MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

OFFICIAL RECORD COPY

Licensee	
1. Columbia University Environmental & Occupational Health	3. License Number 31-28713-01
2. 398 Engineering Terrace 500 W. 120th Street New York, New York 10027	4. Expiration Date June 30, 2007
	5. Docket or Reference No. 030-34376

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Hydrogen 3	A. Any	A. 10 millicuries
B. Carbon 14	B. Any	B. 100 millicuries
C. Thorium 229	C. Any	C. 0.001 microcuries
D. Protactinium 233	D. Any	D. 1.0 microcurie

9. Authorized use

A. through D. Research and development as defined in 10 CFR 30.4.

CONDITIONS

10. Licensed material may be used in research vessels at sea in national and international waters and costal waters located anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

11. Licensed material shall be used by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, David Brenner, Ph.D., Chairman.

12. The Radiation Safety Officer for this license is George Hamawy.

13. Licensed material shall not be used in or on human beings.

14. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

130038

ML 10 0/1

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number: 31-28713-01

Docket or Reference number: 030-34376

15. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Application dated January 17, 1997
B. Letter dated April 9, 1997

Date MAY 29 1997

For the U.S. Nuclear Regulatory Commission

By ORIGINAL SIGNED BY: JAMES M. BONDICK

Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

MAY 29 1997

License No. 31-28713-01
Docket No. 030-34376
Control No. 124215

Mr. James P. Lewis
Director of Projects/Grants
Columbia University
Environmental & Occupational Health
500 West 120th Street
398 Engineering Terrace
New York, NY 10027

Dear Mr. Lewis:

This refers to your request for an NRC license. Enclosed with this letter is the license.

Please review the enclosed document carefully and be sure that you understand all conditions. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Until your license is terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.

2. Not possess and use materials authorized in Items 6, 7, and 8, on the license until:

   a. you have constructed the facilities and obtained the equipment described in the license application and supporting documentation; and

   b. you have notified the U.S. Nuclear Regulatory Commission, Region I, ATTN: Director, Division of Nuclear Materials Safety, 475 Allendale Road, King of Prussia, Pennsylvania 19406 in writing, that activities authorized by the license will be initiated.

OFFICIAL RECORD COPY ML 10

3. Notify NRC, in writing, within 30 days when the mailing address on the license changes (no fee is required if the location of byproduct material remains the same).

4. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license:

   a. when you decide to terminate all activities involving materials authorized under the license; or

   b. if you decide not to complete the facility, acquire equipment, or possess and use authorized material.

5. Request and obtain a license amendment before you:

   a. change Radiation Safety Officer;

   b. order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;

   c. add or change the areas of use, or address or addresses of use identified in the license application or on the license; or

   d. change ownership of your organization.

6. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or a certifying official of the licensee rather than the Radiation Safety Officer or a consultant.

You will be periodically inspected by the NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), NUREG 1600.

Since serious consequences to employees and the public can result from failure to comply with NRC requirements, prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Thank you for your cooperation.

Sincerely,

ORIGINAL SIGNED BY:
JAMES M. BONDICK

James M. Bondick
Health Physicist
Division of Nuclear Materials Safety

License No. 31-28713-01
Docket No. 030-34376
Control No. 124215

Enclosures:
1. License No. 31-28713-01
2. 10 CFR Parts 2, 19, 20, 21, 30, 71 and 170
3. NRC Forms 3 and 313
4. Section 206 of the Energy Reorganization Act of 1974

DOCUMENT NAME: R:\WPS\MLTR\L3128713.01

To receive a copy of this document, indicate in the box; "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	N	DNMS/RI	N				
NAME	JBondick/jmb		JKinneman					
DATE	04/24/97		04/25/97		04/ /97		04/ /97	

OFFICIAL RECORD COPY

TELEPHONE CONVERSATON RECORD	Date:4/24/97	Time:11:35 am
Mail Control No.: 124215	**License No.:** 31-28713-01	**Docket No.:** 030-34376
Person Called: George Hamawy, RSO	**Organization:** Columbia University	**Telephone Number:** 212-854-8749
Person Calling: J. Bondick	**Organization:** NRC	**Telephone Number:** 6951
Subject: Clarification of location of use and RSC oversight.		
Summary: Asked Mr. Hamawy if there was actually a location on the continent of Antarctica where they intended to use licensed material, since it appeared that the request for location of use included on Antarctica. Mr Hamawy stated that they wrote the application based on a letter from the NRC (this letter is not in this new license file). Mr. Hamawy stated that they do not intend to use licensed material on Antarticia. He also stated that their intent is to have the Radiation Safety Committee (RSC) fully involved and responsible for the program for this license. Told Mr. Hamawy that the oversight by an RSC would change the category of license of license.		
Action Required/Taken: Prepare draft license for Br. Chief to review		
Signature: J.Bondick	**Date:** 4/24/97	

OFFICIAL RECORD COPY ML 10

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

MS-16
G6

April 9, 1997

James M. Bondick
Health Physicist
Division of Nuclear Material Safety
Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

Docket No. 030-34376
Control No. 124215

Dear Mr. Mondick:

Thank you for your Feb. 19, 1997 letter and enclosures, as well as your granting us an extension for reply to your letter. Enclosed please find a copy of our reply (in duplicate) to your inquires. We hope that the information we are supplying is sufficient to answer all questions that you have raised.
We would like also to mention the fact that the Lamont-Doherty Earth Observatory was granted the New York State License # 537-2 for using radioactive material.
If you need any further information or clarification, please call me at (212) 854-4442.
Thank you for your assistance in this matter.

Sincerely,

James P. Lewis

James P. Lewis
Executive Director for Research Administration
Office of Vice Provost

George Hamawy

George Hamawy
Radiation Safety Officer

cc: D. Brenner
L. Greenholtz

OFFICIAL RECORD COPY ML 10 APR 14 1997

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

1- Attached : The information that was requested for George Hamawy, Robert Anderson, John Marra, and Raymond Nicholas Sambrotto.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatroy Commision (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: George Hamawy, Radiation Safety Officer

Title / Dept.: Environmental and Occupational Health

Highest degree and field in which awarded: MS. Environmental Health Science;
MS. Applied Science

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70-91)	> 100	> 1000
Units of radiation dose and quantities	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70 - 91)	> 100	> 1000
Radiation detection instrumentation	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70 - 91)	> 100	> 1000
Biological hazards of exposure to radiation	Hunter College (74 - 76) / Brooklyn Polyteck (81 - 83)	> 100	> 1000

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
In - 111	18.5 MBq (5mCi)	Mem.- Sloan Kettering	>1000	Medical
I -131	18.5 GBq(500 mCi)	Mem. -Sloan Kettering	>1000	Medical
Mo -99	37 GBq (1000 mCi)	Mem.- Sloan Kettering	> 1000	Medical
Tc - 99m	1.1 GBq(30 mCi)	Mem.- Sloan Kettering	> 1000	Medical
Ga - 67	185 MBq(5mCi)	Mem.- Sloan Kettering	> 1000	Medical
Tl - 201	1.1 GBq (30mCi)	Mem.- Sloan Kettering	> 1000	Medical
P - 32	18.5 GBq(500mCi)	Mem.- Sloan Kettering	> 1000	Medical
F - 18	1.85 GBq(50 mCi)	Albert Eienstein	> 10	Research
H - 3	37 MBq (1 mCi)	Egyptian Atomic Energy	> 100	Research
Ru - 106				

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

---

1. NAME and EDUCATION

Proposed authorized user: Robert Anderson, Ph.D

Title / Dept.: Lamont Doherty Earth Observatory y

Highest degree and field in which awarded: Ph.d. Chemical Oceanography

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Univ. Washington- 74-75 Woods hole oceanography -75-77 Univ. Rhode Island - 76-77	≪ 30	≪ 40
Units of radiation dose and quantities	"	"	"
Radiation detection instrumentation	"	"	"
Biological hazards of exposure to radiation	Above - plus Columbia Univ. 81-Present	≪10	≪0

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
Natural U, Th series	10^{-11} - 10^{-12} Ci	Woods Hole Oceanographic	Hundreds	Ph.d. Theses
Many - Neutron Activation of sediment	up to 1 mCi	Univ. Rhode Island	≪20	Elemental analysis - Inaa / spectrometry
233 - Pa	0.1 mCi	Woods Hole Oceanographic	≪40	Preparation of Isotope Yield monitor
237 Np - 233 Pa	0.1 mCi	Lamont - Doherty	≪100	"

54 Mn, 60Co, 57 Co, 58 Co, 113 Sn, 59 Fe, 65 Zn, 134 Cs, 203Hg, 75Se, 51 Cr, 22Na, 125 Sb	0.1 to 1.0mCi each	Experimental Lakes Area (canada) an Lamont - Doherty)	≪ 100	Lakes mesocosm studies of trace metal behavior

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Prof. John Mara

Title / Dept.: Lamont - Doherty Earth Observatory

Highest degree and field in which awarded:

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	3/79 , LDEO	1	20
Units of radiation dose and quantities	3/79 , LDEO	1	20
Radiation detection instrumentation	3/79 , LDEO	1	300
Biological hazards of exposure to radiation	3/79 , LDEO	2	40

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
14C	1850 Mbq (50 mCi)	LDEO; Various oceanographic vessels	900	Photosynthesis of marine algae

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Raymond Nicholas Sambrotto

Title / Dept.: Lamont - Doherty Earth Observatory

Highest degree and field in which awarded: Ph.D. Biological Oceanography

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Columbia Univ. Rad. Safety Office June/1993, Univ. AK /1980	4	40
Units of radiation dose and quantities	" "	2	40
Radiation detection instrumentation	" "	3	120
Biological hazards of exposure to radiation	" "	2	8

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
14c	3.7 MBq (0.1 mCi)	Univ Ak, Several research ships, Lamont-Doherty	80	as tracer to measure photosynthesis rate
32p	3.7 MBq (0.1 mCi)	CCNY, Univ. AK	40	as indicator of hybridization in DNA probing.

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

2- Carbon-14 is used to measure primary production by measuring the rate of photosynthesis in algae. An amount of approximately 1 mCi(37 MBq) will be used per research project (per cruise). The scintillation vials containing the scintillation fluid and the algae as well as the sea water used are collected and brought back to port for disposal as radioactive waste.

Hydrogen-3 is used in the form of tritiated organic compounds(amino acids) to measure bacterial growth and respiration. An amount of approximately 1 mCi per research project (per cruise) will be used. The scintillation vials and the bacteria as well as the sea water used will be brought back at the end of the trip to be disposed as radioactive waste.

Protactinium-233 is used to measure natural productivity of sea water in different ancient weather periods by measuring the ratios of the natural protactinium-231 and the added protactinium- 233 (half life 27 days). An amount of less than 1 uCi is used per experiment. Protactinium (both natural Pa-231 and added Pa-233) are quantitatively extracted from sea water onto iron hydroxide. The extracted sea water is not radioactive and is disposed of at sea. The iron hydroxide is brought back to the laboratory at the end of the trip for analysis and decay in storage.

Thorium-229 is used to measure the ratios of Th-230 and Th-232 for dating marine sediments. The amount used is a small fraction of 1 uCi.

3- **Radiation Safety Officer Certification**

We certify that the individual to be named on this license to perform the function of radiation safety officer (RSO):

1. has read and understands the applicable provisions of the Nuclear Regulatory Commission regulations and the specific conditions in the license; and
2. has sufficient technical knowledge to perform the duties of a radiation safety officer; and
3. has, and will continue to have, sufficient resources to accomplish the tasks of the radiation safety officer; and
4. has, and will continue to have, sufficient time to perform the duties of the radiation safety officer; and
5. is completely willing to perform the functions of the radiation safety officer; and
6. has, and will continue to receive, the support of the management of this licensee in ensuring that all licensed activities will be conducted in accordance with the provisions of the Nuclear regulatory Commission regulations and the specific terms of the license.
7. has the authority to communicate with and direct all personnel regarding NRC regulations and license provisions, and to enforce these requirements including the ability to terminate any unsafe operation involving the use of licensed material.

