COMMUNITY HOSPITAL OF INDIANAPOLIS, INC.

1500 NORTH RITTER AVENUE
INDIANAPOLIS, INDIANA 46219

May 10, 1985

Nuclear Regulatory Commission
Office Of Licensing
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Sirs:

Enclosed please find material to support my request for approval to provide the required training in radiation physics, biology and protection for physicians desiring to obtain a license to possess a bone mineral analyzer. I have included a copy of the transcripts of my educational courses, a resume, and the outline and objectives of the training that I am proposing to provide. If you need more information, please contact me.

Sincerely,

Andrea D Browne

Andrea D. Browne, PhD
Director - Nuclear Medicine

ADB:bd

NAZARETH COLLEGE

Louisville 3, Kentucky

BROWNE, MRS. ANDREA D'ANDREA
Miss-Andrea-Louise-D'Andrea-
Name and Home Address

309 Grandview Ave., Tiltonsville, Ohio

Wheeling, West Virginia - June 6, 1948
Place and Date of Birth

Mr. & Mrs. Vincent C. D'Andrea - same as above.
Name and Address of Parent of Guardian

St. John Central, Bellaire, Ohio
High School from Which Admitted

Certificate.
Basis of Admission

June, 1966
Date of Graduation

Catholic
Religion

White
Race

Entrance Units	LANGUAGES		MATH		NATURAL SCIENCES		SOCIAL SCIENCES		MISCELLANEOUS		MISCELLANEOUS		TOTAL UNITS
	English	4	Algebra	2	Physics	1	XXXX History Anc.	1	Music -Chorus	1/4	Speech & Dram.		
	Latin	2	Geometry	1	Chemistry	1	M & M History		Bookkeeping		Phys. Ed.	1/2	
	French		Gen'l Math		Gen'l Science		Amer. History	1	Typewriting		Religion		
	German		Trigonometry		Biology	1	Civics		Shorthand		Health	1/2	
	Spanish	2	Sr. Ma.	1	Physiology		Sociology		Home Ec.				
							Pro. in Democ.	1					19 1/4

College Aptitude Test Date:
SAT: Verbal 649 Math 554 (3/149)
Rank

College Credits Transferred from:
Sem. Hrs.

Degree Bachelor of Arts
Date Conferred May 17, 1970

Major Chemistry and Biology
Minor(s)

PT. NO.	COURSE TITLE	Semester Hours	GRADE 1st Sem.	GRADE 2nd Sem.	GRADE Sum. Session	Quality Points
	1966-1967					
th 107	Freshman Math	3	A			9
g. 101	Freshman Composition	3	B+			6
o. 103	General Zoology	2	A			6
em.101	General Chemistry	4	A-			12
eo.107	Salvation History I	3	A			9
ys.Ed.101	Freshman Phys. Ed.	-	B			-
.Ed.107	Modern Dance	1	A-			3
	Crs. 16 Pts. 45 2.81	16				45
104	General Zoology	2		A		8
102	General Chemistry	4		B+		8
.102	Freshman Composition	3		B+		6
108	Freshman Mathematics	3		A-		9
.102	Freshman Phys. Ed.	-		B+		-
101	Intro. to Effective Spkg.	2		B		4
108	Salvation History	3		A		9
.106	Modern Dance	-		B+		-
	Crs. 17 Pts. 42 2.47	33				87

DEPT. AND NO.	COURSE TITLE	Semester Hours	GRADE 1st Sem.	GRADE 2nd Sem.	GRADE Sum. Session	Quality Points
	1967-68					
Math203	Analytic Geom. & Calculus	4	B+			
Phil.101	Logic	3	B-			
Chem.301	Organic Chemistry	4	B-			
Ger.011	Elementary German	3	B+			
Bio.251	Anatomy and Physiology	3	A-			
Bio.101	Intro. to Plant Biology	3	A			
	Crs.20 Pts.46 2.30	53			1	33
Math204	Analytic Geometry & Cal.	4		A-		12
Theo.205	Redemptive Incarnation	3		A		9
Chem.302	Organic Chemistry	4		C		4
Ger.012	Elementary German	3		B+		6
Bio.252	Anatomy and Physiology	3		A-		9
Psy.201	Intr . to Psychology	3		C		3
	Crs.20 Pts.43 2.15	73			1	76
	1967-8					
Spn.101-2	Intermed. Spanish (Exam)	6		C		6
	Crs.6 Pts.6 1.00	79			1	82

A semester hour represents a fifty minute period of lecture or a one hundred minute period of laboratory a week for one semester of sixteen weeks. The normal semester load is sixteen semester hours. Semester hours required for graduation, 128; quality points, 128.

