

December 23, 1985

J. Nelson Grace, Regional Administrator  
United States Nuclear Regulatory Commission  
Region II  
101 Marietta Street, N.W.  
Atlanta, Georgia 30303

Dear Mr. Grace:

At the Nuclear Regulatory Commission (NRC) Enforcement Conference held on November 20, 1985, five deficiencies were brought our attention. Reference is made to our letter to the NRC dated November 19, 1985, which outlined how two of the five deficiencies would be eliminated. The three remaining deficiencies and the manner in which they have been removed are as follows:

- (1) Lack of controlled access to the Gammacell Room and the lack of recommended training for gammacell users.

Response: On December 16, 1985, a numerical pad-Cardkey reader was installed on the door of the Gammacell Room to monitor and to control access to the gammacell. Access to the room is limited to authorized gammacell users who are given a programmed Cardkey and a numerical password. Authorized users are laboratorians who have successfully completed CDC's eight-hour NRC approved gammacell course. In this regard, on December 9, 1985, the gammacell course was taught and 27 persons successfully completed the program (see enclosure No. 1).

- (2) Inadequate laboratory surveys performed by laboratorians and by the Office of Biosafety.

Response: The Office of Biosafety (OBS) completed surveying all 66 of the laboratories using radioisotopes on December 19, 1985, in compliance with the requirement that OBS perform laboratory surveys once every four months. Other measures implemented to encourage laboratorians to perform surveillance surveys in a timely manner are: (1) the Director of the Office of Biosafety will write a memorandum to the Center Directors soliciting support; and (2) the Radiation Safety Officer will check each laboratorian's radioisotope log book for compliance as a component of OBS's four-month laboratory survey activity.

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10-06772-01 PDR

- (3) Failure to survey the sealed sources in the gas chromatographs in a timely manner.

Response: As required by CDC's Radioactive Materials License, the gas chromatographs are to be surveyed twice a year except for the unit located in the Chemical Toxicant Laboratory (CTL) which is to be surveyed annually. The unit in the CTL is scheduled to be surveyed in January 1986 when the CTL is closed for preventive maintenance. The remaining units will also be surveyed in January due to the fact that they were last surveyed in August 1985.

We trust that this response to the concerns raised during the enforcement conference is satisfactory and continues to reflect our commitment to develop and implement an exemplary radiation safety program.

Frank S. Lisella, Ph.D.  
Director  
Office of Biosafety

Enclosure



## Memorandum

Date December 19, 1985

From Radiation Safety Officer  
Safety and Health Operations Branch, OBS

Subject Laboratorians Who Passed the Gammacell Course

To Record

The Centers for Disease Control's Gammacell Course was conducted on December 9, 1985, in Auditorium A, Building 2. All of the 27 laboratorians taking the course passed the examination. The new authorized gammacell users are as follows:

Carol Aloisio	Joseph McDade
Burt Anderson	Jerri McLaughlin
Patricia Andrysiak	Shiela Mitchell
Renee Black	Bill Morrill
Mei Castor	Gilda Perez
Shiela Cort	Martha Redus
Bob Davis	Suyo Ruo
Barry Fields	Anthony Sanchez
Barbara Forrester	Judy Scheppler-Campbell
Bill Gamble	Catherine Spruill
Eddie George	Terry Thompson
Greg Hoyes	Ted Tzianabos
Michael Kiley	Art Wozniak
Allison Mawle	

There are several authorized gammacell users who took a one-week course at the Georgia Institute of Technology in 1977, including Ms. Luanne Elliot, Ms. Sally Baker, Dr. James Lange, Dr. Paul Feorino, and Dr. Helen Regnery. All of the gammacell users gain access to the gammacell room by the utilization of a programmed Cardkey and a numerical password.

Paul D. Simpson

November 19, 1985

J. Nelson Grace, Regional Administrator  
United States Nuclear Regulatory Commission  
Region II  
101 Marietta Street, N.W.  
Atlanta, Georgia 30303

Dear Mr. Grace:

During the out-briefing by the Nuclear Regulatory Commission Inspector, Ms. Carol Connell, on November 7, 1985, the following deficiencies were brought to our attention:

1. Failure to post NRC Form-3, "Notice to Employees," at the Chamblee facility.
2. The unauthorized transfer of radioactive packages from Clifton Road to Chamblee.
3. Lack of controlled access to the Gammacell Room and the lack of recommended training for gammacell users.
4. Inadequate laboratory surveys performed by laboratorians and by the Office of Biosafety.
5. Failure to survey the gas chromatographs in a timely manner.

To eliminate these deficiencies, the following actions have been taken:

1. As of November 18, 1985, NRC Form-3's containing a note to radiation workers were installed in all areas where radioactive materials are used (see Enclosure No. 1).
2. A decision has been made not to transfer any more radioactive packages between CDC facilities. To solve this problem, laboratorians at Chamblee will request suppliers to ship radioactive packages directly to the shipping and receiving office at Chamblee. Each package will be surveyed for contamination and the paperwork will be processed by the Supply Management Officer in Building No. 17 (see Enclosure No. 2).