Radiation Safety Officer Applicant: George Hamawy

Date: 4/9/97

Certifying Official: James Plumb

Date: 4/9/97

4 - The Radiation Safety Officer is responsible for managing the radiation safety program; identifying radiation safety problems; initiating, recommending, or providing corrective actions; verifying implementation of corrective actions; and ensuring compliance with regulations. The Director of the Office of Environmental and Occupational Health delegates to the Radiation Safety Officer, the authority necessary to meet these responsibilities.

At present the Radiation Safety Officer is a full-time position. Support staff include a full time Health Physics technician, a part time Health Physics Technician and a part time secretary.

The Radiation Safety Officer shall:

1. Coordinate the Radiation Safety Committee's review of safety evaluations of all proposed uses of radioactive material.
2. Oversee all activities involving radioactive material, including conducting routine monitoring and special surveys of all areas in which radioactive material is used. The Radiation Safety Officer generally conducts periodic surveys of work areas to supplement and audit routine monitoring by authorized users.
3. Determine compliance with rules and regulations, license conditions and the conditions of project approval specified by the Radiation Safety Committee.
4. Maintain a centralized program for the receipt and inspection of radioactive shipments, and keep an inventory record of the radioactive materials on hand, as well as package and ship all radioactive material leaving the University ;
5. Ensure that the use of licensed material is by or under the direct supervision of individuals specifically listed on our NRC License.
6. Ensure that radiation safety survey and testing equipment is calibrated at the required frequency;
7. Evaluate the effectiveness of the radiation safety program through routine inspections and surveys;
8. Implement and maintain a personnel monitoring program including the distribution and collection of dosimeters, bioanalysis testing, maintenance of personnel dosimetry records and the establishment of action levels which, when exceeded, shall initiate an investigation to determine the cause;

9. Ensure that the users (where appropriate) wear personnel monitoring equipment when using licensed materials.
10. Ensure that licensed materials are properly secured against unauthorized removal at all times when not in use.
11. Investigate all incidents involving radioactive materials including unauthorized removal and/or theft, spills and accidental releases, unauthorized receipt, and any activities which are not being conducted in full compliance with Nuclear Regulatory Commission, and implement corrective actions as necessary;
12. Maintain records and reports required by the Nuclear Regulatory Commission and prepare reports and program audits;
13. Prepare and present radiation safety training sessions for personnel handling radioactive materials or working with ionizing radiation equipment or frequenting areas where ionizing radiation is present;
14. Supervising and coordinating the radioactive waste disposal program, including keeping waste storage and disposal records, and monitoring effluents. Manage a program for processing, packaging, and disposal of radioactive waste;
15. Implement the recommendations of the Radiation Safety Committee.
16. The Director of the Radiation Safety Office shall issue interim approvals of Radioactive Material Use as needed. These will be discussed with the Chairperson of the Radiation Safety Committee before granted. Interim approvals will be reviewed at the next regularly scheduled meeting of the Committee.
17. Perform or arrange for the performance of leak tests on all sealed sources and for a semi-annual inventory of sealed sources under NRC jurisdiction.
18. Maintain an inventory of all radioisotopes at the institution and limit the quantity of radionuclides to the amounts authorized by the license. The inventory will include the name of the person responsible for each quantity of radioisotope, the date and the quantity picked up by the investigator. When items are removed from the inventory, it should show how and when the radioisotope was disposed of.
19. The authority to terminate immediately a project that is found to be a threat to health or property.
20. Furnish consulting services on all aspects of radiation safety to personnel at all levels of responsibility.
21. Monitoring and maintaining special filter systems associated with the use, storage or disposal of radioactive materials.
22. Supervising decontamination in cases of contaminating accidents.

5. (a) The Radiation Safety Committee reviews and acts on all proposed uses of radioactive material and other ionizing radiation sources, ensures the development and approves radiation safety programs consistent with the ALARA (As Low As Reasonably Achievable) philosophy, performs routine audits of safety program effectiveness, and reviews and acts on all incidents involving radioactive material and reported items of noncompliance with State, Federal, and New York City regulatory requirements. The Radiation Safety Committee is appointed by the President of Columbia University. The Radiation Safety Committee may establish subcommittees to expedite the review of license applications, radiation safety codes, enforcement issues, education and training and policy development.

(b) Membership: The composition of the Radiation Safety Committee shall meet the requirements set forth in Regulatory Guide 10.5. The membership shall include, but not be limited to the following: individuals who represent each type of use of ionizing radiation for which the University has authorization, and who through training or experience possess special competence in the areas of radiation protection and/or risk assessment; the Radiation Safety Officer; a representative of management who is not an authorized user . A Chairperson for the Committee will be appointed by the President of the University.

(c) Meeting Requirements: The Radiation Safety Committee shall meet as often as necessary to conduct its business, but not less than once in each calendar quarter and:

i At least one-half of the Committee shall be present:, including the Radiation Safety Officer and a representative of management, to establish a quorum and conduct business;

ii Minutes of the proceedings shall be recorded which include the meeting date, members present and absent, a summary of deliberations, discussions and recommendations, and a record of the ALARA program reviews undertaken.

(d) Committee Responsibilities:

(i) The Radiation Safety Committee will be responsible for ensuring that all individuals who work with or in the vicinity of radioactive materials have sufficient training and experience to perform their duties safely and in accordance with Department regulations and the conditions of the license.

(ii) The Radiation Safety Committee shall ensure that all use of radioactive material is conducted in a safe manner and in accordance with NRC regulations and the conditions of the license.

(e) Committee Duties: The Radiation Safety Committee shall :

1. Be familiar with all pertinent NRC Regulations, the terms of the license and its amendments., the license application, the licenses, and amendments;
2. Review the training and experience of the proposed users (Responsible Investigators), the Radiation Safety Officer (RSO), and individuals to determine that their qualifications are sufficient to enable the individuals to perform their duties safely and are in accordance with the regulations and the conditions of the license;
3. Review on the basis of safety and approve or deny, consistent with the limitations of the regulations, the licenses and the ALARA philosophy, all requests for authorization to use radioactive material and other radiation sources (ionizing and non-ionizing) at the Columbia University.
4. Evaluate the adequacy of facilities and equipment for specific radionuclide applications;
5. Be responsible for monitoring the institution's program to maintain individual and collective doses as low as reasonably achievable. Review quarterly the Radiation Safety Officer's summary report of the occupational radiation exposure records of all personnel, giving attention to individuals or groups of workers whose occupational exposure appears excessive;
6. Review at least annually the entire radiation safety program to determine that all activities are being conducted safely, in accordance with the NRC regulations and the conditions of the licenses, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, written safety procedures and the adequacy of the institution's management control system;
7. Establish a table of investigational levels for occupational radiation exposure, which when exceeded, will initiate an investigation and consideration of action by the Radiation Safety Officer.
8. Recommend remedial action to correct any deficiencies identified in the radiation safety program; working with radioactive material, and all incidents involving radioactive material with respect to the cause and the corrective actions taken;

9. Ensure that the Radioactive Material licenses are amended if required prior to any changes in facilities, equipment, policies, procedures, and personnel.
10. Ensure that x-ray equipment and non-ionizing radiation equipment is used safely.
11. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive materials (e.g., security and housekeeping personnel) are properly instructed as required by the NRC regulations.

6 - Please see the answer to question number 5.

7- Attached information requested for the Radiation Safety Committee members.

Dr. D. Brenner : Chairman Radiation Safety Committee.

Mr. G. Hamawy : Radiation Safety Officer.

Mr. J. Lewis : Management

Members:

Dr. Carl Gryte : Chemical Engineering
Dr. James Molher : Barnard College, Biological Science.
Dr. Richard Carlson : University Health Service.
Ms. Loretta Greenholtz : Environmental and occupational Health.
Mr. Steve Marino : Nevis, Radiological Science.
Dr. Daniel Kalderon : Biological Science.
Dr. Robert Anderson : Lamont-Doherty Earth observatory. Geochemistry.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: D.J. Brenner

Title / Dept: Prof. Radiation Oncology / Professor School of Public Health

Highest degree and field in which awarded: P.h.D. Radiation Physics

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	M.SC. 1975-1976 London Ph.D. 1976-1979 Surrey	40	
Units of radiation dose and quantities	"	"	
Radiation detection instrumentation	"	"	
Biological hazards of exposure to radiation	"	"	

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
Am-241, Ba-133 Cs-137, Co-57 Co-60, Mn-54 Hg-203, Na-22 Y-88	< 1mCi	Rutherford Laboratory, Harwell; Los Alamos National Lab.	200 100	Calibration

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatroy Commision (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: George Hamawy, Radiation Safety Officer

Title / Dept.: Environmental and Occupational Health

Highest degree and field in which awarded: MS. Environmental Health Science;
MS. Applied Science

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70-91)	> 100	> 1000
Units of radiation dose and quantities	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70 - 91)	> 100	> 1600
Radiation detection instrumentation	Alex. Univ. (62 - 67) / Mem. Sloan Kettering (70 - 91)	> 100	> 1000
Biological hazards of exposure to radiation	Hunter College (74 - 76) / Brooklyn Polyteck (81 - 83)	> 100	> 1000

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
In - 111	18.5 MBq (5mCi)	Mem.- Sloan Kettering	>1000	Medical
I -131	18.5 GBq(500 mCi)	Mem. -Sloan Kettering	>1000	Medical
Mo -99	37 GBq (1000 mCi)	Mem.- Sloan Kettering	> 1000	Medical
Tc - 99m	1.1 GBq(30 mCi)	Mem.- Sloan Kettering	> 1000	Medical
Ga - 67	185 MBq(5mCi)	Mem.- Sloan Kettering	> 1000	Medical
Tl - 201	1.1 GBq (30mCi)	Mem.- Sloan Kettering	> 1000	Medical
P - 32	18.5 GBq(500mCi)	Mem.- Sloan Kettering	> 1000	Medical
F - 18	1.85 GBq(50 mCi)	Albert Eienstein	> 10	Research
H - 3	37 MBq (1 mCi)	Egyptian Atomic Energy	> 100	Research
Ru - 106				

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: James P. Lewis

Title / Dept.: Executive Director for Research Administration

Highest degree and field in which awarded: AB, Economics

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation			
Units of radiation dose and quantities			
Radiation detection instrumentation	- None-		
Biological hazards of exposure to radiation			

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
		- None -		

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

---

1. NAME and EDUCATION

Proposed authorized user: Prof. Carl Gryte

Title / Dept:

Highest degree and field in which awarded: Chem. Engr, Basc (1964), Chemistry PhD. (1970)

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	1964 Natural Uranium Unvir. Toranto Ub Critical Reactor	20Hrs.	
Units of radiation dose and quantities	1971 Columbia		10Hrs.
Radiation detection instrumentation	1971 Columbia		1 Hr
Biological hazards of exposure to radiation	1971 Columbia		1Hr.

