11631C

pq

Veratec

P.O. Box 20
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September 24, 1991

U.S. Nuclear Regulatory Commission
ATTN: Mr. Anthony S. Kirkwood
Region 1
475 Allendale Road
King of Prussia, PA 19406-1415

Dear Mr. Kirkwood:

In response to your letter dated August 30, 1991 (Docket #030-32156, Control #114425), I have found out the following information:

1. The worst case scenario for changing a window would be on one of our LFE Beta Gauges (Source= 1200mCi Kr-85). This data is given by Bill Prendergast, LFE Radiation Safety Officer. Worst case is represented by having a new source with hands in contact with the housing. Over a period of five minutes an employee would be exposed to 10 mRem of gamma and X-rays. Bill feels that this time sufficiently covers the employee exposure level.

   The body exposure, when considering a new source at a distance of one foot, would be 1 mRem of gamma and X-rays.

   Note that in both cases there would not be any Beta radiation present since the source shutter would be closed. Also, for the purposes of figuring employee exposure, one can assume one window change per individual per quarter year. Note, however, that this frequency represents a value much higher than past history has accounted for.

2. This response deals with an additional means to assure that the gauge shutters are closed prior to performing maintenance on the gauges (in addition to the green indicator light). In talking to Bill Prendergast, he stated that the LFE's have a viewing port to ensure that the shutter is closed. However, Don Stephens (Accuray Radiation Safety Officer) stated that the Accuray's are not equipped with any such devices.

B/8

Therefore, in order to have an uniform method to double check if our shutters are closed, I offer the following (the method that Accuray serviceman are taught).

Veratec will purchase a Geiger counter (which will be calibrated on an annual basis) to double check if the shutter is closed. We will then set up and enforce a policy which will not allow our authorized employees to do minor gauge maintenance unless the Geiger counter reading is less than a specified value. At a given distance this specified value and specified distances will be obtained by conversations with Bill Prendergast and Don Stephens, accompanied by data from our typical readings.

3. The responsible individual for Veratec is Jeffrey Loss, acting in the capacity of Radiation Safety Officer, (note that J.Ernest Rogers and Scott Neuhard will also be able to perform minor maintenance. Their qualifications were included in the last letter).

The training for the Radiation Safety Officer includes a two day course taught by Bill Prendergast, LFE Radiation Safety Officer. There were 29 different topics taught during this course (syllabus attached). However, I cannot give you a realistic estimate of the time spent on the individual topics, other than it took two full days. This training dealt with both hands-on and theory. The competency of the students was checked by both demonstrating a "hands-on" window change and a written test (test enclosed).

Other qualifications for the responsible individual include a Bachelor of Science Degree in Electrical Engineering from the Pennsylvania State University. This includes a 3.0 credit course in Nuclear Physics. Also, I have attended a 40 hour course in Gauge Maintenance and Safety at LFE. Note, however, that this course was related mainly to items not included within the scope of this license application.

Training for the other two responsible individuals include the same two day course taught by Bill Prendergast. This is the same course that Bill uses for all specific license applications. Also, they have both attended a 40 hour course at LFE dealing with gauge maintenance and a 160 hour course at Accuray dealing with the same topic.

Jeffrey Loss 9/25/91
Jeffrey Loss
RSO
Senior Maintenance Engineer

James Israelson 9/25/91
James Israelson
Plant Engineer

LFE CORPORATION

CERTIFICATE

LFE CORPORATION

THIS IS TO CERTIFY THAT JEFFREY W. LOSS

SUCCESSFULLY COMPLETED A 16 HOUR COURSE IN RADIATION TECHNOLOGY. SUBJECTS INCLUDED WERE:

- STRUCTURE OF THE ATOM
- THE ELEMENTS
- PRINCIPLES OF RADIOACTIVITY
- PRODUCTION OF X-RAYS
- CHARACTERISTICS OF RADIOISOTOPES
- INTERACTION WITH MATTER
- RADIOACTIVE DECAY
- UNITS OF RADIOACTIVITY
- DESIGN OF RADIOACTIVE SOURCES
- DETECTION OF RADIATION
- DETECTION STATISTICS
- COUNTING EFFICIENCY
- PRINCIPLES OF RADIATION GAUGING
- GEIGER TUBE SURVEY METER
- UNITS OF RADIATION EXPOSURE
- ION CHAMBER SURVEY METER
- LICENSING
- NRC AND AGREEMENT STATES
- SOURCE CHECKING
- PROTECTION AGAINST RADIATION
- BIOLOGICAL EFFECTS OF RADIATION
- RADIATION SAFETY OFFICER
- TRANSPORTATION OF RADIOACTIVE MATERIAL
- CALIBRATION OF SURVEY METERS
- EMERGENCY PROCEDURES
- REPORTING INCIDENTS

