Environics

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Appendix 4-RSO training and Certificates for Rolf Meinholtz

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RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Non-ionizing Radiation

Day 1

Format: ☒ Lecture ☐ Lab

Category: Non-ionizing Radiation

Start Time: 8:30 AM End Time: 9:00 AM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

1. Identify sources of non-ionizing radiation.
2. Define what makes a radiation ionizing.
3. List the organs that are sensitive to the non-ionizing radiation.
4. Define the laser device classification system.
5. List which devices are hazardous.
6. Name which devices require registration in the State of Arizona.

Outline:

VII. Definition of radiation.
VIII. The Electromagnetic spectrum.
  A. Spectroscopy as a method of analysis
IX. Non-ionizing radiation vs. ionizing radiation.
  A. Sources of non-ionizing radiation
X. Risks vs. benefits of using radiation
XI. CDRH Laser classification system
  A. Registration requirements in Arizona
XII. Radiofrequency sources and strengths
  A. Registration requirements in Arizona

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Atomic Theory

Day 1

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 9:00 AM End Time: 10:00 AM
(Ten minute break at 9:30)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

7. List the components of an atom.
8. Relate the relative masses of the proton, neutron, and electron.
9. Relate where the strong/nuclear force is present and why.
10. Define how atomic nomenclature is used.
11. Define the concept of the line of stability of nuclides.
12. Define what makes an atom unstable.

Outline:

XIII. The Bohr model of the atom.
  A. Previous models of matter
  B. Patterning after the model of the solar system
XIV. Atomic components: proton, neutron, and electron.
  A. Relative masses of the proton, neutron, and electron.
  B. Charges associated with the proton, neutron, and electron
XV. The nucleus.
  A. The strong/nuclear force
XVI. Binding of the electrons to the nucleus.
XVII. Atomic nomenclature.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radioactivity

Day 1

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 10:00 AM End Time: 10:30 AM
(Ten minute break at 10:30)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

13. Define what radioactive decay is.
14. Name the pioneering scientists in the field of radioactivity
15. Describe the decay curve
16. Describe what a half life is.
17. Define the units of radioactivity: the Curie and the Becquerel
18. Discuss the general perspectivse of risks posed by different activity sources.
19. Define the added safety features of sealed sources
20. Define the legal limit of removable contamination from a sealed source.
21. Define the hazards associated with Radon in the air.

Outline:

XVIII. The release of energy through radioactive decay.
XIX. The migration to the line of stability.
XX. The decay curve and the half life.
    A. The equation for radioactive decay (with time)
XXI. Units of radioactivity: the Curie and the Becquerel
    A. SI units
XXII. Uses of radioactive material in medicine and industry, naturally occurring radioactive material
    A. The activities of radioactive material in medicine, industry and naturally occurring.
XXIII. Sealed Sources
    A. Sealed source leak tests

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - The Primary Radiations

Day 1

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 10:40 AM End Time: 2:30 PM
(One hour lunch break at noon)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

22. List the primary radiations.
23. Define the relative masses of the proton, neutron, and electron.
24. Define where the strong/nuclear force is present and why.
25. Define how atomic nomenclature is used.
26. Define the concept of the line of stability of nuclides.
27. Define what makes an atom unstable.

Outline:

XXIV. The primary radiations: Alpha, Beta, Gamma, X-rays, neutrons
XXV. Sources of the radiations.
XXVI. The decay diagram for each radiation emission.
XXVII. Shielding material for each radiation
XXVIII. Detection method for each radiation
XXIX. The ranges (air and tissue) for each radiation
XXX. Typical spectra for each radiation
XXXI. Interactions of each radiation with matter
XXXII. Method of ionization for each radiation.
XXXIII. Types and degree of hazard for each radiation
XXXIV. X-ray production

Title: Radiation Safety Officer's Course - Primary Radiations Laboratory

Day 1

Format: ☐ Lecture ☒ Lab

Category: General Nuclear Medicine Topics

Start Time: 2:40 PM End Time: 3:30 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

28. Operate a Geiger counter with different probes.
29. Use varying scales of the GM counter.
30. Use different absorber materials and probes, differentiate materials emitting alpha, beta, and gamma radiation.