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
Cobalt 60 Cesium 137	1500 Curies 900 Curies	172 Terrace Columbia University	1971 - Present 1980 - Present	Polymer Chemistry

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: James P. Mohler

Title / Dept: Ph.D. Biology

Highest degree and field in which awarded:

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Massachusetts Inst. Tech.	2	
Units of radiation dose and quantities	Princeton University 11/82	1	
Radiation detection instrumentation	Baylor College of Medicine 1/85	1	
Biological hazards of exposure to radiation	Columbia University 10/86	2. 5	

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
3H, 14C, 35S, 32p	0.25 uCi	M.I.T. Princeton Univ. Baylor College Med. Columbia Univ.	1000 100 300 1000	Biochemical Labeling

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Richard Carlson, MD

Title / Dept.: Director of University Health\ John Jay

Highest degree and field in which awarded: MD - Medicine, P&S 1970

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation			
Units of radiation dose and quantities			
Radiation detection instrumentation			
Biological hazards of exposure to radiation			

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Loretta A. Greenholtz

Title / Dept: Director Environmental and Occupational Health

Highest degree and field in which awarded: M.P.H Environmental Health Science

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation			
Units of radiation dose and quantities			
Radiation detection instrumentation			
Biological hazards of exposure to radiation			

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Steve Marino

Title / Dept: Senior Staff Associate Nevis Labs

Highest degree and field in which awarded:

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	RPI \ 1967-1968 BNL \ 1969-1971	50	>100
Units of radiation dose and quantities	BNL 1968,1978,1989	5	50
Radiation detection instrumentation	BNL, CU 1969-71, 1980-81, 1995	50	>100
Biological hazards of exposure to radiation	BNL, CU 1968,1978,1989,1992,1993	5	50

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
Tritium	4000 mCi	Brookhaven National Laboratory (BNL),	>100	Absorbed in Ti accelerator targets
137 Cs	10,000 mCi	Columbia University (CU)	100	Irradiator calibration
226Ra	50 mCi		>100	
241 Am/Be	50 mCi		10	Calibration

OFFICIAL RECORD COPY ML 10

124215

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Daniel Kalderon, Ph.D.

Title / Dept:

Highest degree and field in which awarded:

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	NIMR, London 9/80 UC. Berkelei	4 HR 4 HR	12 HR 4 HR
Units of radiation dose and quantities	Cambridge Univ. England 1977 - Chemistry & maths.	8 HR	
Radiation detection instrumentation	NIMR, London 9/80	4 HR	
Biological hazards of exposure to radiation	NIMR London 9/80	12HR	

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
32p 35s	1mCi 0.2 mCi	NIMR London UC Berkeley Columbia Univ.	> 500 HRS.	
3H	0.2 mCi	Columbia Univ.	10	
125I	0.1 mCi	"	5	

Nuclear Regulatory Commission (NRC)

APPLICATION FOR RADIOACTIVE MATERIALS LICENSE

TRAINING AND EXPERIENCE OF AUTHORIZED USER (NON HUMAN USE)

1. NAME and EDUCATION

Proposed authorized user: Robert Anderson, Ph.D

Title / Dept.: Lamont Doherty Earth Observatory y

Highest degree and field in which awarded: Ph.d. Chemical Oceanography

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

	Location and Dates of Training	Type and Length of Training	
		Clock hours in lecture or laboratory	Clock hours of supervised on the job experience
Characteristic of ionizing radiation	Univ. Washington- 74-75 Woods hole oceanography -75-77 Univ. Rhode Island - 76-77	≤ 30	≤ 40
Units of radiation dose and quantities	"	"	"
Radiation detection instrumentation	"	"	"
Biological hazards of exposure to radiation	Above - plus Columbia Univ. 81-Present	≤10	≤ 0

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

Isotope	Bq (mCi) used at one time	Location	Clock Hours	Use
Natural U, Th series	10^{-11} - 10^{-12} Ci	Woods Hole Oceanographic	Hundreds	Ph.d. Theses
Many - Neutron Activation of sediment	up to 1 mCi	Univ. Rhode Island	≤20	Elemental analysis - Inaa / spectrometry
233 - Pa	0.1 mCi	Woods Hole Oceanographic	≤40	Preparation of Isotope Yield monitor
237 Np - 233 Pa	0.1 mCi	Lamont - Doherty	≤100	"

54 Mn, 60Co, 57 Co, 58 Co, 113 Sn, 59 Fe, 65 Zn, 134 Cs, 203Hg, 75Se, 51 Cr, 22Na, 125 Sb	0.1 to 1.0mCi each	Experimental Lakes Area (canada) an Lamont - Doherty)	≪ 100	Lakes mesocosm studies of trace metal behavior

8- The Radiation Safety Committee will establish criteria to be used by the RSC or RSO when evaluating requests for authorizations for research for new facilities and new users. Each RSC member will have detailed guidance to assess the training and experience, as well as the facilities and equipment needs for each research request, to include but not be limited to:
Training and experience commensurate with proposed use : in addition to the training detailed in the answer to question # 12 , the training and experience of users authorized by the RSC to independently use or supervise the use of byproduct material will be at least equivalent to that specified in 10 CFR 33 .15 (b)(1) and (2) :

(1) A college degree at the bachelor level, or equivalent training and experience, in the physical or biological sciences or in engineering; and

(2) At least 40 hours of training and experience in the safe handling of radioactive materials, and in the characteristics of ionizing radiation, unites of radiation dose and quantities, radiation detection instrumentation, and biological hazards of exposure to radiation appropriate to the type and forms of byproduct material to be used.

In addition to the training and qualification of individuals applying for authorization to use radioactive material, the following criteria will be evaluated:

Facilities and Equipment:

- lab layout
- space limitations
- storage of radioactive material
- location and type of equipment

Operating and Handling Procedures:

- training of supervised individuals
- ordering and receipt of radioactive material
- monitoring of radioactivity
- procedures of handling radioactive spills
- waste disposal
- storage of radioactive material

Please see radioactive material use authorization application in the answer to question # 13.

9- We are not intended to deliberately release any licensed material into the environment.

10- In the future, we will not provide private information such as date of birth, home address, telephone number, or internet address or other personal information in support of a license action unless specifically requested to do so.

11- We confirm that personnel will be instructed before begining duties with, or in the vicinity of, licensed materials and will be reinstructed whenever there is a significant change in duties, regulations, or the terms of the license.

12- **Training Program for Individuals using Radioactive Material**

Responsible Investigators and Users under their supervision

Responsible Investigators are individuals who by virtue of experience and training (usually full-time Faculty and/or Research Staff) are permitted to use radioactive materials and supervise others in their laboratories. Responsible Investigators are responsible for providing to users working under their license: on the job training covering the specific procedures and attendant hazards associated with the work to be performed. Responsible Investigators have the responsibility to make arrangements for isotope users to attend the Radiation Protection Orientation provided by the Radiation Safety Office. The usual length of time for this program is 2 hours.

All Personnel will be instructed:

1. Before assuming duties with, or in the vicinity of, radioactive materials.
2. During refresher training that will be given annually.
3. Whenever there is a significant change in duties, regulations, or the terms of the license.

Instruction for individuals in attendance will include the following subjects:

1. Principles of Radiation Safety
   a. Minimizing Personal Exposure
   b. Radioisotope Handling Techniques and Properties with special emphasis of isotopes being used.
   c. Control of personal and area contamination
   d. Emergency Procedures
   e. Radioactive Material Storage
   f. Handling Radioactive Waste
   g. Labeling and Posting Requirements
   h. Receiving, monitoring incoming packages and transferring materials to other laboratories inside or outside the institution.
2. Radiation Detection Equipment
3. Risks from exposure to Ionizing Radiation
   Biological Effects of Radiation
4. Federal, State, New York City and University Radiation Safety Policies
   a. Requirements for licensure of Responsible Investigators by the University RSC
   b. Responsibilities of Responsible Investigators
   c. Responsibilities of isotope users
   d. Radiation Safety Committee
   e. Radiation Safety Office Activities
   f. Enforcement Policies of the University
5. The right of radiation workers to review their radiation exposure and where the radiation exposure are kept.

6. The responsibilities of Radiation Workers to report any unsafe condition to the Radiation Safety Officer.
7. Question and Answer Period
8. Exam

Individuals wishing to become Responsible Investigators must take additional training that is equivalent to 40 hours (either by lecture or in a take home course with problem solving sheets):

1. The Nature of Radionuclides and Radioactivity
   a. Atomic Structure
   b. Radioactive Decay and Emissions
   c. Radioactive Half Life
   d. Units of Measurement

2. Interactions of Ionizing Radiation with Matter
   a. Interactions of alpha and beta particles, gamma and x-rays with matter.
   b. Range of emissions vs. energy
   c. Units of exposure and dose
   d. External Radiation Hazards
   e. Internal Radiation Hazards
   g. Radiation Biology

3. Detection and Measurement of Radioactivity
   a. Types and operation of portable survey equipment
   b. Personal Radiation Monitoring devices
   c. Interpretations of reading and measurement
   d. Laboratory bench instruments

4. Mathematics pertaining to the use an d measurement of radioactivity

Under some circumstances prospective licensees may waive the instructional material on radiation physics and measurement. The Radiation Safety Office Committee may reserves the right to waive these topics if the applicant is certified as a radiation physicist, health physicist or if the applicant submits written documentation of similar training at another institution totaling 40 hours in the above listed subjects in a combination of didactic and experiential training.

Records will be kept of training sessions. The records will include the dates, instructors, trainees and outlines of the topics covered.

Physical Plant, Custodial Personnel, Security and other Ancillary Personnel

1. Personnel will be instructed before assuming duties with, or in the vicinity of, radioactive materials.
2. During Annual Refresher Training
3. The Training provided to staff will take approximately 45 minutes.

Instructions for Individuals in attendance will include the following subjects:

1. Applicable regulations.
2. Areas where radioactive material is used or stored.
3. Potential Hazards associated with radioactive material in each area where the employees may work.
4. Appropriate radiation safety procedures.
5. Radiation Safety Committees work Rules.
6. Individuals obligation to report unsafe conditions to the Radiation Safety Officer.
7. Appropriate response to emergencies or unsafe conditions.
8. Workers right to know about occupational radiation exposure and bioassay results.
9. Locations where the copies of the licenses or regulations are maintained for review.
10. Question and Answer Period.

13-

a) Attached: i) diagrams of facilities at the Lamont- Doherty Earth Observatory Spike Laboratory where radioactive materials will be used and stored.

ii) a typical drawing of the 20 foot container vessel on each ship designated for radioactive material work to be performed at sea.

iii) a diagram of Columbia ship showing two possible location for placing the 20 feet radioactive work vessel.

All radioactive materials being used do not require any special shielding. Unrestricted areas are adjacent to the container vessel and the spike laboratory building.

b) We confirm that the transportation of licensed materials will be in accordance with 10 CFR part 71 and Department of Transportation regulations.

c) Before the commencement of work with a source of radiation a Responsible Investigator(R.I.) must satisfy the Radiation Safety Committee that he/she is qualified to work with ionizing radiation. An application form (a copy attached) must be completed by the prospective R.I. The application is reviewed initially by the Radiation Safety Officer for completeness and adequacy. If necessary, the Radiation Safety Officer will visit the laboratory and interview the applicant. A copy of the application will be sent to each Radiation Safety Committee member. The status of the application will be decided at the next regulatory scheduled Radiation Safety Committee. Interim approval may be granted prospective R.I. by the Radiation Safety Officer in consultation with the Chairman of the Radiation Safety Committee.
After approval, a staff member of the Radiation Safety Office will visit the laboratory to insure initial compliance as of posting and radiation signs and other requirements.
Records of proposed users and users approved by the Radiation Safety Committee will be maintained in the Radiation Safety Office file under the name of the applicant. The authorization to use radioactive material is renewable every two years.
Each time an R.I. needs to purchase a radioactive material, an approval must be granted from the Radiation Safety Officer or his designee prior to purchasing. The radiation Safety Officer or his designee will check the material and the amount ordered against what the R.I. is authorized to use and the amount already in his/her possession.

d) The parent isotope neptunium-237 is in a liquid form. It is dissolved in nitric acid and contains approximately 100 uCi. The parent material is kept in storage for several month until a secular equilibrium is reached. Using protective clothing and disposable gloves, working in a fume hood on an absorbent pad, the neptunium-237 is passed over a silica gel in a column. The protactinium - 233 will be adsorbed on the silica gel. The parent isotope will be collected, the column will be washed with nitric acid to retrieve all the remaining neptunium for re- storing. The protactinium-233 will be separated from the silica gel by washing with low concentrated hydrofluoric acid.