PRESENTED AT:

VERATEC
Lewisburg, Pennsylvania

November 6 and 7, 1990

William R. Prendergast
Radiation Safety Officer
LFE Corporation

2 DAY COURSE

LFE CORPORATION

CERTIFICATE

LFE CORPORATION

THIS IS TO CERTIFY THAT SCOTT D. NEUHARD

SUCCESSFULLY COMPLETED A 16 HOUR COURSE IN RADIATION TECHNOLOGY. SUBJECTS INCLUDED WERE:

STRUCTURE OF THE ATOM
THE ELEMENTS
PRINCIPLES OF RADIOACTIVITY
PRODUCTION OF X-RAYS
CHARACTERISTICS OF RADIOISOTOPES
INTERACTION WITH MATTER
RADIOACTIVE DECAY
UNITS OF RADIOACTIVITY
DESIGN OF RADIOACTIVE SOURCES
DETECTION OF RADIATION
DETECTION STATISTICS
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PRINCIPLES OF RADIATION GAUGING
GEIGER TUBE SURVEY METER
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ION CHAMBER SURVEY METER
LICENSING
NRC AND AGREEMENT STATES
SOURCE CHECKING
PROTECTION AGAINST RADIATION
BIOLOGICAL EFFECTS OF RADIATION
RADIATION SAFETY OFFICER
TRANSPORTATION OF RADIOACTIVE MATERIAL
CALIBRATION OF SURVEY METERS
EMERGENCY PROCEDURES
REPORTING INCIDENTS

PRESENTED AT:

VERATEC
Lewisburg, Pennsylvania

November 6 and 7, 1990

William R. Prendergast
William R. Prendergast
Radiation Safety Officer
LFE Corporation

CERTIFICATE

LFE CORPORATION

THIS IS TO CERTIFY THAT J. ERNEST ROGERS

SUCCESSFULLY COMPLETED A 16 HOUR COURSE IN RADIATION TECHNOLOGY. SUBJECTS INCLUDED WERE:

STRUCTURE OF THE ATOM
THE ELEMENTS
PRINCIPLES OF RADIOACTIVITY
PRODUCTION OF X-RAYS
CHARACTERISTICS OF RADIOISOTOPES
INTERACTION WITH MATTER
RADIOACTIVE DECAY
UNITS OF RADIOACTIVITY
DESIGN OF RADIOACTIVE SOURCES
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PRINCIPLES OF RADIATION GAUGING
GEIGER TUBE SURVEY METER
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BIOLOGICAL EFFECTS OF RADIATION
RADIATION SAFETY OFFICER
TRANSPORTATION OF RADIOACTIVE MATERIAL
CALIBRATION OF SURVEY METERS
EMERGENCY PROCEDURES
REPORTING INCIDENTS

PRESENTED AT:

VERATEC
Lewisburg, Pennsylvania

November 6 and 7, 1990

William R. Prendergast
William R. Prendergast
Radiation Safety Officer
LFE Corporation

Name: JEFFREY W. LOSS

Date: NOV. 7, 1990

TEST FROM 2 DAY COURSE

LFE CORPORATION

RADIATION TECHNOLOGY

FINAL EXAMINATION

1. How many protons, neutrons, and electrons does an atom of Krypton-85 possess?

Protons 36 Neutrons 49 Electrons 36

2. Balance the following nuclear equations:

a. $_{13}Al^{27} + {_2}He^{4} \longrightarrow {_{15}}P^{30} +$ $_0N_1$

Z = 13+2 = 15, A = 27+4 = 31

b. $_7N^{14} + {_1}H^{1} \longrightarrow {_6}C^{11} +$ $_2He_4$

c. $_{16}S^{32} + {_0}N^{1} \longrightarrow$ $_{15}P_{32}$ $+ {_1}H^{1}$

d. $_4Be^{9} + {_2}He^{4} \longrightarrow {_6}C^{12} +$ $_0N_1$

e. $_7N_{14}$ $+ {_0}N^{1} \longrightarrow {_6}C^{14} + {_1}H^{1}$

3. A certain gamma source produces a radiation field of 100 mr/hr at a distance of one meter. What is the radiation field at a distance of 5 meters?