Outline:

XXXV. Students are provided with GM survey meters with pancake probes and with alpha scintillation probes.
XXXVI. Items, some common, some rare, are presented as being radioactive.
XXXVII. Items include: a rock, a smoke detector, salt substitute, a glass blank, an anti-static brush, Fiestaware, Coleman lantern mantles, an anti-tank round, Trinitite, and a jar with a radium ceramic.
XXXVIII. Exercise is for the students to identify which radiations, alpha, beta, or gamma, are being emitted from each item.
XXXIX. Students are to publish their findings.
XL. The radiations are identified in a summary by the instructor. The uses of the radioactive material in each item are stated.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radiation Units

Day 1

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 3:40 PM End Time: 4:30 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

31. Identify the appropriate unit for different radiation quantities.
32. Identify what type of quantity is being measured and with what type of instrument.
33. Define the different units in historical and in SI units.
34. Identify that the regulations are written using units of dose equivalent.
35. Relate the use of the Quality Factor in calculating dose equivalent.
36. Apply the conversions between different systems of units.
37. Demonstrate how to calculate the exposure rate from a source activity and the gamma ray factor.
38. Identify the presence and amount of background radiation.

Outline:

XLI. Units of activity: Curie and Becquerel.
XLII. Units of exposure: Roentgen and C/kg
XLIII. Units of dose: rad and Grays.
XLIV. Units of dose equivalent: rem and Sievert
XLV. Calculation of the dose equivalent from the dose and the quality factor.
XLVI. Conversion factors between each system of units.
XLVII. Calculation of exposure rate from a known activity of a radionuclide and the gamma factor.
XLVIII. Background radiation: the sources, the doses from each.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Bioeffects

Day 1

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 4:40 PM End Time: 5:00 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

39. Identify the principle genetic and somatic bioeffects from radiation.
40. Recognize the stages of radiation injury.
41. Recognize the various risk models of radiation exposure.
42. Relate the current regulatory dose limits.

Outline:

XLIX. The biological stages after acute radiation exposure.
L. The acute effects of radiation exposure
    A. Sub-lethal and lethal doses
    B. The hemopoietic syndrome
    C. The GI syndrome
    D. The CNS syndrome
LI. The effects of chronic exposure to radiation
    A. Somatic effects
    B. Genetic effects
LII. The effect of radiation on DNA; point mutations

Title: Radiation Safety Officer's Course - Transport of Radioactive Materials

Day 2

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 8:30 AM End Time: 10:30 AM
(Ten minute break at 9:30)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

43. Relate how to transport radioactive material by common carrier
44. Define the rules by which RAM is transported.
45. Demonstrate how to properly package the material
46. Demonstrate how to properly label the package
47. Demonstrate how to properly complete the required shipping papers
48. Measure the radiation quantities to ship the package

Outline:

LIII. The safety required to ship RAM.
LIV. Governing authorities and their regulations
  A. DOT
  B. ICAO
  C. IATA
  D. IAEA
LV. Shipping by common carrier.
  A. Federal Express
  B. United Parcel Service
  C. Airborne Express
LVI. Shipping Labels
LVII. The Transport Index
LVIII. Shipping papers
  A. The declaration for dangerous goods
LIX. Type A, B, and C packages
LX. Type A, and B quantities

Title: Radiation Safety Officer's Course - Transportation of RAM Laboratory

Day 2

Format: ☐ Lecture ☒ Lab

Category: General Nuclear Medicine Topics

Start Time: 10: 40 AM End Time: 11:15 AM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

49. Use previously acquired skills in operating a Geiger counter with a cylindrical probe.
50. Measure radiation rates from a package to be transported with the GM meter.
51. Identify labeling requirements for the package.
52. Prepare shipping documents for package.