Grading System: A, excellent; B, good; C, average; D, passing; F, failure; I, incomplete; WP, withdrew passing; WF, withdrew failing.

Mrs.
Miss Andrea Louisa D'Andrea Browne is entitled to honorable dismissal unless otherwise indica

The transcript is not official unless the signature and seal are affixed.

Date July 28, 1976

Registrar

DEPT. AND NO.	COURSE TITLE	Semest. Hours	1st Sem.	2nd Sem.	Sum. Session	Quality Points
	1968-69					
o.355	Cell Biology	3	A			9
oc.311	Cultural Anthropology	3	B			6
hys101	General Physics	4	B-			8
hem401	Physical Chemistry	4	B-			8
oc.201	Introduction to Sociology	3	C			3
	Crs. 17 Pts. 34 2.00	46				216
io357	Genetics	3		A		9
h 252	Metaphysics	3		A-		9
y102	General Physics	4		B-		8
402	Physical Chemistry	4		B		8
h 306	Christian Marriage	3		A-		9
	Crs.17 Pts.43 2.53	113				259
NIVERSITY OF KENTUCKY, LEXINGTON, KENTUCKY						
rrespondence - completed 10-25-69						
s.104	Hist. of Eur. to 1713	3	B-			6
ATHERINE SPALDING COLLEGE, LOUISVILLE, KENTUCKY						
	1969-70					
h.350	Phil.Found. of Sci. Thot.	3	A			9
c207	U. S. in World Affairs	3	B-			6
rt352	Art. Apprec. & His.of Art	3	A			9
io359	Ecology	3	A			9
h.303	Quantitative Analysis	4	B			8
	Crs. 16 Pts. 41 2.56	132				306
	Converted to four point system 2/24/70	132				438
.447	Seminar in Biol.Problems	2		A		8
.304	Quantitative Analysis	4		B		12
h.376	American Literary History	3		B		9
h.442	Theol.& Contemp.Art Forms *	3		P		-
h.403	Biochemistry	4		A-		16
.104	European Civ.since 1715 *	3		Pass		-
.447	Seminar	2		A		8
15	Crs.21 Pts.53 3.53	153				491

Cum = 3.42

GRE TESTS January 1970
Aptitude Test: Verbal:660 Quant.:620
Advanced Test: Chemistry:540

* Pass/Fail. Not included in point standing.

NAME	CONV SCORES	MATH	SCIENCE	SOC. STUDIES	READING	LISTENING	WRITING
[illegible] ANDREA ANDERSON		295	312	314	319		309
ANSWER SHEET NO. 2635559	SPECIAL CODES 00000000	% ILE BANDS 46-75	82-97	84-94	62-86		42-77

TEST FORMS	NAT'L NORMS	GRADE	TEST DATE	VERBAL	QUANTITATIVE	TOTAL
1A STEP LIST. SCAT	149	14	2 66	CONV SCORE % ILE BAND	CONV SCORE % ILE BAND	CONV SCORE % ILE BAND

Director, Educational Services

July 28, 1976

Registrar

ANDREA LOUISE D ANDREA BROWNE
BIRTHDATE JUNE 06, 1948
PARENT-GUARDIAN VINCENT C ANDREA

BA 1970 CATHERINE SPALDING COLLEGE

1970-1971 1ST SEMESTER A GR 1

BNUC	512	INTRO BIONUCLEONICS	2.0	A	12.0
BNUC	522	APPLIED BIONUCLEONICS	2.0	B	10.0
BNUC	690	RADIOISOTOPES RESEARCH	4.0	A	24.0
BNUC	696	SEMINAR IN BNUC	1.0	A	6.0
C E	551	ENVIRON ENGR ADMIN	3.0	A	18.0
C E	554	CHEM ANAL IN ENV ENG	4.0	A	24.0
		CUM 5.87 16.0 94.0 SEM 5.87 16.0			94.0

1970-1971 2ND SEMESTER B GR 1

BNUC	526	RADIATION HEALTH PHYS	3.0	B	15.0
BNUC	540	RADIATION BIOLOGY	2.0	A	12.0
BNUC	658	ADVANCED BIONUCLECN	1.0	A	6.0
BNUC	696	SEMINAR IN BNUC	1.0	A	6.0
BNUC	698	RESEARCH M S THESIS 06	0.0	S	
CHM	548	RADIOCHEMISTRY	2.0	B	10.0
CHM	548L	RADIOCHEM LAB	1.0	A	6.0
V AN	617	ADVANCED ANATOMY	2.0	W	
		CUM 5.73 26.0 149.0 SEM 5.50 10.0			55.0