RADIATION AT 5 METERS = $(100\ mr/hr) \times \left(\frac{1}{5}\right)^2 = \frac{100\ mr/hr}{25}$ =

RADIATION AT 5 METERS = 4 mr/hr

4. The half life of the source of problem 3 is one year. What will be the radiation field one year from now at a distance of 5 meters?

2 mr/hr

5. The present activity of a certain radioactive source is 6.0 curies and its half life is 2 years. What will be the activity 5 years from now?

$A = A_0 e^{-\frac{.693t}{T_{1/2}}} = 6.0\, e^{-\frac{.693(5)}{2}}$ = 1.061 CURIES

6. The present activity of a certain radioactive source is 2.0 curies. How many disintegrations per second are occurring?

(2.0 CURIES)(37 BILLION DISINTEGRATION/SECOND / CURIE) =

74 BILLION DISINTEGRATIONS PER SECOND

7. An ionization chamber with a perfectly flat (horizontal) plateau is exposed to a constant radiation field and the anode voltage is adjusted to the center of the plateau. If the anode voltage is increased slightly, will the ionization chamber current increase, decrease, or remain unchanged?

REMAIN UNCHANGED

8. Assume that the energy required to ionize an atom of argon gas is 32 electron volts. A beta particle with energy of 64,000 electron volts enters an ionization chamber filled with argon gas. What is the maximum number of ion pairs that could be produced by the beta particle if all its energy is expended on ionizing the argon gas?

$$\frac{64{,}000\ eV}{32\ eV/ionization} = \boxed{2000 \text{ ION PAIRS MAX}}$$

9. A beta gauge is used to measure the thickness of plastic film. Does exposure to the beta radiation make the plastic film radioactive?

NO

10. A strontium-90 radioactive source (beta) is enclosed in a steel container with walls ½ inch thick. Will the radiation outside the container be beta, X-ray, neutron, or alpha radiation?

X-RAY

11. The radiation level at a work station from a gamma source is 100 mr/hr. With a shield of ½ inch of lead the radiation level is reduced to 22 mr/hr. What thickness of lead shield is required to reduce the radiation level at the work station to 2 mr/hr?

5/8"

12. When calibrated with a Strontium-90 standard source of .005 microcuries, a geiger tube survey meter reads 2000 counts per minute. A wipe taken from a Strontium-90 sealed source produces 850 counts per minute with the same meter. Is the sealed source considered to be leaking? Explain your answer.

.005μCi = 2000 c/m

NO BECAUSE 850 IS LESS THAN 2000, WHICH ~~LEAK~~ SOURCE WIPE MUST BE LESS THAN .005μCi

13. A radiation field at a work station consists of a mixture of gamma radiation and X-rays. You must survey the area and estimate the potential personnel exposure. For this purpose which type of survey meter would you choose - a geiger tube survey meter or an air ionization chamber survey meter? Explain your answer.

AIR IONIZATION CHAMBER BECAUSE GEIGER TUBE IS USED FOR HIGH SENSITIVITY SUCH AS LEAK CHECKS. ON THE OTHER HAND, AN AIR IONIZATION CHAMBER IS USED RADIATION HAZARD APPLICATIONS (IT IS USEFUL OVER THE ENTIRE ENERGY RANGE)

14. A radiation worker who is 35 years old has a cumulative lifetime exposure of 21,500 millirems. During the quarter just completed his radiation exposure was 1850 millirems. Is this exposure within the limits prescribed by NRC and State regulations? Explain your answer.

ACC = 21.5 Rems
QTR = 1.85 Rems
T... 23.35

5(35-18) = 85

YES

BECAUSE IT DOES NOT PASS 1¼ REM PER QUARTER ... BUT IT DOES PASS PART ... OF 20.101

15. A survey of radiation workers is performed. Whole body radiation exposure from a gamma source is determined to be 235 millirems per quarter. Under NRC and State regulations, are personnel monitors required? Explain your answer.

NO BECAUSE 235 mR/QTR IS LESS THAN 25% OF 1¼ REMS PER QUARTER

16. On June 15, 1985 the activity of a radioactive source is measured and found to be 1.00 curie. On June 15, 1986 it is found to be 0.95 curie. On June 15, 1987 it is found to be 0.90 curie. What is the half life of the radioactive material?

13½ YEARS

17. You must perform a leak test on a sealed source whose radioactive material emits beta and gamma rays. You decide to use the wipe test method. For analyzing the wipe, which type of survey meter would you choose - air ionization chamber or geiger tube? Explain you answer.

