Radiation Safety Officer & Authorized User Training
For Veterinarians and Veterinarian Technicians
40-Hours

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 Use and limitations of the Radiation Work Permit (RWP) Characteristics of Iodine-131 Contamination control: Fixed, Airborne, Removable Swipes, Surveys, Spills and Waste Administration of I-131 and Discharge Cat Owners' Instructions Dosimetry and Bioassays Records Management Transportation and Opening Packages
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
	Atomic Number
	Atomic Weight
TOPIC 3	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
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
  - USEPA
  - OSHA

FDA
USDOE

TOPIC 2 Non-Federal Agencies
Agreement States and Licensing States
Regulate:
Naturally-Occurring Radioactive Materials (NORM) (to include TENORM)
Naturally-Occurring and Accelerator Produced Radioactive Materials (NARM)

TOPIC 3 The Radioactive Materials License
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 and 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: **VETERINARY I-131 INJECTIONS IN CATS**

I-131 Characteristics Volatility
Radiation Protection Program
Controlled and Restricted Room
Controlled Air Supply
Contamination Control
Airborne, Fixed, Removable
Package Receipt and Opening
Administering to Cats
Surveys/Proper Instrumentation
Bioassays Post Injection and Periodically
Dosimetry Program
(W.B. & Extremity Monitors)
Cat Owner Instructions
Emergency Procedures
Major and Minor spills
Spill kit
ALARA: Time, Distance, Shielding
RSO Duties
Radioactive Waste - Decay-In-Storage
Posting and Labelling

Notice to Employees
Case Histories
Transportation

There will be 20 questions per LESSON test for a total of 240 questions.