1971 SUMMER SESSION B GR 1

BNUC	691	NUCLEAR MED THERAPY	3.0	A	18.0
BNUC	698	RESEARCH M S THESIS 05	0.0	S	
		CUM 5.75 29.0 167.0 SEM 6.00 3.0			18.0

1971-1972 1ST SEMESTER D GR 1

BIOL	525	MICROBIOLOGY	3.0	B	15.0
BNUC	505	ENVIRONMENTAL QUALITY	3.0	A	18.0
BNUC	506	ENVIRONM QUALITY SEMNR	1.0	A	6.0
BNUC	524	HEALTH PHYSICS LAB	1.0	A	6.0
BNUC	696	SEMINAR IN BNUC	1.0	A	6.0
BNUC	699	RESEARCH PHD THESIS 02	0.0	S	
PCOL	540	INTROD PHARMACOLOGY I	3.0	B	15.0
STAT	501	EXPERIMENTAL STAT I	3.0	A	18.0
		CUM 5.70 44.0 251.0 SEM 5.60 15.0			84.0

MASTER OF SCIENCE
DEGREE GRANTED JANUARY 26, 1972

1973-1974 2ND SEMESTER D GR 081 1

BNUC	699	RESEARCH PHD THESIS 16	0.0	S
		CUM 5.70 44.0 251.0 SEM		

CREDIT FROM INDIANA UNIVERSITY

ANAT	866	D866 (A)	2.0	CR
BIOP	601	A601 B	3.0	CR
ED	590	T590 A	10.0	CR
ED	650	T650 A	3.0	CR

1974 SUMMER SESSION D GR 081 1

BNUC	699	RESEARCH PHD THESIS 03	0.0	S
		CUM 5.70 44.0 251.0 SEM		

1974-1975 1ST SEMESTER D GR 081 1

	993	FOR EXAM ONLY	0.0	
		CUM 5.70 44.0 251.0 SEM		

1974-1975 2ND SEMESTER D GR 081 1

BNUC	699	RESEARCH PHD THESIS 03	0.0	S
		CUM 5.70 44.0 251.0 SEM		

DOCTOR OF PHILOSOPHY
DEGREE GRANTED MAY 18, 1975

10/70 GRAD ENGL 03/71 MASTER PLAN 10/71 PHD PLA
01/72 PRELIM 4.5 CUM RES

CONTROL NO. 7 8 9 5 0

BROWNE ANDREA LOUISE INDIANA UNIVERSITY BLOOMINGTON, INDIANA 02/02/74

RECORD OF: D ANDREA ANDREA LOUISE 283 44 9279 DATE ENTERED: COMPLETE RECORD 5 C

ADDRESS: 2248 WHITE OAKS DR INDPLS IND 46224 SAT: VERB. MATH. HIGH SCHOOL RANK:

DATE OF BIRTH: 6/06/48 ACT: ENG MA SS N.S.C. COMP.

PLACE OF BIRTH: WHEELING W VA MAJOR OR CONCENTRATION:

HIGH SCHOOL: ST JOHN CENTRAL BELLAIRE OHIO

PARENTS: MR VINCE D ANDREA
309 GRANDVIEW TILTONSVILLE OHIO 43963

LINE	DESCRIPTIVE TITLE	DEPT.	COURSE	SEM. HRS.	GR.
001	IUPU-INDPLS	1ST	SEM 1972-73		
002	INTROD TO BIOPHYSICS	BIOP	A601	3.0	B
003	SEM HRS 3.0 PTS 9.0 GPA 3.00	HRS	PASS	3.0	
004	IUPU-INDPLS UNCLASSIFIED	2ND	SEM 1972-73		
005	ELECTRON MICROSCOPY	ANAT	D866	2.0	A
006	SEM HRS 2.0 PTS 8.0 GPA 4.00	HRS	PASS	2.0	
007	IUPU-INDPLS UNCLASSIFIED	1ST	SEM 1973-74		
008	RESEARCH IN ALLIED HEALTH SCI	EDUC	T590	10.0	A
009	READINGS IN ALLIED HEALTH SCI	EDUC	T650	3.0	A
010	SEM HRS 13.0 PTS 52.0 GPA 4.00	HRS	PASS	13.0	
011	CUM HRS 18.0 PTS 69.0 GPA 3.83	HRS	PASS	18.0	
	CUM AVE INCLUDES ONLY WORK ON THIS RECORD FORMAT				