GEIGER TUBE BECAUSE IT IS USED FOR HIGH ... APPLICATIONS SUCH AS LEAK CHECKS. AIR ... CHAMBER IS ... [illegible]

18. What is the radiation level in mr/hr from an unshielded source of Cesium-137 with an activity of 1.0 curie at a distance of 2 meters from the source?

... R/hr = ... [illegible]

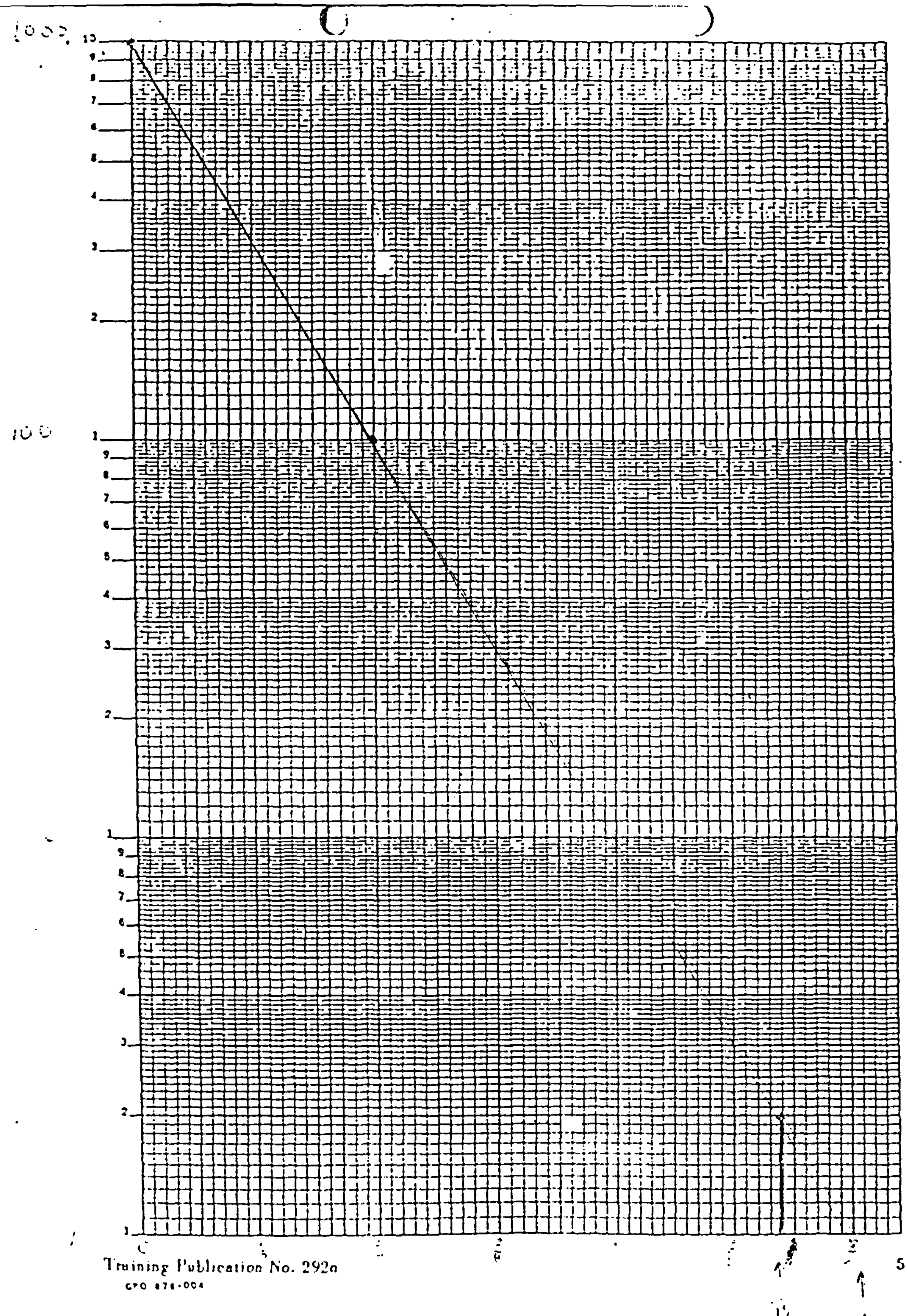
(330 mR/hr)(½)² = 82.5 mR/hr

19. How many electrons are there in the M shell of Strontium (Sr)?

18

20. Your company is an NRC or Agreement State licensee using a gamma gauge for thickness measurement. A fire occurs involving the gauge. Property damage is $5000 and lost operation time amounts to two days. Within what time period must the NRC or Agreement State be notified?