Outline:

LXI. After laboratory time is over, the proper results are discussed.
LXII. The proper labeling is announced and discussed.
LXIII. The proper shipping document is discussed.
LXIV. The conversions from Historical unit to SI units required for shipping is discussed.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Transport of Radioactive Materials

Day 2

Format: ☐ Lecture ☐ Lab ☒ Test

Category: General Nuclear Medicine Topics

Start Time: 11:20 AM End Time: 12:00 PM
(Lunch break at 12:00)

Participation Verification Method: Sign-in sheet

Objectives:

Evaluate the student's knowledge of the Transport of Radioactive Materials Course component.

Outline:

Not applicable

Title: Radiation Safety Officer's Course - Bioeffects (continued)

Day 2

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 1:00 PM End Time: 2:30 PM
(Ten minute break at 2:00)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

53. Continuation of Bioeffects section. Refer to Bioeffects section listed previously.

Outline:

LXV. Refer to Bioeffects section listed previously.

Title: Radiation Safety Officer's Course - Beta Radiation Protection Laboratory

Day 2

Format: ☐ Lecture ☒ Lab

Category: General Nuclear Medicine Topics

Start Time: 2:40 PM End Time: 3:30 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

54. Use previously acquired skills in operating a Geiger counter with a pancake probe.
55. Measure beta radiation rates with the GM meter.
56. Use different absorber materials, determine the materials and thicknesses that are sufficient to protect against the beta radiation.

Outline:

LXVI. Students are provided with GM survey meters with a pancake probe.
LXVII. Behind a beta shield, the students measure the rate of flux from a beta radiation source (either p-32 or Sr-90).
LXVIII. Keeping a constant geometry, students place various absorbers (e.g., gloves of differing materials and thickness, plastic beta shields used in the laboratory) and measure the reduced flux. The absorption coefficient of each item is calculated.
LXIX. Students are to publish their findings. The items providing the most absorption are identified.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radiation Protection Concepts

Day 2

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 3:40 PM End Time: 5:00 PM
(Ten minute break at 4:30 PM)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

57. Use the concepts of Time, Distance and Shielding to protect against radiation.
58. Define the relationship between radiation exposure with the time duration of exposure.
59. Define the relationship between radiation exposure with the distance between the radiation source and the person.
60. Define the relationship between radiation exposure with the amount of shielding in place.
61. Define the hazards from external sources of radiation.
62. Define the hazards from radiation contamination.
63. Recognize ALIs and DACs.

Outline:

LXX. The dependence of radiation exposure with Time, Distance, and Shielding.
LXXI. The use of the Gamma Factor.
LXXII. The inverse square dependence of radiation rate and distance.
LXXIII. The use of shielding; the half-value-layer of materials.
LXXIV. Contamination prevention and remedial actions for contamination.
LXXV. Annual Limits of Intake (ALIs)
LXXVI. Derived Air Concentrations (DACs)

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radiation Safety Program Management (Part 1)

Day 3

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 8:00 AM End Time: 9:00 AM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

64. Set up a radiation safety program.
65. Define applicable regulations and regulatory guides.
66. Define the concept of ALARA
67. Use appropriate posted signs and labels.
68. Recognize the components of dose calculations.
69. Identify the radiation monitoring system and records.
70. Compare relative risks from different health risk factors.

Outline:

LXXVII. Applicable regulations- National and State.
LXXVIII. Radiation Safety Program Policies and Procedures.
LXXIX. Radiation monitoring program: system and records.
LXXX. External and internal dosimetry.
LXXXI. The principle of ALARA.
LXXXII. Dose calculation concepts.
LXXXIII. Limiting external dose.
LXXXIV. Limiting internal dose.
LXXXV. Pregnant employee policy.
LXXXVI. Relative risks from different risk factors.

Title: Radiation Safety Officer's Course - Counting Instrument Laboratory

Day 3

Format: ☐ Lecture ☒ Lab

Category: General Nuclear Medicine Topics

Start Time: 9:10 AM End Time: 10:00 AM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

71. Set up an alpha, or beta/gamma counter.
72. Formulate the voltage plateau for the instrument.
73. Demonstrate how to calibrate the instrument using a standard source.
74. Identify the Lower Limit of Detection (LLD) for their instrument.
75. Compare their LLD against regulatory requirements.