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3. Access to the Gammacell Room will be controlled by a Cardkey reader (see installation Work Request at Enclosure No. 3). As for training of gammacell users, a proposed Gammacell Course is submitted for your approval (see Enclosure No. 3). The proposed class roster, the letter informing users of the class, and the quiz are also provided (see Enclosure No. 3).
4. The subject of laboratory surveillance will be resolved by a short-range and long-range plan. An Office of Biosafety staff member has been assigned to assist the Radiation Safety Officer in the performance of the quarterly laboratory surveys. A safety technician will be hired to perform laboratory surveys and other radiation safety tasks. The request for the technician was forwarded through CDC channels in September 1985. Subsequent discussions involving this position have been very positive.
5. Past administrative procedures used to process gas chromatograph swipe samples for analysis have been modified to alleviate problems associated with the processing of leak test requisitions (see Enclosure No. 5).

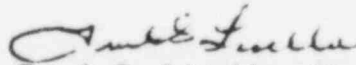
In conclusion, CDC's radiation safety program can be put in perspective by noting that the program has undergone a renaissance during the last year as evidenced by the following accomplishments:

1. Completed a new Radiation Safety Manual which was distributed to all those laboratorians using radioisotopes.
2. Convened all of CDC's authorized radiation users to discuss the Radiation Safety Program and provided them with a copy of the Radiation Safety Manual, the Radioisotope Log Book, and other required materials for the execution of good radiological practices.
3. Developed a thyroid monitoring program and requested laboratorians who work with radioiodine to receive a baseline thyroid scan which will be used to evaluate accidental thyroid exposures. The scans will be performed at the Employee Health Service Clinic with Atomic Products Corporation spectrometer which we recently purchased.
4. Surveyed for contamination at the shipping and loading dock approximately 170 incoming packages containing radioactive material.
5. Participated in radiation safety training for CDC's 'Radiation Safety in the Laboratory' Course, a Gammacell 1000 Course, a seminar for the DeKalb County Fire Fighters, and a safety course for laboratorians involved in AIDS research.
6. Designed a Radiation Exposure Report Form that will be used to ascertain all pertinent information related to any radiological accident.

Page 3 - Mr. J. Nelson Grace

7. Designed, programmed, and tested a computerized Radiation Safety Management System which will contain all data needed to manage and monitor CDC's Radiation Safety Program.
8. Wrote an article entitled "Developmental Aspects of the Computerized Radiation Safety Management System" which was submitted for publication to the American Industrial Hygiene Association Journal.
9. Continued to develop a working relationship with CDC's laboratory in Fort Collins, Colorado, and NIOSH in Cincinnati, Ohio, with respect to their Radiation Safety Programs. The sharing of technical information and ideas has proven to be mutually beneficial.
10. Revised and updated the CDC Radioactive Waste Program.
11. Reconstituted the CDC Radiation Safety Committee (RSC). Each meeting of the RSC involves a telecommunications hook-up between the Clifton Road complex and the Radiation Safety Officers at our facilities in Fort Collins, Colorado, and Cincinnati, Ohio.

We trust that our response to the concerns raised during Ms. Connell's inspection are satisfactory and that you will agree we have a sincere continuing commitment to the development and implementation of an exemplary radiation safety program.

  
Frank S. Lisella, Ph.D.  
Director  
Office of Biosafety

Enclosures



ENCLOSURE NO. 1

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service  
Centers for Disease Control

## Memorandum

Date November 18, 1985

From Radiation Safety Officer  
Office of Biosafety

Subject Posting of NRC Form 3, "Notice to Employees"

To Authorized Users of Radioactive Materials

Please be advised that during the Nuclear Regulatory Commission inspection on October 28 and 29, 1985, one of the deficiencies noted was the failure to adequately post the NRC Form 3, "Notice to Employees." NRC Form 3's have recently been posted on bulletin boards in work areas used by radioactive material users. Please inform all of your radiation workers of the posting of this important NRC Notice.