LINE	DESCRIPTIVE TITLE	DEPT.	COURSE	SEM. HRS

APR 3 1974

CURRICULUM VITAE

NAME: Andrea D'Andrea Browne

ADDRESS: 5304 Far Hill Road
Indianapolis, Indiana 46226

PHONE: Home (317) 546-3896
Business (317) 353 5980

EDUCATION: Ph.D., Bionucleonics, Purdue University, May 1975

M.S., Radiological Health, Purdue Univ., Jan., 1972

B.A., Chemistry and Biology, Spalding College, May, 1970

EMPLOYMENT: Director of Nuclear Medicine
Radiation Safety Officer
Radiation Physicist
Community Hospital, Indianapolis
1975 - present

Research Associate
Health Physicist
Indiana University Medical Center
1972 - 1975

Butler University
Adjunct Assistant Professor
Departments of Pharmacy and Zoology (Nuclear Med.)
1979 - present

Ball State University
Adjunct Assistant Professor
School of Nuclear Medicine Technology
1984 - present

Lecturer in Radiation Biology, Radiation Safety and Nuclear Medicine Technology
Indiana University Medical Center
1972 -1979

Indiana Vocational Technical College
Lecturer in Radiation Physics and Radiation Biology
1976 - 1984

St. Francis Hospital Center, Indpls., IN
Consulting Physicist, Nuclear Medicine and Radiology
1976 - 1980

Hancock Memorial Hospital
Instructor in Radiological Physics and
Radiation Biology
Consulting Physicist in Nuclear Medicine and
Radiology
Greenfield, Indiana
1975 - present

University Heights Hospital
Consulting Physicist in Nuclear Medicine
and Radiology
Indianapolis, Indiana
1977 - present

Community Hospital of Anderson
Consulting Physicist in Nuclear Medicine
Anderson, Indiana
1978 - present

Starke Memorial Hospital
Consulting Physicist in Nuclear Medicine
and Radiology
Knox, Indiana
1979 - present

Dow Chemical Company
Consultant RIA Division
1978 - 1979

Public Health Service
Radiological Health Fellow
Purdue University
1970 - 1972

Laboratory Assistant
Chemistry Department
Spalding College
Lousiville, Kentucky
1966 - 1970

PUBLICATIONS: Browne, A.D. and Wellman, H.N.:"A Method for the Preparation of Tc-99m-Hematoporphyrin Derivative and its Tissue Distribution Patterns". J. Nuc. Med., 15(6): 480, 1974

Kavula, M.P. and Browne, A.D.:"A Ready-to-Use Kit for the Preparation of Tc-99m-Macroaggregated Albumin". Radiopharmaceuticals and Labelled Compounds, Vol. 1, International Atomic Energy Agency Vienna, 1973, p. 127.

Wellman, H.N., Browne, A.D., Kavula, M.P., Khairi, R., Anger, R., Tofe, A. and Francis, M.:"Optimization of a New Kit-Prepared Skeletal Imaging Agent, Compared to NaF-18". Radiopharmaceuticals and Labelled Compounds, Vol. 1, International Atomic Energy Agency, Vienna, 1973, p.108.

Wellman, H.N., Tofe, A., D'Andrea, A., Kavula, M., Khairi, R., Anger, R., and Francis, M.:"Optimization of a New Skeletal Imaging Agent, tc-99m-Sn-EHDP, as Compared to NaF-18". Southern Med. J., 65(11); 1406, 1972.

Wellman, H.N., Anger, R., Browne, A.D., Tofe, A., Francis, M., Khairi, R., and Johnson, c.:"Evaluation of Bone Malignancy with Tc-99m-Sn-EHDP Compared with NaF-18". Presented at the Society of Nuclear Medicine Meeting, June 1973

M.S. Thesis: "The Effect of Noise as Stress on the Placental Transfer of Zinc-65 in the Rat"

Ph.D. Dissertation:
"The Preparation and Investigation of a Tc-99m Labelled Hematoporphyrin Derivative as a Tumor Scintigraphic Agent"

ORGANIZATIONS: American Association of Physicists in Medicine

Society of Nuclear Medicine

Iota Sigma Pi, National Honor Society for Women in Chemistry

Central Indiana Clinical Biochemistry Forum, Board of Directors 1979 - 1983

REFERENCES: Will be furnished on request

COURSE OUTLINE

Unit I Basic Radiation Physics (3Hours)

A. Atomic structure
B. Nuclides and Isotopes
C. Radionuclides and Nuclear Stability
D. Radioactive Decay
E. The Curie, Becquerel and specific activity
F. Characterestics of Ionizing Radiation
G. Interaction of Ionizing Radiation with Matter
H. Measurement of Ionizing Radiation.

