SIEMENS

32-31021-01
03036878

December 29, 1989

William J. Adam, Ph.D.
Materials Licensing Section
Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Re: NRC License No. 12-00369-02

Dear Dr. Adam:

The additional information requested in your December 1, 1989 letter is as follows:

1. a) Enclosed is an outline of the topics covered in the field service radiation safety training course. See Attachment A. These topics are covered during a two day span, eight hours each day. The students, however, are at the Siemens facility for a three week training program which includes hands-on experience with these sealed calibrator sources and the equipment. The students also return periodically for continued training with equipment and sources.

   b) Included is also a sample of the exams with the answers. See Attachments B and C.

   c) Attachment D is a copy for the training document, "Statement of Radiation Training and Experience". This record is completed for each field service engineer and district manager who have taken the required radiation safety course and is filed.

2. District managers receive the same radiation safety training course as the field service engineers. The Siemens corporate office designates district managers, however, experience in the field handling these small sealed calibrator point sources is required. All district managers meet annually where a

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presentation by the corporate RSO is given updating regulatory requirements and going over safe handling procedures.

3. An amendment request will be submitted at any time a field service office changes location and/or district manager.

Please contact me if you require any additional information.

Sincerely,

Inid S. Deneau

Inid S. Deneau
Health Physicist
Health Physics Services

ISD/wb
Enc.

RADIATION SAFETY MODULE
Field Service Training

I. Basic Principles of Radiation

- Types of radioactive material
- Amounts of radioactive material
- Interaction with matter
- Radiation exposure; doses, exposure levels, and limits
- Effects of radiation

II. Radiation Safety

- Handling of radioactive material
- How to perform wipe surveys and action levels
- Contimination control
- Personnel dosimetry
- Storage of radioactive materials
- Disposal of radioactive materials
- Emergency procedures

III. Record Keeping

- Use log card
- Leak testing and leak test certificates
- Accountability of radioactive materials

IV. NRC and/or Agreement State Regulatory Requirements

RADIATION SAFETY FINAL EXAMINATION

BASIC PHYSICS

1. List the basic structure of components of an atom, and electrical characteristic of each:
   A._____ _____
   B._____ _____
   C._____ _____

2. Label the shell structure and the minimum and maximum numbers of electrons that can exist in each shell:
   Min:_____ Max: _____

3. With respect to the proton, what is the size of the electron? _____

4. What is an isotope?_____
   _____
   _____
   _____

5. What is an ion?_____
   _____
   _____
   _____

6. A. Describe an Alpha Particle: _____
   _____
   _____
   _____

   B. Define the electrical characteristics of the Alpha Particle:_____
   _____
   _____
   _____

   C. What happens to the parent atom following Alpha Decay?_____
   _____
   _____
   _____

7. A. Describe a Beta Particle:_____
   _____
   _____
   _____

   B. Describe Beta Decay:_____
   _____
   _____
   _____

8. A. **Describe Gamma and X-Ray radiation:**_____

B. **Where does each originate?**

Gamma:_____
X-Ray:_____

C. Name three ways that Gamma and X-Rays interact with matter:
1._____
2._____
3._____

9. Define the following terms:

A. Half life:_____

B. Half Value Layer:_____

C. Curie: (in disintegrations/second)_____

D. Millicurie:_____

E. Microcurie:_____

F. REM:_____

10. What is the maximum permissable exposure level in REM per NRC regulations for:

A. Whole body: year:_____ quarter:_____

B. Hands: year:_____ quarter:_____

BASIC NUCLEAR INSTRUMENTATION

11. List two types of radiation detectors:

A:_____
B:_____

12. Describe briefly how each works:

A:_____
B:_____

13. List two types of personnel dosimeters:

A: _____
B: _____

14. What types of radiation does each measure?

A: _____
B: _____

15. State the Inverse Square Formula:

_____
_____
_____
_____

16. Do the following problems. Use a separate sheet for your calculations.
If the exposure at 1 meter for ^{60}Co is 1.34R, what is the exposure at:

A. 2.5 meter _____
B. 5.0 meter _____
C. 8.0 meter _____
D. 6 inches _____

RADIATION PROTECTION

17. List three (3) methods for controlling dose:

A. _____
B. _____
C. _____

18. Define the following terms:

A. Restricted Area: _____
_____
_____
B. Radiation Area: _____
_____
_____
C. High Radiation Area: _____
_____
_____

19. Who can use licensable amounts of radioactive material?

_____
_____

20. Leak Testing:

A. How often must sources be leak tested? _____
B. What terminology must be used in describing contamination (for the record)?
_____
C. Describe a Leak Test Procedure: _____
_____
_____

RADIATION SAFETY FINAL EXAMINATION

BASIC PHYSICS

1. List the basic structure of components of an atom, and electrical characteristic of each:

   A. **Protons** — **Positive charge**
   B. **Neutrons** — **Neutral (no charge)**
   C. **Electrons** — **Negative charge**

2. Label the shell structure and the minimum and maximum numbers of electrons that can exist in each shell:

   Min: **1** Max: **32**

3. With respect to the proton, what is the size of the electron?
   1/1900th the size of a proton

4. What is an isotope?**One of the several forms or nuclides of the same chemical element that have the samenumber of protons in the nucleus and therefore have the same chemical properties, but have differing numbers of neutrons and differing nuclear properties.**