*Paul D. Simpson*  
Paul D. Simpson

RECORD OF POSTING OF NRC FORM 3

<u>Building No.</u>	<u>Lab No./Corridor</u>	<u>Date Posted</u>	<u>Name of Poster</u>
17 (Chamblee)	2110 (Spierto)	11/18/85	John Hughes
17 (Chamblee)	2115 (Myrick)		
17 (Chamblee)	2510 (Gunter)		
17 (Chamblee)	2810 (Sowell)		
17 (Chamblee)	(Steinberg)		
17 (Chamblee)	(Burse)		
22 (Chamblee)	8 (Campbell)		
32 (Chamblee)	32 (Eanes)		
1 (Clifton)	1st Floor East Corridor West Corridor	11/18/85	Everett Cowart
1 (Clifton)	2nd Floor East Corridor West Corridor		
1 (Clifton)	Basement East Corridor		
1 South	Basement East Corridor		
1 South	1st Floor West Corridor		
1 South	2nd Floor East Corridor West Corridor		
1 South	3rd Floor West Corridor		
5 (Clifton)	Sub-Basement East Corridor		
5 (Clifton)	Basement East Corridor West Corridor		
5 (Clifton)	3rd Floor East Corridor		
6 (Clifton)	1st Floor (Hepatitis)		
7 (Clifton)	Sub-Basement East Corridor West Corridor		
7 (Clifton)	Basement East Corridor West Corridor		
7 (Clifton)	1st Floor East Corridor West Corridor		
7 (Clifton)	2nd Floor East Corridor West Corridor		
7 (Clifton)	3rd Floor (Smallpox)		





# NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20), NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS, INSPECTIONS (PART 18), EMPLOYEE PROTECTION

## WHAT IS THE NUCLEAR REGULATORY COMMISSION?

The Nuclear Regulatory Commission is an independent Federal regulatory agency responsible for licensing and regulating nuclear power plants and other commercial uses of radioactive materials.

## WHAT DOES THE NRC DO?

The NRC's primary responsibility is to ensure that workers and the public are protected from unnecessary or excessive radiation exposure. The NRC's responsibilities include: reviewing power plants and other nuclear facilities to ensure they meet high safety standards and high quality standards; enforcing Federal Regulations (10 CFR 101, 20.103 and 20.104 of Title 10 of the Code of Federal Regulations); and ensuring that workers are properly trained and supervised.

## AT RESPONSIBILITY DOES EMPLOYER HAVE?

Any company that conducts activities licensed by the NRC must comply with the NRC's requirements. If a company violates NRC requirements, it can be fined or have its license modified, suspended or revoked.

Your employer must tell you when NRC regulations apply to your work and must post NRC Notices of Violation including radiological working conditions.

## WHAT IS MY RESPONSIBILITY?

For your own protection and the protection of your co-workers, you should know how NRC requirements relate to your work and should alert them if you observe violations of the requirements. You should report them.

## HOW DO I REPORT VIOLATIONS?

If you believe that violations of NRC rules or of the terms of the license have occurred, you should report them immediately to your supervisor. If you believe that adequate supervisory action is not being taken, you may report this to an NRC inspector or the nearest NRC Regional Office.

## WHAT IF I WORK IN A RADIATION AREA?

If you work with radioactive materials or in a radiation (controlled) area, the amount of radiation exposure that you may receive is limited by the NRC. The limits on your exposure are contained in actions 20.101, 20.103 and 20.104 of Title 10 of the Code of Federal Regulations (10 CFR 20). While these are the maximum allowable limits, your employer should also keep your radiation exposure as far below these limits as is "reasonably achievable."

## MAY I GET A RECORD OF MY RADIATION EXPOSURE?

Yes. Your employer is required to tell you, in writing, if you receive any radiation exposure above the limits set in the NRC regulations, or your employer's license. In addition, if your job involves radiation, you may request from your employer a record of your annual radiation exposure and a written report of your total exposure when you leave your job.

## HOW ARE VIOLATIONS OF NRC REQUIREMENTS IDENTIFIED?

NRC conducts regular inspections of licensed facilities to ensure compliance with NRC requirements. In addition, your employer and site contractors conduct their own inspections to ensure compliance. All inspections are conducted by Federal law enforcement with them may result in criminal prosecution for a Federal offense.

## MAY I TALK WITH AN NRC INSPECTOR?

Yes. Your employer may not prevent you from talking with an NRC inspector and you may talk privately with an inspector and request that your identity remain confidential.

## MAY I REQUEST AN INSPECTION?

If you believe that your employer has not corrected violations involving radiological

## WORKING CONDITIONS YOU MAY REQUEST AN INSPECTION

Your request should be addressed to the nearest NRC Regional Office and must describe the alleged violation in detail. It must be signed by you or your representative.

## HOW DO I CONTACT THE NRC?

Notify an NRC inspector on site or call the nearest NRC Regional Office. Call NRC inspectors want to talk to you if you are worried about radiation safety or other aspects of licensed activities, such as the quality of construction or operations at your plant.

## CAN I BE FIRED FOR TALKING TO THE NRC?

No. Federal law prohibits an employer from firing or otherwise discriminating against a worker for bringing safety concerns to the attention of the NRC. You may not be fired or discriminated against because you:

- ask the NRC to enforce its rules against your employer;
- testify in an NRC proceeding;
- provide information or are about to provide information to the NRC about violations of requirements;
- are about to ask for or testify, help, or take part in an NRC proceeding.

## WHAT FORMS OF DISCRIMINATION ARE PROHIBITED?

No employer may fire you or discriminate against you with respect to pay, benefits, or working conditions because you help the NRC.