Outline:

LXXXVII. Students are guided in setting up the counter and selecting the plateau of the instrument.
LXXXVIII. Students are guided in the counting the standard and background.
LXXXIX. Students are guided in computing the LLD of their counter and comparing it to regulations.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radiation Safety Program Management (Part 2)

Day 3

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 10:10 AM End Time: 2:15 PM
(Ten minute break at 11:00. Lunch between 12 and 1:00 PM)

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

76. Continuation of topic started earlier.

Outline:

XC. Refer to Radiation Safety Program Management section above.

Title: Radiation Safety Officer's Course - Air Sample and DOT Sample Counting Laboratory

Day 3

Format: ☐ Lecture ☒ Lab

Category: General Nuclear Medicine Topics

Start Time: 2:25 PM End Time: 3:00 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

77. Use the counters set up earlier.
78. Record the air sample count.
79. Record the concentration of radon (and daughters) in the air.
80. Evaluate whether the air exceeds the DAC limits for radon and radon daughters.
81. Record the count from the DOT wipe sample.
82. Evaluate if the package is within transportation regulations to ship.

Outline:

XCI. Students are guided in their counting of the samples.
XCII. Students are guided in the calculation of the air concentration of radon and radon daughters.
XCIII. Students are guided in comparing the concentrations in air against the DACs for each identified radionuclide.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course - Radiation Detection Instruments

Day 3

Format: ☒ Lecture ☐ Lab

Category: General Nuclear Medicine Topics

Start Time: 3:00 PM End Time: 3:50 PM

Participation Verification Method: Sign-in sheet

Objectives:

Upon completion of this activity, participants will be able to :

83. Select the proper radiation detection instrument for the task at hand.
84. Identify the energy response curves of various instrument types.
85. Compare the relative intensity ranges measurable with the different types of instruments.

Outline:

XCIV. Radiation detection principles.
XCV. Radiation detector types.
- A. Ion chamber.
- B. GM chamber.
- C. GM survey meters.
- D. Dosimeters.
- E. Solid state detectors.

XCVI. Energy response curves for each.
XCVII. Intensity ranges for each.

RADIATION PHYSICS & ENGINEERING

Title: Radiation Safety Officer's Course

Day 3

Format: ☐ Lecture ☐ Lab ☒ Test

Category: General Nuclear Medicine Topics

Start Time: 4:00 PM End Time: 5:00 PM

Participation Verification Method: Sign-in sheet

Objectives:

Evaluate student for the entire Radiation Safety Officer's Course (except for the Transport of Radioactive Materials Course component).

Outline:

Not applicable

RADIATION SAFETY ENGINEERING

This is to certify that

Rolf Meinholtz

has successfully completed

Radiation Safety Officer's Course

Given on September 29-October 1, 2003

Roland Wray

Course Director

RADIATION SAFETY ENGINEERING

This is to certify that

Rolf Meinholtz

has successfully completed

Training for Shipments of
Hazardous (Radioactive) Material

Given on September 30, 2003

Roland Wray

Course Director

RADIATION SAFETY ENGINEERING

This is to certify that

Rolf Meinholtz

has successfully completed

Radiation Safety Officer's Course

Given on October 16-18, 2006

Course Director

This is to certify that

Rolf Meinholtz

has successfully completed

Hazardous Material Training (DOT)

Given on October 17, 2006

Course Director

RADIATION PHYSICS & ENGINEERING

certifies that

Rolf Meinholtz

has successfully completed the

Radiation Safety Officer Course

Given on October 12th - 14th, 2009

Course Director

RADIATION PHYSICS & ENGINEERING

certifies that

Rolf Meinholtz

has successfully completed the

Transportation and Shipping of Radioactive Materials Course

Given on October 13th, 2009

Course Director