24 HOURS



1000
100

SYLLABUS FROM
2 DAY COURSE

LFE CORPORATION

RADIATION TECHNOLOGY COURSE

PREPARED FOR

VERATEC

LEWISBURG, PENNSYLVANIA

1) The Structure of the Atom

Fundamental particles - electrons, protons, neutrons
The Nucleus
Electron Shells
The Elements
Periodic Table of Elements

2) Atomic Characteristics

Atomic Number
Mass Number
Isotopes
Nuclides
Chart of Nuclides
Isotopic Behavior

3) Radioactivity

Neutron-Proton Ration
Nuclear Disintegration
Properties of Radioisotopes
Alpha Radiation
Beta Radiation
Gamma Radiation
Electron Capture
Sequential Decay
Equilibrium

4) Characteristics of X-rays

Production of X-Rays
Continous Spectrum (Bremsstrahlung)
Characteristic X-Rays
Fluorescence

5) <u>Production of Radioisotopes</u>

Neutron Bombardment
Transmutation
Neutron Capture
Fission Products
Daughter Products
Accelerator Produced

6) <u>Half Life of Radioisotopes</u>

Definition
General Formula
Use of Semilog Graph Paper

7) <u>Energy Level</u>

Relative Penetrating Power of Alpha, Beta, and Gamma Radiation
The Electron Volt
Kinetic Energy of Particles
Photon Energy

8) <u>Interaction of Beta Radiation with Matter</u>

Interaction with Nucleus
Interaction with Orbital Electrons
Range of Beta Particles
Absorption Characteristics

9) <u>Interaction of Photons with Matter</u>

Photoelectric Effect
Compton Scattering
Pair Production
Photon Absorption
General Absorption Formula

10) <u>Units of Radioactivity</u>

Disintegration Rate
The Curie
The Millicurie and Microcurie
Becquerel

11) Detection of Radiation

Ionization of Gases
The Ion Chamber
Proportional Counter
Geiger Tube
Characteristics of Detectors
Dead Time (Resolving Time)
Photographic Film
Thermoluminescent Devices
Scintillation Detectors

12) Principles of Radiation Gauging

Fundamental Absorption Equation
Basic Gauging System
Density Gauge
Level Gauge
Weight or Thickness Gauge
Backscatter Gauge

13) Geiger Tube Survey Meter

Description
Energy Response
Time Constants
Use of this Meter
Hands-on Training

14) Units of Radiation

Roentgen
Rad
Rem

15) Ion Chamber Survey Meter

Description
Energy Response
Time Constants
Use of this Meter
Hands-on Training

16) Output of Gamma Sources

Typical Output of Selected Sources
Calculations
Inverse Square Law

17) Licensing

General Discussion of Licensing
Federal and State Regulations
General Licensing
Specific Licensing
License Application
Agreement States

18) Standards for Protection Against Radiation

10 CFR Part 20
Agreement State Regulations
Radiation Surveys

19) Other Important Regulations

10 CFR Part 19
10 CFR Part 21

20) Principles of Protection Against Radiation

Film Badge
TLD Detectors
Dosimeters
Protective Equipment
Time, Distance, Shielding

21) Biological Effects of Radiation

Acute Effects
Chronic Effects
Regulatory Guide 8.13
Regulatory Guide 8.29
Natural Background Radiation

22) Design of Radioactive Sources

Encapsulation
Special Form
ANSI Standard

23) Testing of Sealed Sources

Wipe Test
Leak Standards
Analysis of Wipe
Records
Frequency of Test
Hands-on Training
Leak Test Kits

24) Emergency Procedures

Isolating Area
Survey
Decontamination
Disposal

25) Incidents

Definitions
Reporting

26) The Radiation Safety Officer

Responsibilities
Authority
Interfacing with Requlatory Authorities

27) Radiation Gauges

Typical Construction
Containment
Shutters
Sources
Krypton-85
The LFE Gauge
Typical Radiation Levels
The Detection System

28) Other Radiation Applications

Density Gauges
Level Gauges
X-Ray Fluorescence
Activation Analysis
Smoke Detectors
Static Eliminators
Sterilization

29) Hands-On Training

Device with Dummy Source
Source Housing Window Replacement
Detector Housing Window Replacement
Shutter and Indicator Check and Repair
Source Removal and Replacement

William R. Prendergast
Radiation Safety Officer
LFE Corporation
October 25, 1990