## HOW AM I PROTECTED FROM DISCRIMINATION?

If you believe that you have been discriminated against for bringing safety concerns to the NRC, you may file a complaint with the U.S. Department of Labor. Your complaint must describe the firing or discriminating action and must be filed within 30 days of the occurrence.

Send complaints to:

Office of the Administrator  
Wage and Hour Division  
Employment Standards Administration  
U.S. Department of Labor  
Room 33602  
200 Constitution Avenue, N.W.  
Washington, D.C. 20210

or any local office of the Department of Labor, Wage and Hour Division. Check your telephone directory under U.S. Government listings.

## WHAT CAN THE LABOR DEPARTMENT DO?

The Department of Labor will notify the employer that a complaint has been filed and will investigate the case.

If the Department of Labor finds that you, employer has unlawfully discriminated against you, it may order you to be reinstated, receive back pay or be compensated for any injury suffered as a result of the discrimination.

## WHAT WILL THE NRC DO?

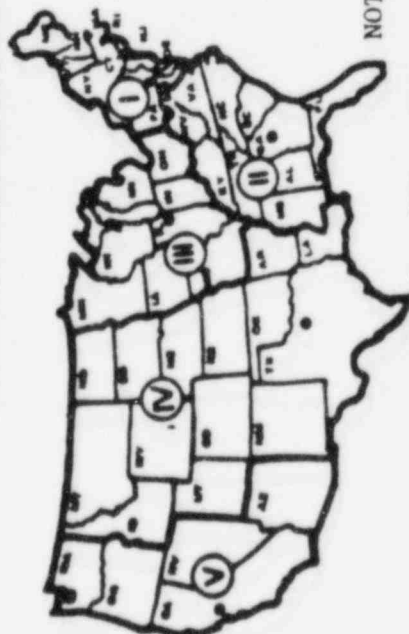
The NRC may assist the Department of Labor in its investigation. NRC may conduct its own investigation where necessary to determine whether unlawful discrimination has prevented the free flow of information to the Commission. Also, if the NRC or Department of Labor finds that unlawful discrimination has occurred, the NRC may issue a Notice of Violation to your employer, impose a fine or suspend, modify, or revoke your employer's NRC license.

## UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.

### Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 811 Park Avenue King of Prussia, PA 19406	215 337 5000
II	U.S. Nuclear Regulatory Commission Region II 101 Main Street, N.W., Suite 2800 Atlanta, GA 30333	335 404 864 4603
III	U.S. Nuclear Regulatory Commission Region III 700 Riverchase Road Glen Ellyn, IL 60137	312 780 5600
IV	U.S. Nuclear Regulatory Commission Region IV 811 Ryan Plaza Drive, Suite 1000 Arlington, VA 22201	817 880 8100
V	U.S. Nuclear Regulatory Commission Region V 1400 Main Street, Suite 210 West Coast, CA 90008	415 943 3100



## NOTICE TO ALL CDC RADIATION WORKERS

Any CDC radiation worker may obtain documents related to CDC's Radiation Safety Program such as 10 CFR 19, 10 CFR 20, Materials Licenses, Operating Procedures, Violations, or any CDC responses to the NRC by either visiting the office of Biosafety, Building 4, Room 232, or by telephoning the office at 329-3883.



ENCLOSURE NO. 2

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service  
Centers for Disease Control

Memorandum

Date November 18, 1985

From Radiation Safety Officer  
Office of Biosafety

Subject Termination of the Transporting of Radioactive Packages Between CDC Facilities

To Lamar Mangum, Manager  
Laboratory Supply Activity, OAS, CID

As a follow-up to our discussion of the above subject on Thursday, November 14, 1985, be advised that the attached memo has been forwarded to all of the radioactive material users at Chamblee. Mr. John Hughes, the CEH Supply Management Officer, has agreed to survey and receive CID radioactive packages and will implement all of CID's inprocessing procedures. Please contact him as soon as possible at extension 5-4146 to work out the details of this new procedure.

The Office of Biosafety extends its appreciation to you for your continuing support in assuring the safe receipt of CDC's incoming radioactive materials. If additional assistance is needed, please contact our office at extension 3883.

*Paul D. Simpson*  
Paul D. Simpson

Attachment



ENCLOSURE NO. 2

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service  
Centers for Disease Control

Memorandum

Date November 18, 1985

From Radiation Safety Officer  
Office of Biosafety

Subject Termination of the Transporting of Radioactive  
Packages between Clifton Road and Chamblee

To Authorized Users at Chamblee

During the Nuclear Regulatory Commission inspection on October 28-29, 1985, one of the deficiencies noted was the transportation of radioactive packages from Clifton Road to Chamblee. To alleviate this problem, radioactive packages will no longer be transported between CDC facilities. Effective immediately, all CID and CEH radioactive packages bound for Chamblee will be delivered directly by the vendor. Authorized users at Chamblee will indicate on their requisition form (CDC form 0.19) to deliver packages to: (1) John Hughes, DEHLS, CEH, Building 17, Loading Dock, Chamblee, GA 30341; and (2) Requesting user's name, building, and room number (see attached sample).