5. What is an ion?**An electrically charged atom or group of atoms or part of an atom whose electrical charge is the results when a neutral atom gains or looses one or more electrons. Such gains or losses can occur in a chemical reaction when electrons are transferred from one atom to another or by interaction with X-Rays, alpha, or gamma rays.**

6. A. Describe an Alpha Particle: **A charged particle emitted from the nucleus of an atom having a mass and charge equal in magnitude of a helium nucleus (2 protons & 2 neutrons).**

   B. Define the electrical characteristics of the Alpha Particle:
   Double Positive charge

   C. What happens to the parent atom following Alpha Decay?
   It is changed into a different chemical element.

   Example: $_{88}Ra^{226}$ » » $_{86}Ra^{222}$

7. A. Describe a Beta Particle: **A particle emitted from a nucleus and whose mass & charge is equal in magnitude to that of an electron.**

   B. Describe Beta Decay: **Some selected unstable atoms decay by transmutation where a neutron is converted into a proton and in most cases emit a charged particle from the nucleus.**

8. A. Describe Gamma and X-Ray radiation:
Short wave electromagnetic radiation of nuclear origin.

B. Where does each originate?

Gamma: **In the nucleus of the atom.**
X-Ray: **Outside the nucleus of the atom (in the orbits, or shells).**

C. Name three ways that Gamma and X-Rays interact with matter:

1. **Compton**
2. **Photoelectric.**
3. **Pair production.**

9. Define the following terms:

A. Half life: **The time required for a radioactive substance to loose 50% of its activity by decay.**
B. Half Value Layer:**The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the exposure rate by one-half.**
C. Curie: (in disintegrations/sec.) **3.7×10^{10} d/sec.**
D. Millicurie: **3.7×10^{7} d/sec.**
E. Microcurie: **3.7×10^{4} d/sec.**
F. REM: **Radiation Equivalent Man - a dose measurement relative to other dose units and depending on the biological effect and conditions of irradiation.**

10. What is the maximum permissable exposure level in REM per NRC regulations for:

A. Whole body: year: **5 R** quarter: **1.25 R**

B. Hands: year: **75 R** quarter: **18.75 R**

BASIC NUCLEAR INSTRUMENTATION

11. List two types of radiation detectors:

A: **G.M. (Geiger Mueller tube, portable survey meter)**
B: **Ion chamber (Cutie Pie)**

12. Describe briefly how each works:

A: **A shell with an anode and a cathode, filled with a special gas. Radiation ionizes the gas. Positive or negative ions are collected (all at once). This causes an electrical pulse to form which is either counted or displayed.**
B: **Similar to the G.M., only filled with air. Continuous electrical current is read instead of voltage discharging.**

13. List two types of personnel dosimeters:

A: **Film Badge**
B: **Pencil Dosimeter (capacitance)**

14. What types of radiation does each measure?

A: **Beta, Gamma, & Neutron**
B: **Gamma and Neutron**

15. State the Inverse Square Formula:

$$I_1 \times (d1)^2 = I_2 \times (d2)^2$$

16. Do the following problems. Use a separate sheet for your calculations.
If the exposure at 1 meter for ^{57}Co is 1.34R, what is the exposure at:

A. 2.5 meter _____ **214.4 mR/Hr**
B. 5.0 meter _____ **53.6 mR/Hr**
C. 8.0 meter _____ **20.9 mR/Hr**
D. 6 inches _____ **57.69 mR/Hr**

RADIATION PROTECTION

17. List three (3) methods for controlling dose:

A. **Time**
B. **Distance**
C. **Shielding**

18. Define the following terms:

A. Restricted Area:
An area restricted or controlled for the purpose of radiation protection
B. Radiation Area:
An area whose rediation level is such that a person could receive 5 mR in an hour, or 100 mR in five days
C. High Radiation Area:
An area whose radiation level is such that a person could receive 100 mR in an hour

19. Who can use licensable amounts of radioactive material?
Those who have specific training and are licensed by a regulatory agency to do so

20. Leak Testing:

A. How often must sources be leak tested?
Every six months
B. What terminology must be used in describing contamination (for the record)?
Micro curie (μCi)
C. Describe a Leak Test Procedure:
Carefully making a smear at that location where, in the event of leakage contamination would most likely appear.

ATTACHMENT D

STATEMENT OF RADIATION TRAINING AND EXPERIENCE

Instruction: Every individual or supervisor proposing to use radioactive material on his own initiative is required to submit a Statement of Training and Experience in duplicate.

1. Name of proposed user:_____ Position title:_____

   Address:_____ City:_____ Zip:_____

   To be included on Lic. No._____ in name of_____

2. Description of proposed use & maximum anticipated amounts user will handle or store for this purpose.

3. Formal Training:
   a. High School Graduate: Yes____ No_____
   b. College or University: Name and location_____
      Years completed_____ Degree_____ Course of study_____
   c. Education specifically applicable to use of radioactive material:

4.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL (Use supplemental sheets if necessary)				
TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection			Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments.			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity.			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

EXPERIENCE WITH RADIATION (Actual use of radioisotopes or equivalent experience)				
ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE

ISOTOPE COMMITTEE APPROVAL:

DATE SUBMITTED_____ DATE APPROVED_____ RSO INITIAL_____