All precautions will be exercised to limit any potential contamination. Items being contaminated will be disposed of as radioactive waste. Following the process an area and wipe survey will be conducted to insure that the area is contamination free. A copy of the results will be retained by the Radiation Safety Office.

e) Area and wipe tests are the responsibility of the Responsible Investigator (R.I.) that is authorized to use the radioactive material on the trip. The Responsible Investigator and his assistance's will receive commensurate training to perform area surveys and wipe tests, and the training of these individuals will be documented.

f) The NRC license number for RSA is 030-33025 with an expiration date: March 31, 2003.

g) The Spike laboratory is always kept locked when no authorized persons are working in the laboratory. The Radiation Safety Officer conduct an audit of the laboratory at least quarterly. During the quarterly auditing the inventory will be checked and matched with the inventory list in the Radiation Safety Office (see answer to question # 18).
At sea , the 20 feet vessel where radioactive material will be used will be kept locked unless an authorized person is working in the vessel. The keys for both spike laboratory and the vessel are the responsibility of Responsible Investigator performing the research.

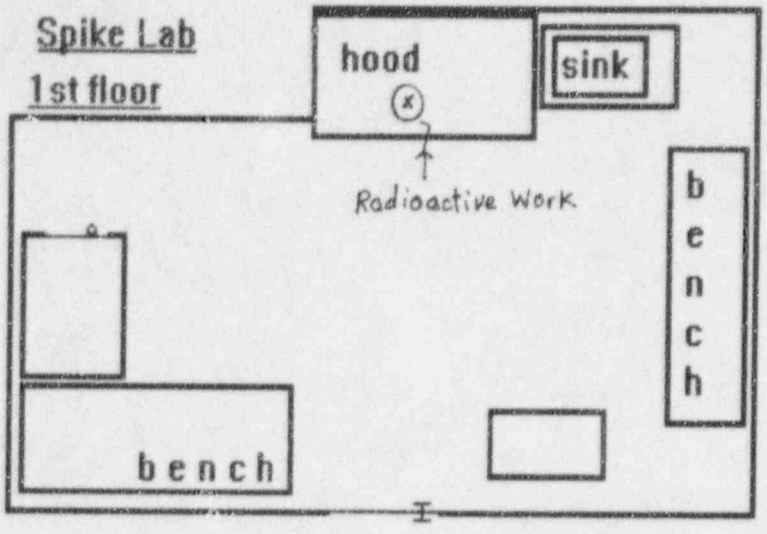
h) We confirm that we will draft and post a set of emergency procedures that will contain:

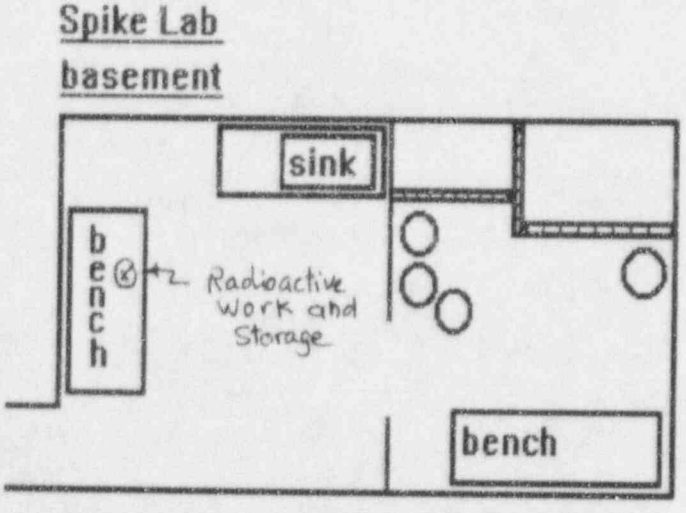
1- instruction to be followed during minor spills.

2- instructions to be followed during major spills, and

3- the radiation safety officer's name, office telephone number, and a telephone number to be used during off-hours.

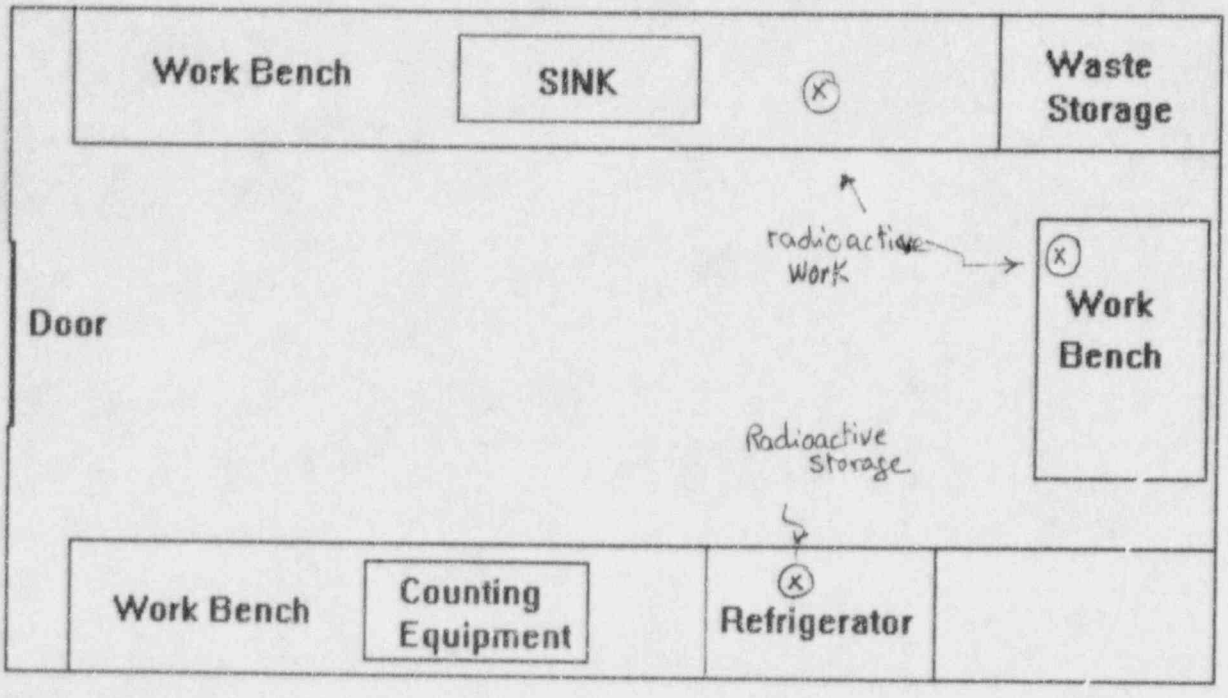
4- at sea, all emergencies will be reported and responded to the Responsible Investigator. A report concerning these emergencies will be written by the R.I. and a copy of the report will be forwarded to the Radiation Safety Officer at the conclusion of each trip.

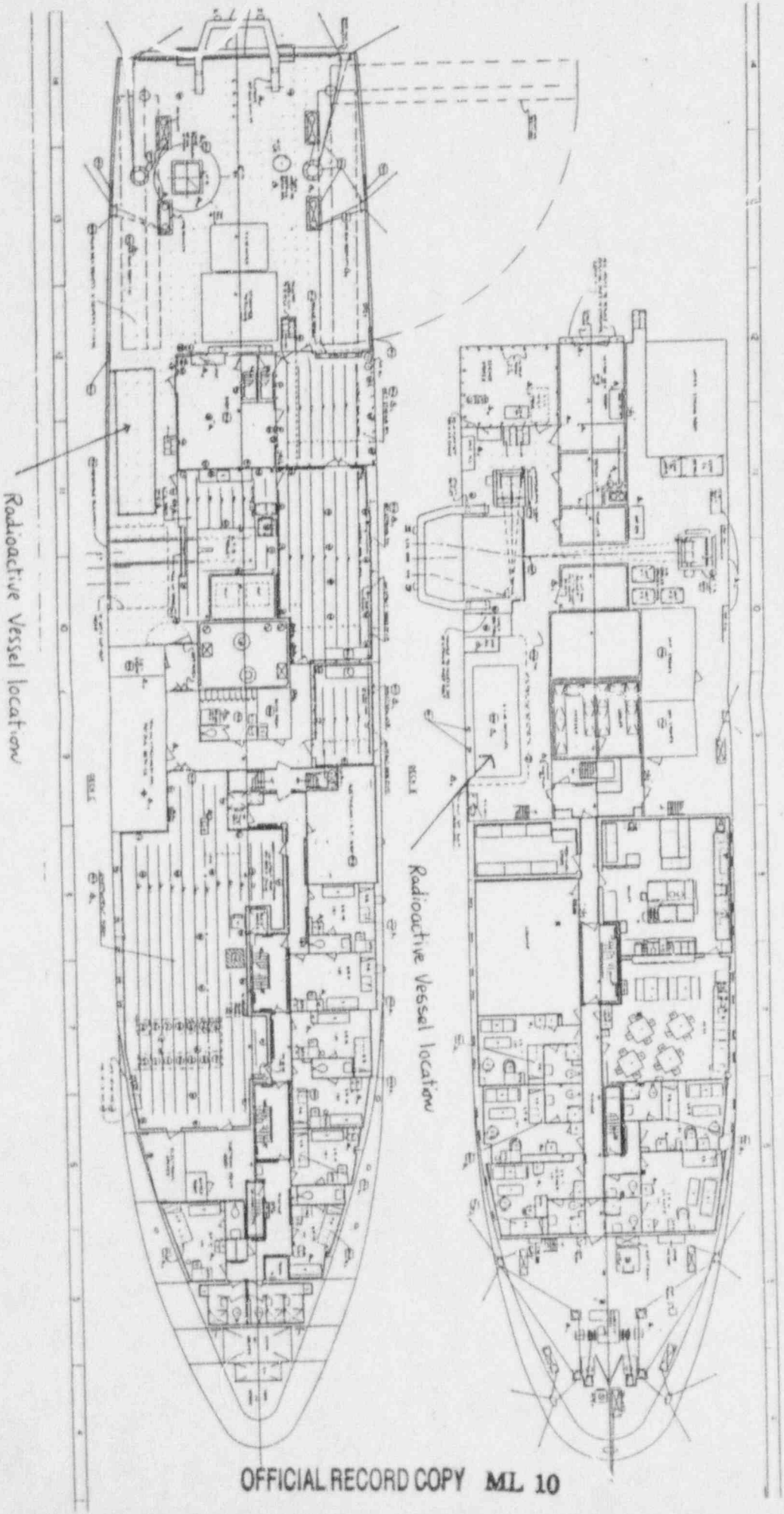

Spike Lab
1st floor
hood
sink
Radioactive Work
bench
bench


Spike Lab
basement
sink
bench
Radioactive Work and Storage
bench

124215

Typical layout of a 20 foot container vessel for radioactive material use





124215

Radiation Safety Office 854-4442

Columbia University
Environmental Health and Safety Department
Radiation Safety Office

Application for authorization to use Radioactive Materials

This application is for: _____ New License _____Amendment

Please type all information Date:_____

1. Name of Applicant: _____
2. Title of Applicant: _____
3. Department: _____
4. Location of Laboratory: _____
5. Extension: _____
6. Radionuclides for which permission is required (amount is the maximum possession limit).

Element	Chemical form	Amount of Activity (mCi)	Type of Radiation	Half life of Radionuclides

7. Describe purpose for which these by product materials are to be used. Be specific, such as amount of radioactive material to be used per experiment, and how many experiments are to be carried out per week or month.

8. List Radiation Detection instruments in your possession.

9. Specify method of personnel monitoring (film badges, dosimeters, etc.); Describe your Radiation Safety Program for your laboratory including control measure and protection of radioactive areas.

10. Facilities and equipment: Describe Laboratory Facilities e.g. remote handling equipment, storage containers, shielding, fume hoods, etc.

11. Waste disposal: Indicate the form of waste and how you propose to dispose of the waste. Estimate the maximum amount and type of activity to be dispose of per day or week.

12. Records: In accordance with article 175, section 114 of the Radiological Health Code of the City of New York, you will be required to supply records of the procurement, utilization and disposal of all radionuclides. The radiation safety office will be surveying your laboratory's working and storage area for any possible radioactive contamination. The survey and wipe test will be performed monthly.