If you have any questions or comments on this new procedure, please contact the Office of Biosafety at extension 3883.

*Paul D. Simpson*  
Paul D. Simpson

Attachment

# REQUISITION FOR THE PURCHASE OF SERVICES, SUPPLIES, EQUIPMENT, & REPRINTS

		<table border="1"> <tr> <td>REQUESTED</td> <td>REQUIRED</td> </tr> <tr> <td>11/14/85</td> <td>12/1/85</td> </tr> </table>		REQUESTED	REQUIRED	11/14/85	12/1/85	REQUISITION	
		REQUESTED	REQUIRED						
11/14/85	12/1/85								
ISSUING OFFICE: MB, DPD, CID		Allowance 3-1513		CONTRACT NO. (if any)	PURCHASE ORDER				
REQUESTED BY: ANDRYSLAK		CAN No. 3921 1273							
PHONE NUMBER: 4030									
FOR PROCUREMENT USE ONLY				PURCHASE AUTHORITY:					
APPROPRIATION	TIME OF DELIVERY:	DISCOUNT TERMS:							
SHIPPING POINT	F.O.B. POINT:	METHOD OF DELIVERY:							
SUGGESTED SUPPLIERS (include zip codes in addresses): New England Nuclear 549 Albany Street Boston, MA 02118			DELIVER TO: 1. Centers for Disease Control DEHLS, CEH Building 17, Loading Dock Chamblee, GA 30341 ATTN: John Hughes 2. Debbie Nixon, Chamblee 22, Room 14						
STOCK NUMBER	SUPPLIES or SERVICES (Please double-space between items) If reprints, include: Title of Journal and Reprints, Author's names, Pages, & Page charges, Manuscript No. and Date.		QUANTITY	UNIT PRICE	AMOUNT				
NET-027	Thymidine ( <sup>3</sup> H) 6.7 Ci/mmol 1mCi/Vial  <div style="text-align: center;">_____ Radiation Safety Officer</div>  <u>SAMPLE REQUISITION</u>		1 EA	140.00	140				
			TOTAL \$ 140						
PROGRAM APPROVAL (Signature and Date):			ADMINISTRATIVE SERVICES APPROVAL:						

CDC 6-343  
REV. 11-81

WORK REQUEST ENGINEERING SERVICES				ENGINEERING SERVICES USE ONLY		
CENTER OR OFFICE		ADMIN. CODE	DATE INITIATED	DATE	NUMBER	
Office of Biosafety		HCA1	Nov. 16, 1985			
FOR REFERENCE CALL	EXT. NO.	ROOM & BLDG. NO.		MAINT.	SHOP	OTHER
Paul Simpson	3883	209 - 4		EL. TECH.	CAB.	CONSTR.
APPROVED BY: (APPROPRIATE OFFICIAL)		REMARKS		ELEC.	MACH.	CHAMB.
<i>OS Layton</i>		See Note		GEN. MNT.	METAL	L'VILLE
DESCRIPTION OF WORK (ATTACH SKETCHES & ADDITIONAL INFORMATION IF NEEDED)				PLUMB.		OPER.
Please expedite the installation of a Cardkey reader in Building 7, Room SSB 67.				REFR.		PAC. SVC.
Note: During the Nuclear Regulatory Commission inspection on October 28 and 29, 1985, one of the deficiencies noted was the lack of controlled access to the Gammacell Irradiator. We request the ESO install the reader immediately recognizing that the contract vendor would take too long to resolve the security problem.						DESIGN
				DRAWING NUMBER	ESTIMATOR	
				DATE	EST.	
				START	ACT.	
				DATE	EST.	
				COMP.	ACT.	
				LABOR	STD.	
				M. HR.	ACT.	
				MTLS.	EST.	
				COST	ACT.	
				FOREMAN APPROVAL & SIG.		

SEND ORIGINAL &amp; COPY TO ENGINEERING SERVICES - RETAIN LAST COPY



## DEPARTMENT OF HEALTH &amp; HUMAN SERVICES

Public Health Service  
Centers for Disease Control

## Memorandum

Date November 18, 1985

From Radiation Safety Officer  
Office of Biosafety

Subject Gammacell Course Authorized for All Gammacell Users

To Potential Gammacell Users

During the Nuclear Regulatory Commission inspection on October 28-29, 1985, one of the deficiencies noted was the absence of required training for CDC gammacell users. To solve this problem, the Office of Biosafety is scheduling an eight-hour gammacell course on December 10, 1985, beginning at 8:00 a.m. in Building 1, Room 206. Attendees who complete this course will be granted Cardkey access to the Gammacell Room while all other users will have to be accompanied. Please register for the course no later than December 6, 1985, by telephoning the Office of Biosafety at extension 3883.