Unit II Radiation Biology (3 Hours)

A. Physical Factors Affecting Radiosensitivity
B. Biological Factors Affective Radiosensitivity
C. Law Of Bergonie and Tribondeau
D. Radiation Dose-Response Relationships
E. LET, RBE, OER
F. Acute Effects of Radiation, Local Tissue Damage
G. Chronic or Late Effects of Radiation
H. Radiation and Pregnancy

Unit III Radiation Protection (2 Hours)

A. Standard Units of Radiation Exposure and Dose
B. Hazare Factors in Handling Radionuclides
C. Time, Distance and Shielding
D. Radiation Monitoring Instrumentation
E. Decontamination
F. Disposal of Radioactive Waste
G. Radionuclide Laboratory Safety Rules
H. Nuclear Regulatory Commission Licensing
I. Code of Federal Regulation, Chapter 10, Parts 19 and 20.

COURSE OBJECTIVES UNIT I

At the conclusion of the unit, the student should be able to:

1. Define the atom.
2. Define the atomic number and relate it to electron configuration.
3. List the fundamental particles within the nucleus.
4. Relate the mass number to the fundamental particles in the nucleus.
5. Define an isotope.
6. Describe the system of atomic weights.
7. Briefly describe the shell model of the atom and the placement of electrons within the orbitals.
8. Define the electron volt.
9. Describe the results of movement of an electron between the various orbitals.
10. Describe the line of stability on a plot of the nuclides (no. of neutrons vs. no. of protons)
11. Write the nuclear changes that occur during negatron emission.
12. Write the nuclear changes that occur during positron emission.
13. Describe electron capture.
14. Describe isomeric transition.
15. Describe internal conversion.
16. Describe alpha particle emission.
17. Define the decay constant.
18. Write and use the equation describing radioactive decay ($N + N_o e^{-t}$)
19. Define half-life.
20. Calculate the half-life given the decay constant.
21. Define the curie and the Becquerel and be able to write the subdivisions of these units in common use.
22. Describe the concept of specific activity.
23. Define an alpha particle, list the fundamental particles that make up an alpha particle and describe the range of energy from natural alpha emitters.

24. Define excitation and ionization.

25. Write the average energy expended by an ionizing radiation in the formation of an ion pair in gas.

26. Draw and explain a Bragy curve.

27. Discuss the range of alpha particles in matter.

28. Discuss the practical considerations in handling an alpha emitter.

29. Describe the beta particle and the distribution of energy during beta emission.

30. Be able to estimate the mean energy in terms of the maximum beta energy.

31. Define Bremsstrahlung.

32. Draw the specific ionization curve for beta particles in air.

33. Dompare the specific ionization of alpha and beta particles.

34. Describe some of the practical considerations when utilizing beta emitters.

35. Define electromagnetic radiation and discuss the electromagnetic spectrum.

36. List the six ways gamma rays may interact with matter.

37. Describe the energy distribution that occurs with the photoelectric effect.

38. Relate the probability of the occurence of a photoelectric interaction with the energy of the photon and the Z of the absorber.

39. Describe the energy distribution that occurs with a Compton interaction.

40. Relate the probability of the occurence of a Compton interaction with the energy of the photon and the Z of the absorber.

41. Describe the events that occur in pair production.

42. Write the names of the two particles that are created in pair production.

43. Describe the fate of the positron.

44. Write the minimal photon energy required for pair production to take place.

45. Relate the probability of pair production occurring with the energy of the photon and the Z of the absorber.

46. Define the linear attenuation coefficient.

47. Define the half value layer.

48. Describe the curve of photon intensity vs. absorber thickness or linear-linear and log-linear axes.

49. Write the equation that relates photon intensity to thickness of absorber ($I + I_o e^{-ux}$)

50. Differentiate between absolute and relative detection of radiation.

51. Describe the use of gas ionization in the detection of ionizing radiation.

52. Label a simple ionization chamber circuit of the integrating type.

53. Discuss the difference between a cimple ionization chamber and one using gas amplification.

54. Correctly label a graph illustrating the relation of pulse size to potential gradient in an ionzation chamber.

55. Discuss the sensitivity and use of the various types of gas ionzation chambers described.

56. Describe the mechanism of solid Scintillation detection.

57. Discuss the energy transfers that occur in a solid scintillation detector.

58. Describe the proportionality of energy conversion in a solid scintillation detector and the applicability to gamma ray spectroscopy.