13. Training: Describe your training in the use of radionuclides and your previous experience in the use of radioactive material(indicate amounts used, type of use, where and with whom experience was gained, giving name and address.

14. Attachment: Please attach
a - A resent curriculum vitae
b - a diagram of your laboratory indicating where radioactive materials will be used and stored

Please forward completed application to :

George Hamawy
Radiation Safety Officer
289 Engineering Terrace
Tel: (212) 854-4442

14- The Radiation Safety office keep a store of several calibrated and well maintained survey meters. In addition, the Radiation Safety Office has a Packard 1900 CA TRI-CARB liquid scintillation analyzer for measuring wipe survey samples and package wipe surveys.

At the Lamont-Doherty Laboratory two survey meters (Ludlum- Model 3) are available for area surveys and radiation level measurements of packages prior to transportation, and for assuring that radiation levels in unrestricted areas are in compliance with NRC regulations. In addition, there are both alpha spectrometer and a mass spectrometer for sample analysis.

At sea, if appropriate a survey meter will be available as well as a quantitative sample measuring device (alpha or mass spectrometer) .

15- We confirm that backup instruments will be available to replace instruments off- site for calibration.

16-

a- We confirm that we will modify our procedures to reduce the action level for beta or gamma emitters to 100 dpm/100 cm^2, and that we will decontaminate all contaminated areas to 100dpm/100 cm^2 for beta or gamma emitters and that we will decontaminate all areas contaminated with alpha emitters to 20 dpm/100 cm^2.

b- We confirm that area surveys and wipe tests will be conducted at the end of each experiment, and monthly, by the responsible investigator on all vessels.

c- We will not release any licensed material in liquid effluents to unrestricted areas such as streams, rivers, or sanity sewerage treatment facilities privately owned or operated by us (septic tanks, leach fields or other).

17-

We would like to confirm that our radiation protection program content and implementation will be reviewed at least annually. The review process will include the following criteria:

a) Senior management oversight of the radiation protection program. A senior manager is a member of the Radiation Safety Committee. An annual Radiation Safety program evaluation report will be sent to the senior management. All major changes in NRC regulations, the provisions of the license, and all NRC inspection results will be sent to the senior management for review and evaluation.

b) The Radiation Safety Officer and staff performance will be reviewed annually. The review will be conducted by qualified member(s) of the a Radiation Safety Committee or of an independent qualified person. The individual must be familiar with the NRC regulations and has educational and working knowledge of radiation and radioactive sources. All review results will be reported to the senior management.

c) The Radiation Safety Officer and Staff will conduct quarterly auditing each Responsible Investigator's activity. A typical auditing form is attached. The audit will include such topics as: reviews of users' inventory and survey records, evaluation of users' radiation safety procedures through observation and discussion, and performance of independent work area surveys.

COLUMBIA UNIVERSITY
RADIATION SAFETY OFFICE
289 ENGINEERING TERRACE
EXT. 44442

QUARTERLY LABORATORY INSPECTION

Responsible Investigator: _____ Building/Rm.: _____

Date: _____ Department: _____ Inspected by: _____

	Yes	No
General		
Signs / Posting		
Lab Coat / Badges		
Gloves used		
Shielding adequate		
Hands / clothing surveyed		
Food / drinks in Lab		
Waste Disposal	Yes	No
Disignated and Labeled		
well shielded		
waste overflowing		
use and disposal records		

Survey Meters

Model #: _____
Serial #: _____
Calibration Date: _____
Working Conditions: Yes _____ No _____

Fume Hood

Air flow checked Yes ___ No ___
Air Flow _____ LFM
Date Checked: _____

Radionuclides Used

_____
_____
_____

Radiation Safety Contamination Survey

_____
_____

Training adequate: Yes___ No___
Inventory: adequate Yes _____ No _____
Survey: adequate Yes _____ No _____

Survey Meters

Model #: _____
Serial #: _____
Calibration Date: _____
Working Conditions Yes___ No ___

Sink disposal records
Yes _____ No_____

Comments: _____
_____
_____
_____
_____

18-

For each Responsible Investigator a radioactive material received form is generated. all radioactive materials received will be logged in the form with information pertaining to the shipment received (see attached form). A radioactive material use form will accompany each shipment when delivered to the Responsible Investigator (see attached form) . The radioactive material use form will be returned after complete use of the material or the discarding of the vial in the radioactive waste. an entry in the above two form will indicate the day of disposal.

Every laboratory quarterly auditing that is conducted by the RSO, all radioactive materials inventory will be auditing and must agree with information retained by the radiation safety office.

Information pertaining to the receiving and the use of radioactive materials will be logged in our computer database. The aggregated amount of radioactive material inventory for each RI and for each isotope will be calculated each quarter. The radioactive material inventory must not exceed the authorized amount for each RI and the amount for each isotope must not exceed the amount specified in our license allowance. All data will be presented to the Radiation Safety Committee members in their quarterly meeting.

RADIOACTIVE MATERIAL RECEIVED

Responsible Investigator: ____________________

Department: ____________________

Location: ____________________ Ext: ____________________

Date	P.O. #	Vender	Activity	Isotope	Chemical Compound	Use/Disp Date	Signature

RADIATION SAFETY OFFICE

RECORD OF RADIOACTIVE MATERIALS

R.I.Name:_____ Vender:_____

Isotope:_____

Chemical Form:_____ LOT#:_____

Date Received	Amount Received (mCi)	Remainder (balance) (mCi)	Date Used	By (Initials)	Amount Used (mCi)	Date Disposed	Sink (mCi)	Waste (Dry, Liq., LSV) (mCi)

PLEASE RETURN A COPY OF THIS FORM AFTER COMPLETE USE OF THE MATERIAL OR DISCARDING OF THE VIAL.

(RECRMAT.DOC) RETAIN THE ORIGINAL FORM IN YOUR RADIOACTIVE FILE

19- As was mentioned in the previous question, all radioactive material packages will be received in the Radiation Safety Office in the Morningside Campus, Room 398 Engineering Terrace building. Package surveys and wipe surveys as well as all documentation are performed in this location. Packages and the radioactive material use form as well as an outgoing shipment of radioactive material form (see attachment) will be transported to the Lamont Laboratory using an authorized Columbia vehicle. In special occasions, with the approval of the RSO, the material will be shipped directly to the Lamont Laboratory . In these cases, a copy of all recite documents will be sent to the Radiation Safety Office, and package surveys will be conducted by the RI. and a copy of the results will be sent to the radiation safety office.

In case that the radioactive material will be shipped to the ship, the package and all required documentation will be shipped via Federal Express to the nearest port. The package will be picked up by the RI or his assistant.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

ENVIRONMENTAL AND OCCUPATIONAL HEALTH

OUTGOING SHIPMENT OF RADIOACTIVE MATERIAL

From:

☐ Columbia University
Radiation Safety Office
500 W. 120th. Street
398 Engineering Terrace
New York, N.Y. 10027

☐ Lamont Doherty Earth Observatory
Route 9W
Palisades, N.Y. 10964

☐ Nevis Laboratories
Route 9
Irvington, N.Y. 10533

Date: _____

To: _____

_____

_____

_____

_____

Principal Isotope: _____ Amount: _____

Physical Form: _____ Chemical: _____

RADIOACTIVE MATERIAL, EXCEPTED PACKAGE LIMITED QUANTITIES, NOS UN2910

This package conforms to the conditions and limitations specified in 49 CFR 173-421 for radioactive material, excepted package, limited quantity of material, UN2910.

Exported under United States Nuclear Regulatory Commission General License in Accordance with 10CFR 110.27(a).

_____

George Hamawy
Radiation Safety Officer

Surface Exposure Rate: _____

Removable Contamination: _____

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

20- We will maintain records of the following activities:

a) radiation safety training, including initial and retraining, list of topics covered, the amount of time spent, the date(s), and the instructor(s) and Student(s) names.

b) Receipt, inventory, transfer, and disposal of licensed material,

c) dosimetry, and personnel monitoring,

d) surveys of areas where licensed materials are used or stored,

e) training of authorized users and ancillary personnel,

f) Radiation Safety Committee meeting minutes, including review and approval of authorized users and uses of licensed material,

g) results of audits performed by the Radiation Safety Committee,

h) results of audits and surveys performed by the Radiation Safety Officer and staff, and,

I) calibration of radiation monitoring instruments and equipment.

21- Attached a copy of our Radiation Safety Laboratory Instructions.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Radiation Safety Laboratory Instructions

a) Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.

b) Wear disposable gloves at all times while handling radioactive materials.

c) Either after each procedure or before leaving the area, monitor your hands for contamination in low-background area.

d) Do not eat, drink, smoke or apply cosmetics in any area where radioactive material is stored or used.

e) Do not store food, drink or personal effects in areas where radioactive material is stored or used.

f) Wear required personnel monitoring devices at all times while in areas where radioactive materials are used or stored.

g) Dispose of radioactive waste only in designated, labeled and properly shielded receptacles.

h) Never pipette by mouth.

I) Confine radioactive solutions in clearly labeled containers.

j) Secure all radioactive material when not under the constant surveillance and immediate control of the authorized users and their staff.

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

22- If we use a thin end-window G-M counter to measure the contamination on the skin, assuming that the contamination was caused by an energetic beta emitter, and the count rate was found to be, for example, 30,000 counts / minutes when positioned over the contaminated area. If the window has a diameter of 2.54 centimeter, the cross -sectional area of the window is 5 cm^2. If we assume there is no attenuation in the window, then the number of beta particles incident on 1 cm^2 of the counter window per second is 30,000/(60 x 5) = 100.

Consider a thin layer of tissue, say 0.1 cm, and assume the tissue is equivalent to water, density = 1 g/cm^3. At an energy loss of 2 Mev/cm, a beta particle deposits 0.2 Mev in the layer.

A 100 beta particles/cm^2 will deposit 20 Mev in a volume 1 cm^2 x 0.1 cm = 1 cm^3, with a mass of 0.1g. The energy deposited per unit mass is 20/0.1 = 200 Mev/g.

$$\text{Dose rate} = \frac{\text{200 Mev/ g-sec}}{\text{62,400 Mev /g-mrad}} = \text{0.0032 mrad/sec ;}$$

0.0032 mrad / sec x 3600 sec/hr = 11.5 mrad / hr.

as a rough rule of thumb, we may use the relationship 100 beta particles/ cm^2- sec = 10 mrem/hr. This relationship holds only for high-energy beta particles. This dose rate increases appreciably at lower energies because the rate of energy loss increases. However , the beta particles undergo greater attenuation in the dead layer of the skin at lower energies and the net result is to bring the dose rate to the basal cells of the epidermis for the various energies to within about 30 percent of 10, for a nominal dead layer thickness of 0.007 cm.

1- The Radiation Safety Officer or a designee will authorize each order for radioactive materials and will ensure that the requested materials and quantities are authorized by the license for use by the requesting authorized user and that the possession limits are not exceeded. A copy of the order will be retained by the Radiation Safety Office.

2- For deliveries during normal working hours, the RSO will tell carriers to deliver radioactive packages directly to the Radiation Safety Laboratory, Room number 398 in the Engineering Terrace building.

3- For deliveries during off-duty hours, an unlikely event in our case, the RSO will tell security personnel or other designated persons to accept delivery of radioactive packages in accordance with procedures outlined in the sample memorandum below:

MEMORANDUM

Memo to: Chief of Security
From: Radiation Safety Officer
Subject: Receipt of Packages Containing Radioactive Material

The security guard on duty shall accept delivery of packages containing radioactive material that arrive during other than normal working hours, immediately contact one of the individuals identified below, whereas the package(s) will be placed on a cart and taken immediately to the Radiation Safety Laboratory, unlock the door, place the package on top of the counter in the laboratory and relock the door.

If the package papers to be damaged, immediately contact one of the individuals identified below, and ask the carrier to remain at the Security office until it can be determined that neither the driver nor the delivery vehicle is contaminated.

If you have any question concerning this memorandum, please call the Radiation Safety Officer,----------, at ---------- .