*Paul D. Simpson*  
Paul D. Simpson

CENTERS FOR DISEASE CONTROL  
GAMMACELL COURSE  
AND  
LABORATORY SCHEDULE

Building 1, Room 206  
December 10, 1985

8:00	Atomic Structure	Paul Simpson
8:30	Decay of Radioactive Nuclei	Paul Simpson
9:30	Interaction of Radiation with Matter	Paul Simpson
10:00	Break	
10:15	Biological Effects of Radiation	Dr. William Wagner
11:00	Principles of Radiation Detection	Paul Simpson
12:00	Lunch	
12:30	Radiation Measurement Parameters	Paul Simpson
1:00	Contamination Control and Surveillance	Paul Simpson
1:30	Nomenclature and Operation of the Gammacell	Luanne Elliot
2:00	Gammacell Laboratory Exercise	Paul Simpson Luanne Elliot
6:00	Quiz	
6:30	Critique of Quiz, Questions and Answers	Paul Simpson Luanne Elliot

DETAILED OUTLINE OF COURSE TOPICS

I. Atomic Structure

The Atom

Binding Energies

Relativistic Velocities

Energy Levels

II. Decay of Radioactive Nuclei

Natural Radioactivity

Radioactive Decay Processes

Alpha Decay

Beta Emission

Orbital Electron Capture

Proton Decay

Neutron Emission

Isomeric Transition

Internal Conversion

Simple and Complex Decay Schemes

Decay Rates and Half-Lives

III. Interaction of Radiation With Matter

Heavy Charged Particles

Light Charged Particles

Gamma and X-Rays

Neutrons



#### IV. Biological Effects of Radiation

- External Exposure

- Internal Exposure

- Effects of Acute Exposure

- Effects of Chronic Exposure

- Exposure Protection Guides

#### V. Principles of Radiation Detection

- Simplest Ionization Type Detector

- Ion Counters

- Proportional Counters

- Geiger-Muller Counters

- Scintillation Counters

#### VI. Personnel Monitoring

- Explanation of Personnel Monitoring Devices

- Bioassays

- Dosimetry Reporting

#### VII. Radiation Measurement Parameters

- Definition of a Roentgen

- Definition of a Rad

- Definition of Quality Factor

- Linear Energy Transfer (LET)

- Definition of a Rem

## VIII. Contamination Control and Surveillance

Procedures for Handling Radiation Spills

Emergency Procedures

Methods of Performing Laboratory Surveillance

Determination of Laboratory Surveillance Frequency

## IX. Nomenclature and Operation of the Gammacell

Description and Function of Gammacell Components

Explanation of the Operational Procedure

Discussion of Gammacell Applications

### I. Gammacell Laboratory Exercise

Hands-on-Training (Each Student)

<u>Name</u>	<u>Signature</u>	<u>Building/Lab. No.</u>	<u>Telephone Extension</u>
1. Luanne Elliot			
2. Anthony Sanchez			
3. Sheila Mitchell			
4. Gilda Perez			
5. Art Wozniak			
6. Suyu Ruo			
7. Mei Castor			
8. Greg Hayes			
9. Barry Fields			
10. Ted Tzianabos			
11. Catherine Spruill			
12. Bill Gamble			
13. Sally Bauer			
14. Jean Smith			
15. Burt Anderson			
16. James Lange			
17. Martha Thieme			
18. Allison Mawle			
19. Donna Sasso			
20. Dave Auperin			
21. Michael Kiley			
22. Sheila Cort			
23. Dane Sanderlin			
24. Ling Xiong Kong			
25. Hang Chang-Shou			

ENCLOSURE NO. 3

Gammacell Quiz

1. Isotopes are atoms that possess the same atomic number but have different
  - (a) chemical properties
  - (b) atomic weights
  - (c) physical properties
  - (d) atomic energy
2. The binding energy per nucleon is
  - (a) 5
  - (b) 6
  - (c) 7
  - (d) 8
3. In an atom, the electron and the positively charged nucleus are balanced by the centrifugal force and
  - (a) long-range nuclear force
  - (b) short-range nuclear force
  - (c) gravitational force
  - (d) electric force
4. Gamma rays originate from which of the following?
  - (a) X-ray machine
  - (b) the sun
  - (c) the electronic configuration
  - (d) the nucleus
5. In alpha decay, the parent nucleus is reduced by how many atomic units?
  - (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
6. Beta particles are electrons emitted from the nucleus of atoms and may have the following charge:
  - (a) positive
  - (b) negative
  - (c) positive and negative
  - (d) neutral

