Contamination Control Fixed, Removable & Airborne Friskers, glovebox & step-off pads
TOPIC 6	Wearing of PPE & Personnel monitoring Protective clothing Protective masks
TOPIC 7	Performing Personnel Monitoring
TOPIC 8	Emergencies and Spills Major Spills Minor Spills
TOPIC 9	Storage/Disposition of radioactive wastes
TOPIC 10	Posting and Notification
TOPIC 11	Radiation Work Permit Tools for the RSO Documents task Can be used in lieu of personnel badges
TOPIC 12	Record Keeping

LESSON 9: REGULATORY AUTHORITY

TOPIC 1	Regulatory Agencies (Federal) USNRC	Types of radioactive materials regulated: By-Product Material Source Material (Source of SNM) Depleted uranium Special Nuclear Materials (SNM) Fissionable
TOPIC 2	Non-Federal Agencies	USEPA OSHA FDA USDOE
TOPIC 3	The Radioactive Materials License	Agreement States and Licensing States Regulate: Naturally-Occurring Radioactive Materials (NORM) (to include TENORM) Naturally-Occurring and Accelerator Produced Radioactive Materials (NARM) Authorized Materials Authorized Use Authorized Users CONDITIONS Location Leak Testing Surveys Inventory Training Record keeping requirements “Catch all” Condition
TOPIC 4	Role of Regulatory Agencies	Issue licenses based on: ENGINEERING, TRAINING, PROCEDURES Inspections Amendments Termination REGUIDE Sealed Source and Device Registry

LESSON 10: ENSURING COMPLIANCE

TOPIC 1	Annual ALARA review
TOPIC 2	Delegation of Authority
TOPIC 3	Facilities Management
	Record Keeping (Maintaining LOGBOOK)
	Instrument calibration
	Inventory
	Surveys
	Transfer/shipment documents
	Leak tests (for sealed sources)
TOPIC 4	Training
	Training of new personnel and refresher
TOPIC 5	Set up a Personnel Monitoring Program
TOPIC 6	Radiation Work Permit (RWP)
	Pros & Cons

LESSON 11: TRANSPORTATION

TOPIC 1	Regulations
	Items required to be trained in HAZMAT site specific to the facility to include: Type of packages: Type A, Type B, LSA, Strong-tight container
	Definition of Package
	Reportable Quantities
	Bill of Lading
	Labels, markings and placards
	Exempt quantities
	Receiving/Shipping radioactive materials
	Opening packages
	What to do for damaged items
	Roles of RSO / Authorized Users

LESSON 12: GAUGES

FIXED GAUGES

- TOPIC 1 Cesium-137 & Cobalt-60
Parts of the Gauge
Operating Principle
- TOPIC 2 Portable Gauges
Security
Logbook
USDOT HAZMAT Training
ALARA: Time, Distance & Shielding
- TOPIC 3 Shutter operations
- TOPIC 4 Gauge Condition: Good/Fair/Poor
Surveys
- TOPIC 5 Leak Testing
- TOPIC 6 Care & Maintenance
- TOPIC 7 RSO Duties
Radiation Personnel
Advanced Authorized User
Authorized User
Ancillary Worker
- TOPIC 8 Radiation Work Permit (RWP)
- TOPIC 9 Instrumentation Used
- TOPIC 10 Transportation (USDOT HAZMAT)
- Cf-252**
- TOPIC 11 Activation Analysis
Continuous elemental analysis
Produces neutrons for activation of elements
Leak testing at 6 months by the manufacturer
Transportation (USDOT HAZMAT)