Radiation Safety Officer: ---------- , Home Phone ----------

Director of Environmental & Occupational Health :----------, Home Phone -----

Radiation Safety Supervisor : ----------, Home Phone ----------

4- All information regarding each package will be logged in special form assigned to each authorized user(sample form is attached). Information must be in agreement with material ordered.

5- After performing all package receipt requirements (see answer to next question),each authorized user will be contacted to pick up their package(s).

6- When the authorized user or his/her designate come to pick up the package(s), an ID will be checked and a signature will be obtained.

7- The Radiation Safety Laboratory , if not occupied by the safety personnel, will be locked at all time, to secure against unauthorized removal at all times.

8- All unrestricted areas surrounding the Radiation Safety Laboratory,in addition to the laboratory itself will be surveyed monthly to insure that all non radiation workers and individual members of the public are not exposed in excess of those specified in 10 CFR 20.1301(a) :

i) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 millisievert) in a year.

ii) The dose in any unrestricted area from external sources dose not exceed 0.002 rem(0.02 mSv) in any one hour.

iii) All other provisions in the 10 CFR 20.1301(a).

RADIOACTIVE MATERIAL RECEIVED

Responsible Investigator: ____________________

Department: ____________________

Location: ____________________ Ext: ________________

Date	P.O. #	Vender	Activity	Isotope	Chemical Compound	Use/Disp Date	Signature

i) Special requirements will be followed for packages containing quantities of radioactive material in excess of the A quantities specified in 49 CFR 173.435. They will be monitored for surface contamination and external radiation levels within 3 hours after receipt if received during workinghours or not later than 3 hours from the beginning of the next working day if it is received after normal working hours. The NRC will be notified in accordance with regulations if removable contamination exceeds .01 uCi/100 square centimeters (22,000 dpm) or if external radiation levels exceed 200 mR/hr at the package surface or 10 mR/hr at 3 feet (or 1 m).

ii) For all packages, the following procedures for opening packages will be carried out:

a- Put on gloves to prevent hand contamination.

b- Visually inspect packages for any sign of damage (i.e. wetness, crushed). If damage is noted, stop procedure and notify Radiation Safety Officer.

c- Measure exposure rate at 3 feet (or 1 m) from package surface and record. If it is higher than usual, stop and notify the Radiation Safety Officer.

d- All packages will be wipe tested by the Radiation Safety Office before delivering to authorized users and information will be logged in special form(see attachment).

e- We will maintain the following procedures for safely opening packages in which radioactive material is received:

1) Open the outer package (following manufacturer's directions, if supplied) and remove packing slip.

2) Open inner package and verify that contents agree with those on packing slip. Compare requisition, packing slip and label on container.

3) Check integrity of final source container (i.e., inspect for breakage of seals or vials, loss of liquid, or discoloration of packaging material) .

f) If there is any reason to suspect contamination, wipe external surface of final source container and remove wipe to low background area. Assay the wipe and record amount of removable radioactivity (i.e., dpm/100 square centimeters, etc.) . Check wipes with thin-end window GM survey meter, and take precautions against the spread of contamination as necessary.

g) Monitor the packing material and packages for contamination before discarding,

i) if contaminated, treat as radioactive waste.
ii) If not contaminated, obliterate radiation labels before discarding in regular trash.

h) Maintain records of the results of checking each package.

Columbia University
Environmental & Occupational Health
Radiation Safety Office

Survey of Incoming Shipments of Radioactive Materials

Shipping Information:

Date Received:_____ Name of Investigator:_____

Name of Vender:_____

P.O.#:_____

Isotope:_____

Amount (mCi):_____

Chemical Form:_____

Lot #:_____

Radiation Survey:

Date of Survey:_____

Properly Tagged? Yes_____ / No_____

mR/hr at surface of package:_____

Transport Index (TI):

(mR/hr at one meter from package):_____

Contamination Outside Package:_____ DPM/100cm^2

_____ _____

Signature Radiation Safety Officer

25- Instructions to determine which lable (Radioactive white I, Radioactive Yellow II, or Radioactive Yellow III) is correct to use, based on a package survey:

Warning Labels:

Each package of radioactive material, except those containing exempt quantities or LSA material shipped under exclusive-use provisions, must be labled on two opposite sides with one of three warning labels. These labels bear the unique trefoil symbol and alert persons handling the package that it may require special handling. The labels are called radioactive white-I , radioactive yellow-II ,and radioavtive yellow-III. Which lable is used depends on the dose-equivalent reading at the surface of the package and on the transport index for the package.

A) Radioactive white-I : The radioactive white-I label is used when the dose-equivalent rate at any point on the surface of the package is less than or equal to 0.5 mrem/hr.

B) Radioactive Yellow-II : The radioactive yellow-II label is used when the transport index will not exceed 1.0 during transport and the dose-equivalent rate at any point on the surface of the package is between 0.5 and 50 mrem/hr.

C) Radioactive Yellow-III : The radioactive yellow-III label is used when the dose-equivalent rate at the surface of the package is greater than 50 mrem/hr but less than or equal to 200 mrem/hr. The transport index may be greater than 1.0 but must be less than or equal to 10.0.

26- The disposal of the radioactive waste at the conclusion of each trip is carried out by the ship operator. The ship operator being a university or government agency, will have its licenses, Radiation Safety Officer, and Radiation Safety Committee . A copy of the radioactive waste disposal manifest and report will be sent to our radiation safety office.

27- At the conclusion of each trip, the responsible investigator will perform a thorough area and wipe survey of the radioactive work vessel as well as all the equipment, if any contamination is observed, the area will be decontaminated to within the limits of the table attached. A report of the survey will be forwarded to the Radiation Safety Officer.
since the radioactive work vessel is continuously used for radioactive work, the vessel will also be checked in the beginning of the trip, before starting working with any radioactive material.

28- Currently, all work with radioactive material is being performed at sea, south and south east of New Zealand. future research projects might include other areas of the sea. We confirm that we will abide by all international regulations and we confirm that no license material will be left at an Antarctica site.

TABLE 1

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[b,c,f]	MAXIMUM[b,d,f]	REMOVABLE[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

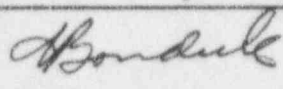
[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

TELEPHONE CONVERSATON RECORD	Date: 3/13/397	Time: 9:15 am
Mail Control No.: 124215	**License No.:** New	**Docket No.:** 030-34376
Person Called: George Hamawy, RSO	**Organization:** Columbia University	**Telephone Number:** 212-854-8749
Person Calling: J.Bondick	**Organization:** NRC	**Telephone Number:** 6951
Subject: March 10, 1997 letter requesting a 30 day extension to respond to the deficiency letter.		
Summary: Mr. Hamawy on vacation until 3/18/87; spoke to Loretta Greenholtz (cc: on their 3/10 letter); she will notify Dr. David Brenner that the 30 day extension was granted, and that their response is due by April 10, 1997.		
Action Required/Taken: MS 15; expect response by April 10, 1997		
Signature: J. Bondick 	**Date:**3/13/97	

ML 10

OFFICIAL RECORD COPY

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

March 10, 1997

James M. Bondick
Health Physicist
Division of Nuclear Materials Safety
Region 1 Office
475 Allendale Road
Kings Of Prussia, Pennsylvania 19406-1415

Docket No. 030-34376
Control No. 124215

Dear Mr. Bondick:

Thank you for your letter of February 19, 1997 regarding our Nuclear Regulatory Commission License application. We are in the process of addressing all the issues that you have raised, however, we would like to request an additional 30 days for our reply so that we can collect all the information that you have requested.
Thank you for your assistance in this important matter.

Sincerely,

George Hamawy

George Hamawy
Radiation Safety Officer

cc: Dr. D. Brenner
L. Greenholtz
J. Lewis

OFFICIAL RECORD COPY ML 10

124215

MAR 12 1997

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

FEB 19 1997

Docket No. 030-34376
Control No. 124215

Mr. James P. Lewis
Director of Projects/Grants
Columbia University
Environmental & Occupational Health
500 West 120th Street/398 Engineering Terrace
New York, NY 10027

Dear Mr. Lewis:

This is in reference to your application dated January 17, 1997 requesting a Nuclear Regulatory Commission License. In order to continue our review, we need the following additional information:

1. With your application, you submitted the curriculum vitae for George Hamawy, Robert Anderson, John Marra, and Raymond Nicholas Sambrotto. However, the curriculum vitae for these individuals did not contain all the required information. The resumes should include the type (on-the-job or formal course work), location, and duration of the training. Training should cover (a) principles and practices of radiation protection, (b) radioactivity measurements, standardization, and monitoring techniques and instruments, (c) mathematics and calculations basic to the use and measurement of radioactivity, and (d) biological effects of radiation. The description of the use of licensed materials should include the specific isotopes handled, the maximum quantities of materials handled, where the experience was gained, the duration of experience, and the type of use.

2. Item 6 of your application states that the radioactive materials will be used for research and development. Provide additional details in regard to the type of research to be conducted with each of the radionuclides requested in your application. Include the typical quantities of radionuclide to be used in each experiment, the safety precautions to be used, and the disposition of the radionuclides used.

3. Provide a copy of senior management's written statement of delegation of authority to the Radiation Safety Officer. This statement should include the requisite authority to communicate with and direct your personnel regarding NRC regulations and license provisions and to enforce these requirements including the ability to terminate any unsafe operation involving the use of licensed material.

OFFICIAL RECORD COPY ML 10

4. Submit a description of the duties and responsibilities of your Radiation Safety Officer. The typical duties of a Radiation Safety Officer would be:

   a. To assess radiological hazards and prescribe, and ensure the implementation of, appropriate radiation safety precautions.

   b. To ensure that the use of licensed material is by or under the direct supervision of individuals specifically listed on your license.

   c. To ensure that all users (where appropriate) wear personnel monitoring equipment when using licensed materials.

   d. To ensure that licensed materials are properly secured against unauthorized removal at all times when not in use.

   e. To perform routine inspections of all laboratories using or storing licensed materials.

   f. To ensure that the terms and conditions of your license are met, and that all required records are maintained.

5. Submit a specific and detailed description of the duties and responsibilities of the Radiation Safety Committee and the administrative procedures by which these functions are carried out. Regulatory Guide 10.5, Second Proposed Revision 2 (DG-0005), Appendix C may be helpful to you in developing your response.

6. Confirm that the Radiation Safety Committee will meet at least once each calendar quarter. Specify the minimum representation which will be required at each meeting, and the quorum requirements for voting, and confirm that you will maintain a list of all individuals and departments represented on the Radiation Safety Committee for inspection by the NRC so that the total number of representatives and a quorum can be determined at the time of NRC inspections.

7. Identify the Radiation Safety Committee Chairperson. Provide documentation on their training and experience involving licensed materials and identify their position in your organization. Do **NOT** submit a curriculum vitae for each member.

8. Describe the criteria your Radiation Safety Officer (RSO) will use to approve authorized users and uses for activities utilizing licensed material. These criteria should specify the minimum acceptable standards for training and experience of the users, facilities and equipment, the operating or handling procedures, and the survey frequency requirements. Your application must provide sufficient detail to assure that the RSO evaluations are sufficient in scope and depth to satisfy 10 CFR 33.14(b)(2). The review and approval must be documented by the RSO prior to use of licensed material. Appendix K of Regulatory Guide 10.5, Second Proposed Revision 2 (DG-0005) provides model criteria for approving research authorizations and may be helpful in preparing your response. In addition, you may wish to correlate the survey frequency for research laboratories to the hazard using a scheme such as that found in Appendix J of the same Regulatory Guide.

9. In your application you did not specify whether you intend to deliberately release licensed material into the environment. If you wish to deliberately release licensed material into the environment for the purpose of field studies, submit the information required for field use of licensed materials contained in Regulatory Guide 10.5, Second Proposed Revision 2 (DG-0005), Appendix E. Although 10 CFR 51.22(c)(14)(v) identifies certain categorical exclusions from environmental assessment, this exclusion may not encompass the performance of field studies in which licensed material is deliberately released directly into the environment for study purposes, such as insect or animal tagging where the animal remains in the wild.