7. An isomer is a nucleus that remains in an excited state before decaying by the emission of
- (a) electron
  - (b) proton
  - (c) neutron
  - (d) gamma radiation
8. The half-life of a radioisotope is inversely proportional to
- (a) its activity
  - (b) atomic weight
  - (c) its decay constant
  - (d) temperature constant
9. Decay schemes show energy levels of radioisotopes and
- (a) the number of electrons
  - (b) the number of neutrons
  - (c) the modes of decay
  - (d) the number of neutrinos
10. The half-life of Cobalt-60 is
- (a) 2.2 years
  - (b) 3.2 years
  - (c) 4.2 years
  - (d) 5.2 years
11. The gamma radiation emitted from the nucleus of Cobalt-60 is
- (a) 1.33 MeV
  - (b) 1.17 MeV
  - (c) 1.33 MeV and 1.17 MeV
  - (d) Zero MeV
12. In an alpha particle path, ionizations increase to a maximum at what point along the track?
- (a) at the beginning
  - (b) at the middle
  - (c) at the 2/3 point
  - (d) at the end
13. Lightly charged particles interact actively with matter and have characteristic paths that are
- (a) smooth
  - (b) erratic and irregular
  - (c) long-range
  - (d) null range

14. Gamma radiation interacts with matter by the following number of physical processes:
- (a) one
  - (b) two
  - (c) three
  - (d) four
15. In the Photoelectric Effect, the gamma photon interacts with:
- (a) the whole atom
  - (b) essentially free electrons
  - (c) tightly bound electrons
  - (d) the nucleus
16. In the Compton Effect, the gamma photon interacts with:
- (a) the whole atom
  - (b) essentially free electrons
  - (c) tightly bound electrons
  - (d) the nucleus
17. In the Pair Production Effect, the gamma photon interacts with:
- (a) the whole atom
  - (b) protons
  - (c) coulomb field of the nucleus
  - (d) nucleus
18. Radiation exposure is dependent on the radioisotope concentration, effective half-life, and
- (a) energy of disintegration
  - (b) isotopic mass
  - (c) isotopic charge
  - (d) isotopic angular momentum
19. Synergistic Radiation Effects produce which type of biological effects?
- (a) No
  - (b) Less
  - (c) increased
  - (d) less or increased
20. Exposure protection limits related to the biological exposure to radioactive material are found in Title 10, Chapter 1, Code of Federal Regulations,
- (a) Part 10
  - (b) Part 20
  - (c) Part 30
  - (d) Part 40

21. Light production in the scintillator is proportional to:
- (a) the multiplication factor of the PM tube
  - (b) the energy deposited in the scintillator by radiation
  - (c) all of the above
  - (d) none of the above
22. Ionization chambers are useful for measuring radiation doses and dose rates because
- (a) ions do not build up on the central electrode
  - (b) the output signal is proportional to the energy deposited by the radiation field
  - (c) all of the above
  - (d) none of the above
23. In what kind of detector is the propagation of Townsend Avalanches from one to another in a single discharge terminated by the buildup of the ion sheath around the central wire?
- (a) ionization counter
  - (b) proportional counter
  - (c) Geiger-Muller counter
  - (d) scintillation counter
24. A major advantage of use of G-M tubes for particle counting is:
- (a) the dependence of the pulse height
  - (b) the low sensitivity of the tube
  - (c) the large output signal
  - (d) the low cost
25. For a proportional counter operated in the alpha plateau region, and with a source which emits alphas and betas, the count rate will be due to:
- (a) alphas only
  - (b) beta only
  - (c) alphas and betas
  - (d) none of the above

26. Personnel monitoring badges have become more efficient in detecting radiation emissions, mainly because of the introduction of
- (a) better film emulsion
  - (b) thermoluminescent crystal
  - (c) improved film developing
  - (d) better analysis techniques
27. What type of radiation is detected by whole-body radiation badges used at CDC containing a TLD chip and a crystalline powder?
- (a) beta
  - (b) gamma
  - (c) beta and gamma
  - (d) none of the above
28. What are some of the specimens used in bioassay sampling?
- (a) blood
  - (b) urine
  - (c) teardrops
  - (d) all of the above
29. If one is working with quantities of 1 mCi or greater at the open workbench, how soon after completing one's work should one obtain a thyroid scan?
- (a) within 1 hour
  - (b) within 1 to 6 hours
  - (c) within 6 to 72 hours
  - (d) after 72 hours
30. The deposition of a 100 ergs of radiation of any kind into one gram of tissue is defined as a
- (a) roentgen
  - (b) rem
  - (c) rad
  - (d) gray
31. The gray is a unit of absorbed dose and is equal to
- (a) 1 rad
  - (b) 10 rads
  - (c) 100 rads
  - (d) 1000 rads



32. The quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 gm of air produces, in air, ions carrying one esu of quantity of electricity of either sign is called
- (a) rem
  - (b) roentgen
  - (c) rad
  - (d) none of the above
33. The linear energy transfer (LET) is defined as the energy (E) loss per distance unit of the particle path which is given by the formula
- (a)  $dE/dM$  ( $M = \text{mass}$ )
  - (b)  $dE/dQ$  ( $Q = \text{charge}$ )
  - (c)  $dE/dV$  ( $V = \text{medium volume}$ )
  - (d)  $dE/dL$  ( $L = \text{path length}$ )
34. In contamination control, every effort should be made to contain the radiation spill because of what primary reason?
- (a) the radiation will decay faster
  - (b) to stop the spreading of contamination
  - (c) it is easier to clean up
  - (d) none of the above
35. When decontaminating any area in the gammacell room, what procedures are always executed?
- (a) wear protective coat and gloves
  - (b) keep the contamination confined to a small area
  - (c) call the Office of Biosafety
  - (d) all of the above
36. What information should be entered in the Gammacell Log Book?
- (a) biological agent/specimen irradiated
  - (b) date of irradiation and researcher name
  - (c) length of irradiation
  - (d) all of the above