59. List the operating characteristics of solid scintillation detectors including the effect of a) photomultipliers potential, b) amplifier gain c) gamma energy dependence of detection efficiency.

Unit II Radiation Biology (3 Hours)

At the conclusion of the unit the student should be able to:

1. Generally discuss the sequence of events that follow radiation exposure of humans.

2. Describe the cell life cycle and process of cell probiferation.

3. Write, discuss and apply the Law of Bergonie and Tribondeau.

4. List the physical factors affecting radiosensitivity.

   A. Define and discuss RBE
   B. Define and discuss OER
   C. Define and list some radiosensitizing agents.
   D. Define and list some radioprotective agents.

5. Discuss the effect of age, sex and physical condition on radiosensitivity.

6. Describe various common dose-response relationships.

   A. Identify linear dose-response relationships.
   B. Identify non-linear dose-response relationships.
   C. Identify and discuss the importance of threshold versus non-threshold dose-response relationships.

7. Describe radiation induced lesions in biologically important macromolecules.

8. Discuss the radiosensitivity of DNA.

9. List the types of damage that can occur in the DNA molecule and describe the results on the cellular and organ level.

10. Describe a free radical.

11. Describe the significance of the organic free radical.

12. Describe the target theory.

13. Define the direct and indirect effect of radiation.

14. Discuss cell survival curves.

15. Write the range of Dq values for most mammalian cells.

16. Define recovery.

17. Describe the results obtained by split dose experiments.

18. Discuss the acute radiation syndrom.

19. Write the dose range necessary to elicit the hematologic, gastrointestional and CNS syndrome.

20. Define the LD 50/30.

21. Write the LD 50/30 range for man.

22. Discuss total body versus partial body high dose radiation.

23. Define relative, absolute and excess risk.

24. Define the latent period.

25. List some recognized late effects of radiation exposure.

26. Relate the radiosensitivity of the embryo with stage of development.

27. Discuss the relationship of incidence of leukemia with in utero radiation exposure.

28. Discuss fractionation of fetal radiation dose with production of congenital abnormalities.

29. Describe some congenital abnormalities that have been attributed to in utero radiation exposure.

30. Write the normal incidence of congenital defects that occur regardless of radiation.

31. Write the maximum permissible dose for the fetus from occupational exposure of the mother.

32. Describe the dose-response relationship for radiation induced mutations.

33. Define the Doubling Dose.

34. Write the Doubling Dose for acute and protracted radiation exposure.

35. Discuss the evidence regarding genetic mutation in human populations that have received radiation exposure.

Unit III - Radiation Protection

At the conclusion of the unit, the student should be able to:

1. Write and define the standard units of radiation exposure and dose.

2. Discuss the cardinal principles of radiation protection

    A. Time

    B. Distance

    C. Shielding

Unit III - Radiation Protection - Continued

3. Define HVL, MPD.

4. List the Maximum Permissible Doses presented.

5. Calculate the cumulative MPD for an occupationally exposed individual given the age.

6. Describe the information required on a personnel monitoring report.

7. Describe the purpose and content of 10 CFR Parts 19 and 20.

8. Define a restricted and unrestricted area.

9. Identify the conditions for posting an area as a radiation or high radiation area.

10. Define the conditions for posting a caution Radioactive Materials sign.

11; Define the exposure rate constant.

12. Describe a method for calibrating a survey meter and its precautions and limitations.

13. List the appropriate regulatory guides for licensing and operating a radionuclide laboratory.

14. List the general types of radiation survey equipment.

15. Discuss the proper operation and use of ionization type and GM survey meters.

16. List the types of radiation surveys required by the NRS and the appropriate frequency.

17. Discuss the general rules of good practice in an area where radioactive material is stored or used.

18. List some appropriate procedures for handling sealed vs. unsealed sources of radioactive material.

19. Describe the appropriate procedure for safely opening packages containing radioactive material.

20. Discuss the ALARA concept.

21. Describe the instructions that should be provided to workers frequenting a restricted area.

22. Describe the types of byproduct material licenses issued by the NRC.

23. Describe the procedure for safely replacing the sealed source in a bone mineral analyzer.

Unit III - Radiation Protection - Continued

24. List the appropriate records that need to be maintained as required by the byproduct license.