10. The curriculum vitae and list of Radiation Safety Committee members submitted with your application contain private information about these individuals. Since any information contained in documents provided for byproduct material licenses is subject to release under the Freedom Of Information Act, in the future, do not provide private information such a date of birth, home address, telephone number, or internet address or other personal information in support of a licensing action unless specifically requested to do so.

11. Item 8 of your application states: "All individuals that will be working with radioactive materials will receive Radiation Safety Training as outlined in the attached Session Outline." "A refresher training session will be offered annually." Please confirm that personnel will be instructed before beginning duties with, or in the vicinity of, licensed materials and will be reinstructed whenever there is a significant change in duties, regulations, or the terms of the license.

12. While you provide some information on training, we need you to more adequately describe your program for training and refresher training for all persons who handle licensed material or who frequent areas where licensed material is used. This training program must include a review of emergency procedures and response criteria and include sections that are tailored to types of radiation and ancillary workers such as authorized users, laboratory supervisors and technicians; purchasing department personnel receiving licensed material; housekeeping, security and other ancillary personnel; and the radiation safety office staff. Confirm that you will maintain records of initial and refresher training, date, the instructor(s), and student(s) names. Policy and Guidance Directive FC 85-7, Revision I, Appendix I model training program may be of some help in formulating your response. Confirm that annual training will be provided for ancillary personnel.

13. The following questions are in regard to Item 9 in your application. This section states: 1) all radioactive materials will originate from Lamont-Doherty Earth Observatory at 9W Palisades, N.Y., 2) the material will be transported to Lamont-Doherty Earth Observatory, where it will be transported to Research Vessels, 3) some radioactive material will be purchased from local vendors, 4) protactinium-237 will be extracted from a generator containing the parent nuclide, neptunium-237, that is stored in the Lamont-Doherty Earth Observatory in the Spike Laboratory, 5) each research ship will have a 20 feet container vessel for all radioactive material work for counting equipment, radiation monitors, 6) radiation monitors to conduct area surveys and to detect any contamination will be the responsibility of the ship operator, and 7) in the case of a Columbia ship, radiation monitors will be calibrated annually, and after any repair using a certified vendor such as RSA, Inc.

    a. Provide specific diagrams of facilities at the Lamont-Doherty Earth Observatory Spike Laboratory where radioactive materials will be used and stored, and a typical drawing of the 20 foot container vessel on each ship designed for radioactive material work to be performed. In these drawings at the Lamont-Doherty Earth Observatory and the 20 foot container vessels, indicate where licensed material will be stored, including placement and thickness of shielding and proximity of the storage area to unrestricted areas.

    b. Please confirm that the transportation of licensed materials will be in accordance with 10 CFR Part 71 (enclosed) and Department of Transportation regulations.

    c. Describe your procedures to ensure that all procurement of licensed material and all use of licensed material are properly authorized by the license and approved by your Radiation Safety Committee.

d. Describe the elution process used to extract the protactinium-237, and include the radiological precautions to be observed in the elution, handling, packaging and transporting of the eluant.

e. You appear to combine the concept of radiation monitors (instruments) with the tasks of performing area surveys and wipe tests for contamination in your statement: " Radiation monitors to conduct area survey and to detect any contamination will be the responsibility of the ship operator." Please specify whose responsibility it is to perform area surveys and wipe tests, confirm that these individuals will receive commensurate training to perform area surveys and wipe tests, and confirm that the training for these individuals will be documented.

f. Provide the NRC or Agreement state license number for RSA, Inc., which is the company you named that will perform calibrations of your radiological monitoring and counting equipment.

g. 10 CFR 20.1801 requires that licensed material be secured against unauthorized removal from the place of storage. 10 CFR 20.1802 requires that the licensee control and maintain constant surveillance over materials in unrestricted areas that are not in storage. In your application, you did not indicate how you will secure licensed material. Describe how you will preclude the unauthorized removal of licensed material from the place of storage and in unrestricted areas at the Lamont-Doherty laboratory or on the research vessels.

h. In your application, no mention was made of establishing and posting emergency procedures. Regulatory Guide 10.7 recommends that licensees establish emergency procedures that address immediate actions to be taken and persons to be contacted (including appropriate phone numbers). Please confirm that you will draft and post a set of emergency procedures. It is recommended that such procedures contain:

1. instructions to be followed during minor spills,

2. instructions to be followed during major spills, and

3. your radiation safety officer's name, office telephone number, and a telephone number to be used during off-hours.

4. How will emergencies be addressed for a vessel at sea?

14. Describe the types and numbers of survey and monitoring instruments available to the radiation safety staff at the Doherty-Earth Observatory, and on each vessel where licensed material will be used or stored. Instruments should be appropriate for the types and quantities of materials requested on your license application, and you should have instruments for both quantitative as well as qualitative measurements. You must have at least one portable radiation monitoring instrument that is capable of making quantitative measurements required for such activities as: radiation level measurements of packages prior to transportation; package receipt surveys; incidents; and assuring that radiation levels in unrestricted areas are in compliance with NRC regulations.

15. Please confirm that backup instruments will be available to replace instruments off-site for calibration.

16. Item 10 of your application states: "Area surveys and wipe tests will be the responsibility of the ship operator (normally a university or research institution). In the case of a Columbia ship, an area and wipe survey will be conducted monthly," and states: "Areas greater than 100 dpm/100 square centimeter of beta or gamma or greater an 20 dpm/100 square centimeter of alpha will be decontaminated or posted as a contaminated area."

    a. Your action level for beta or gamma emitters of 1000 dpm/100 cm^2 is too high. Please confirm that you will modify your procedures reduce the action level for beta or gamma emitters to 100 dpm/100 cm^2, and that you will decontaminate all contaminated areas to 100 dpm/100 cm^2 for beta or gamma emitters and that you will decontaminate all areas contaminated with alpha emitters to 20 dpm/100 cm^2.

    b. Confirm that area surveys and wipe tests will be conducted at the end of each experiment, and monthly, by the responsible investigator on all vessels, not only on a Columbia ship.

    c. Describe your procedures for complying with 10 CFR 20.1302 for releases of licensed material in liquid effluents to unrestricted areas such as streams, rivers, or sanitary sewerage treatment facilities privately owned or operated by the licensee (septic tanks, leach fields or other). Include a description of the types of surveys to be performed, the frequency of surveys, the individuals responsible for performing surveys, the equipment to be used, and the procedures for evaluating results.

17. 10 CFR 20.1101(c) requires that the licensee review the radiation protection program content and implementation at least annually. Submit a description of your program for performing the required annual review. It should include the following criteria:

    a. Senior management oversight of the radiation protection program. Specify the mechanisms that will be used by senior management to ensure that they are aware of NRC regulations, the provisions of the license, and the compliance status of the institution's licensed program.

    b. Review of the Radiation Safety Officer and staff performance. Specify the minimum qualifications for an individual who will perform this review, and confirm that the results will be reported to senior management.

    c. Audits by the Radiation Safety Officer and staff to determine user compliance with the requirements of the NRC license and your radiation protection program. Audits should include such topics as: reviews of users' inventory and survey records, evaluation of users' radiation safety procedures through observation and discussion, and performance of independent work area surveys.

18. Describe your licensed material inventory, control and accountability program. Your inventory and control system should have the capability to assure that licensed material possession limits are not exceeded and that material is accountable throughout the institution and on all research vessels at any given time.

19. Submit your procedures for transfer and transportation of licensed material between authorized users at your facility, and your procedures for transfer and transportation of licensed material to the research vessels. Describe your program to control such transfers, including update of material inventory and audits of users' procedures.

20. Confirm that you will maintain records of the following activities:

    a. radiation safety training, including initial and retraining, list of topics covered, the amount of time spent, the date(s), and the instructor(s) and student(s) names.

    b. Receipt, inventory, transfer, and disposal of licensed material,

    c. dosimetry, and personnel monitoring,

    d. surveys of areas where licensed materials are used or stored,

    e. training of authorized users and ancillary personnel,

f. Radiation Safety Committee meeting minutes, including review and approval of authorized users and uses of licensed material,

g. results of audits performed by the Radiation Safety Committee,

h. results of audits and surveys performed by the Radiation Safety Officer and staff, and,

i. calibration of radiation monitoring instruments and equipment.

21. Please provide a copy of your laboratory instructions. Typical instructions should include:

a. Wear laboratory coats or other protective clothing at all times in areas where licensed materials are used.

b. Wear disposable gloves at all times while handling licensed materials.

c. Either after each procedure or before leaving the area, monitor your hands for contamination in low-background area.

d. Do not eat, drink, smoke or apply cosmetics in any area where licensed material is stored or used.

e. Do not store food, drink or personal effects in areas where licensed material is stored or used.

f. Wear required personnel monitoring devices at all times while in areas where licensed materials are used or stored.

g. Dispose of radioactive waste only in designated, labeled and properly shielded receptacles.

h. Never pipette by mouth.

i. Confine radioactive solutions in clearly labeled containers.

j. Secure all licensed material when not under the constant surveillance and immediate control of the authorized users.

22. 10 CFR 20.1201 requires, in part, that skin dose be limited to 50 rems per year. 10 CFR 20.2203(b) requires, in part, that each report filed in response to a reportable event include an estimate of each individual's dose. The NRC has observed that programs of your scope have experienced skin contamination incidents. Describe your procedures for assessing dose from skin contamination with licensed material.

23. Describe your procedures for ordering licensed materials, for delivery of materials during off-duty hours, and for notification of responsible persons upon receipt of licensed materials. These procedures should be adequate to ensure that possession limits are not exceeded, that licensed materials are secured against unauthorized removal at all times, and that radiation levels in unrestricted areas will not result in doses to individual members of the public in excess of those specified in 10 CFR 20.1301(a).

24. Describe your procedures for receiving and opening packages in accordance with requirements of 10 CFR 20.1906. 10 CFR 20.1906(a)(b) and (c) address package receipt requirements and state, in part, that each licensee shall monitor the surfaces of a labeled package for radioactive contamination within 3 hours of receipt if it is received during normal working hours or not later than 3 hours from the beginning of the next working day if it is received after normal working hours. 10 CFR 20.1906(e) addresses package opening requirements and states, in part, that each licensee shall establish and maintain written procedures for safely opening packages in which licensed material is received. Appendix L of the enclosed regulatory guide may be helpful in preparing your response and provides a program for opening packages that is acceptable to the NRC.

25. Your operating procedures should include instructions addressing the labeling of packages for shipment that contain licensed materials. It is not acceptable to merely reference DOT regulations. Please submit instructions that will be incorporated into your operating procedures on how to determine which label (Radioactive White I, Radioactive Yellow II, or Radioactive Yellow III) is correct to use, based on a package survey.

26. Item 11 of your application states: "The ultimate disposal of the radioactive waste at the conclusion of the trip is the responsibility of the ship operator. If it was a Columbia ship, arrangements for the disposal of the waste at the terminal port will be made with local licensed commercial broker." How will you control the disposition of radioactive waste from a non-Columbia ship? As a licensee you must control the possession, use and disposition of all material authorized under your license. Please describe in detail the method you will use to ensure the proper disposition of all licensed material from a vessel other than a "Columbia ship."

27. Describe the surveys you will require and the criteria you will use for release of facilities and equipment on vessels for unrestricted use. Confirm that facilities and equipment will not be released until the results of surveys are reviewed and approved by the Radiation Safety Officer. A copy of the NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" is enclosed for your information.

28. Specify the location in Antarctica where licensed material will be used, and confirm that you will abide by all international regulations and confirm that no licensed material will be left at the Antarctica site.

We will continue our review upon receipt of this information. Please reply in duplicate to my attention at the Region I Office and refer to Mail Control No. 124215. If you have any technical questions regarding this deficiency letter, please call me at (610) 337-6951.