37. How often must the gammacell be tested for radiation leaks?
- (a) once per quarter
  - (b) twice per quarter
  - (c) biannually
  - (d) annually
38. The radiation survey of the gammacell must be able to detect radiation to the following level:
- (a) 1 microcurie
  - (b) 0.5 microcuries
  - (c) 0.05 microcuries
  - (d) 0.005 microcuries
39. Laboratory surveillance can be performed by two methods based on the radioisotopes being surveyed; these methods are:
- (a) taking wipe samples
  - (b) using a portable survey meter
  - (c) all of the above
  - (d) none of the above
40. The frequency required for performing radiation surveys is based on the following three factors:
- (a) \_\_\_\_\_
  - (b) \_\_\_\_\_
  - (c) \_\_\_\_\_
41. The components of the gammacell include:
- (a) Co-60 radiation source
  - (b) sample chamber
  - (c) irradiator timer
  - (d) all of the above

42. The three types of gamma radiation interactions are:
- (a) Pair Production, Compton Effect, Beta interaction
  - (b) Compton Effect and Pair Production
  - (c) Pair Production, Compton Effect, and Photoelectric Effect
  - (d) None of the above
43. When the gammacell was installed in 1979, the activity of the Co-60 source was 25,000 curies. What is the approximate activity of the source today?
- (a) 11,000 curies
  - (b) 11,500 curies
  - (c) 12,000 curies
  - (d) 12,500 curies
44. What is the name of the manufacturer of the gammacell?
- (a) Honeywell
  - (b) Packard
  - (c) Atomic Energy of Canada, Ltd.
  - (d) Brown Boveri
45. Name two levels of radiation exposure security characterizing the gammacell in Building 7, Room SSB-67.
- (a) \_\_\_\_\_
  - (b) \_\_\_\_\_
46. What kind of personnel protection devices should be worn and procedures followed to reduce radiation exposure in the gammacell room?

47. In case of an emergency in the gammacell, what actions would you take?

48. What is the telephone number of the Office of Biosafety?

49. What is the telephone number of the security guard in the lobby of Building 1?

50. List the simple procedures required to operate the gammacell.

## GAMMACELL LABORATORY EXERCISE

- I. TITLE: Exploring the Gammacell
- II. PURPOSE: To acquire an understanding of the gammacell and to execute the steps required to operate the gammacell.
- III. NOMENCLATURE: A. Draw a picture of the gammacell and label the main components.  
  
B. Explain the function of each gammacell component.
- IV. OPERATIONAL PROCEDURE: Execute all the steps required to operate the gammacell and obtain the instructor's check-off.
- V. CALCULATIONS: Using the formula for the activity of a radioisotope at any time,  $t$ , calculate the activity of Co-60 present in CDC's gammacell in the years 1980, 1985, 1990, 1995, 2000.
- VI. APPLICATIONS: Discuss three applications of the gammacell related to your research activities.
- VII. Discuss the safety precautions and procedures related to operation of the gammacell.

ENCLOSURE NO. 5

LEAK TESTING OF THE SEALED SOURCES  
PRESENT IN THE GAS CHROMATOGRAPHS

In accordance with CDC's Radiation Safety Manual, each gas chromatograph will be tested for leakage every 6 months by the laboratorians. Following the present schedule of required Radiation Safety Program activities, leak tests will be performed in the months of August and February of each year. In the past there has been an unsatisfactory time lag between the time the wipe samples have been returned from the laboratorians and the time they have been forwarded to the Nuclear Radiation Development Company for analysis. To remedy this problem, the following steps will be implemented:

1. The electron capture cell decontamination kits will be mailed to the laboratorians at the beginning of the last week in July and January. At the same time the requisition requesting a purchase order number to have the leak test analysis performed will be forwarded to the Purchasing Office. The requisition will be stamped "Expedite" - the indicator recognized by the Purchasing Office to process the action in a timely manner.

2. By the third week in August and February, four weeks should have elapsed and the wipe samples and the requisition should have been returned to the Office of Biosafety where they will be sent off immediately for analysis. The implementation of the aforementioned procedural changes will solve the existing problems related to the leak testing of the gas chromatographs except for the unit in the dioxin laboratory in Chamblee requiring an extended leak test period. A letter will be forwarded to the NRC requesting that CDC's Radioactive Materials License be amended to allow an annual leak test of the unit in question because of the ultra-sensitivity required in the research project.