If we do not receive a reply from you within 30 calendar days from the date of this letter, we shall assume that you do not wish to pursue your application.

Sincerely,

Original Signed By:

James M. Bondick
Health Physicist
Division of Nuclear Materials Safety

Docket No. 030-34376
Control No. 124215

Enclosures:
1. 10 CFR Parts 2, 19, 20, 30, 33, 71 and 170
2. Regulatory Guides 10.5, and 10.7
3. Policy and Guidance Directive FC 85-7, Revision 1
4. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material

DOCUMENT NAME: R:\WPS\DLTR\D3128713.01
To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	N	DNMS/RI					
NAME	JBondick/jmb							
DATE	02/19/97		02/ /97		02/ /97		02/ /97	

OFFICIAL RECORD COPY **ML 10**

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

January 17, 1997

L 28713
030-34376
03620

Licensing Assistant Section
Nuclear Material Safety Branch
U.S. Nuclear Regulatory Commission, Region I
475 Alendale Road
King of Prussia, PA 19405-1415

Subject: New License Application

Dear Sir/Madam:

Enclosed please find a license application to use radioactive material as presented in our application. If you need any more information or clarification, please contact me either in writing or by telephone: (212) 854-4442.
Thank you for your assistance in this important matter.

Sincerely,

George Hamawy

George Hamawy
Radiation Safety Officer

cc: Dr. D. Brenner
L. Greenholtz
J. Lewis

124215

OFFICIAL RECORD COPY ML 10

FEB 24 1997

FEB - 5 1997

FAX REC'D

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 FAX 212-316-4557

NRC FORM 313 (7-98)
10 CFR 30, 32, 33, 34, 35, 36, 39 and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 7/31/99

Estimated burden per response to comply with this information collection request: 7 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Forward comments regarding burden estimate to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0120), Office of Management and Budget, Washington, DC 20503. NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION II
101 MARIETTA STREET, NW, SUITE 2900
ATLANTA, GA 30323-0199

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
801 WARRENVILLE RD.
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

L 28713
030-34376
03620

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
   - [X] A. NEW LICENSE
   - [ ] B. AMENDMENT TO LICENSE NUMBER _____
   - [ ] C. RENEWAL OF LICENSE NUMBER _____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip code)*
   Columbia University
   Environmental & Occupational Health
   500 West 120th Street/398 Engineering Terr.
   New York, NY 10027

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED
   (SEE ATTACHMENT)

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION
   George Hamawy

   TELEPHONE NUMBER
   (212) 854-4442

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
   a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 1, 31)*
    FEE CATEGORY Exempt
    AMOUNT ENCLOSED $ 0.00

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
James P. Lewis, Director of Projects/Grants	James P Lewis	1/17/97

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		124215
APPROVED BY			DATE		FEB 24 1997

OFFICIAL RECORD COPY

ML 10

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

1) **License Information:**

New License

2) **Name and Mailing Address of Applicant:**

Columbia University
500 West 120 street
398 Engineering Terrace
New York, N.Y. 10024

3) **Location of Use:**

Radioactive materials to be used in international waters or on or near Antarctica on board of ships that is being operated by independent organizations, such as The National Science Foundation or The Office of Naval Research. The material might also be used on a vessel belonging To Columbia University.

4) **Person to Be Contacted About Application:**

George Hamawy
Radiation Safety Officer
Tell:(212) 854-4442

5) **Radioactive Material:**

Element and Mass Number	Chemical or physical Form	Maximum Amount
Carbon -14	any	100 mCi
Hydrogen -3	any	10 mCi
Protactinium -233	any	1 uCi
Thorium -229	any	0.001 uCi

6) **Purpose for Which Licensed Material Will Be Used:**

The radioactive materials listed in item 5 will be used for research and development.

7) **Individuals Responsible for Radiation Safety Program and Their Training and Experience:**

Individuals responsible for Radiation Safety Program and their training and experience:

George Hamawy , Radiation Safety Officer (see attached C.V.)

Radiation Safety Committee Members (see attached list of members)

Principal Investigators:

Dr. Robert Anderson (see attached C.V.)

Dr. John Marra (see attached C.V.)

Dr. Raymond Nicholas Sambrotto (see attached C.V.)

Every Responsible investigator must submits to the Radiation Safety Officer an application for authorization to use radioactive materials (a copy of the application is attached). The application will be evaluated by the RSO and a copy of the modified application will be sent to each Radiation Safety Committee members. The status of the application will be decided in the next Radiation Safety Committee meeting.

8) **Training for Individuals Working in or Frequenting Restricted Areas:**

All individuals that will be working with radioactive materials will receive Radiation Safety Training as outlined in the attached Session Outline. A refresher training session will be offered annually(see attached outlines).

9) **Facilities and Equipment**:

All radioactive materials will originate from Lamont- Doherty Earth Observatory at route 9W , Palisades, N.Y. Radioactive material will be purchased after the Radiation Safety Office approval, and will be received by the Radiation Safety office in room 398 E.T. for inspection, surveying and record keeping. The material will be transported to Lamont-Doherty Earth Observatory where it will be transported to the Research Vessels. In some

isolated cases the local regulations will require purchasing radioactive materials from a local vender; all records in these cases will be send to the radiation safety office.
The Protactinium will be extracted from a generator containing the parent nuclide (neptunium -237) that is stored in Lamont - Dorhetery Earth Observatory in the Spike Laboratory.

Each research ship will have a 20 feet container vessel for all radioactive material work. Radiation Counting equipment and radiation monitors will be located in this vessel. No radioactive material will be allowed inside the shell of ships.
Radiation monitors to conduct area survey and to detect any contamination will be the responsibility of the ship operator. In case of a Columbia ship, radiation monitors will be calibrated annually, and after any repair, using a certified calibration vender (RSA, Inc. or any other certified vendor).

10) **Radiation Safety Program:**

Personnel monitoring will be in the form of film badges provided by the R.S. Landauer&Co. These will be changed monthly or at the conclusion of a trip (trips vary from 1 week to 6 weeks).

Area surveys and wipe tests will be the responsibilities of the ship operator (normally a university or research institution). In the case of Columbia ship an area and a wipe survey will be conducted monthly. The test will be conducted by the responsible investigator or his/her staff on the ship. A copy of the results will be sent to the Radiation Safety Office upon the completion of the trip.
Areas greater than 1000 dpm/100 square centimeter of beta or gamma or greater than 20 dpm/100 square centimeter of alpha , will be decontaminated or posted as contaminated areas.

11) **Waste Management**:

All radioactive waste will be collected in double package plastic container and will be kept in a designated and labeled area within the 20 feet radiation designated vessel. The ultimate disposal of this radioactive waste at the conclusion of the trip is the responsibility of the ship operator. If it was a Columbia ship, arrangements for the disposal of the waste at the terminal port will be made with a local licensed commercial broker. All copies of the disposal records will be sent to the Radiation Safety Office.

12) **Licensee Fees:**

Columbia University is an educational institution and is exempt of license fees.

Curriculum Vitae
George Hamawy

Date: August 1996

Office address
Columbia University
500 West 120th. Street
398 Engineering Terrace
New York, N.Y. 10027
Tel: (212) 854-4442

Home address
[redacted]

Date of Birth: 29 April 1946
Place of Birth: Alexandria, Egypt
Nationality: U.S.A

Education:

1962 - 1967	Alexandria University, Alexandria Egypt B.Sc in Nuclear Engineering
1972 - 1974	Hunter College, New York City MS. in Environmental Health Science Dean's outstanding achivement award
1979 - 1981	New York University (NYU), New York City MS. in Applied Science
1981 - 1983	Brooklyn Polytechnic, Brooklyn, N.Y. Graduate courses in Environmental Engineering

Certification: American Board of Scientists in Nuclear Medicine - 1984

Certified in : Radiochemistry and Nuclear Pharmacy.

Professional History:

1995 - Present — Radiation Safety Officer
Columbia University
New York, New York
Managed the Radiation Safety Program at:
- Morningside Campus
- Nevis Labs
- Lamont Dorherty Earth Observatory

1992 - 1995 — Radiation Safety Officer
Albert Einstein College of Medicine
Bronx, N.Y.
Managed the Radiation Safety Program at:
- Albert Einstine Medical College
- Jacobi Hospital

1992 - 1992 — Radiation Safety Officer
Self-Powered Lighting Company
Elmsford, New York
Managed the Radiation Safety Program
at SPL Company.

1970 - 1991 — Associate Chief
Memorial Sloan - Kettering Cancer Center
New York City
Managed the Nuclear Pharmacy
and the Central Isotope Laboratory.

1967 - 1968 — Nuclear Engineer
Egyptian Atomic Energy Commission
Cairo, Egypt
Research engineer in Nuclear Chemistry

Memberships:

Heatlh Physics Society
Society of Nuclear Medicine

Selected Publications:

Hamawy, G (1995) - Freeze-Drying as a potential mean for waste handling of animal carcasses containing radioactive material. Health phys. 69:115-116

Hamawy, G., Passler, C. (1995) - The Decay - in - storage room at the Einstein College of Medicine. Radwaste March:14:17.

RADIATION SAFETY COMMITTEE MEMBERS

David Brenner, Ph.D
Prof. Radiation Oncology
Chairman of the Radiation Safety Committee
P&S 11-23
Office: (212) 305-9930
Fax: (212) 305-3229
Home: [redacted]

James P. Lewis
Director of Projects and Grants
351 Engineering Terrace
Office : (212) 854-6851
Fax: (212) 678-2628
[redacted]

Carl Gryte, Ph.D
Chemical Engineering
376 Engineering Terrace
Office: (212) 854-2470/4453
Fax: (201) 692-9847
[redacted]

George Hamawy
Radiation Safety Officer
289 Engineering Terrace
Office: (212) 854-4442
Fax: (212) 316-4937
[redacted]

James Molher
Barnard College
1306 Altschul
Office: (212) 854-4381
Fax: (212) 854-7491
[redacted]

Richard Carlson, MD.
Director of University Health Services / John Jay Hall
Office: (212) 854-2281
Fax: (212) 854-8949
[redacted]

Loretta Greenholtz
Director of Environmental Health and Safety
744 Mudd
Office: (212) 854-8749
Fax: (212) 316-4937
lg20@columbia.edu

Steve Marino
Nevis / RARAF
Irvington, N.Y.
Office: (914) 591-9244
Fax: (914) 591-9405
[redacted]

Daniel Kalderon, Ph.D.
Biological Science Department
1013 Fairchild Building
Office : (212) 854-6469
dak1@columbia.edu

Robert Anderson
Lamont-Doherty Earth Observatory
Palisades, N.Y.
Office: (914) 365-8508
Fax: (914) 365-8155
[redacted]

ROBERT F. ANDERSON

PERSONAL HISTORY

Date of Birth
Place of Birth
Social Security No. [redacted]

EDUCATION

1975 — B.S. Chemistry/ Oceanography
University of Washington, Seattle, Washington
Summa Cum Laude

1981 — Ph.D., Massachusetts Institute of Technology/ Woods Hole Oceanographic Institution Joint Program in Oceanography

EMPLOYMENT

Adjunct Professor, 1/95-Present, Columbia University
Senior Research Scientist, 7/89-Present, Lamont-Doherty Earth Observatory
Research Scientist, 7/86-6/89, Lamont-Doherty Geological Observatory
Assoc. Res. Scientist, 7/83-6/86, Lamont-Doherty Geological Observatory
Research Associate, 6/81-6/83, Lamont-Doherty Geological Observatory
Post Doctoral Investigator, 12/80-5/81, Woods Hole Oceanographic Institution

PROFESSIONAL MEMBERSHIPS AND SERVICE

American Geophysical Union
American Society of Limnology and Oceanography
Geochemical Society
The Oceanography Society
Phi Beta Kappa
U.S. JGOFS Steering Committee: 1987-present
JGOFS Southern Ocean Planning Group: 1990-present
U.S. National Ocean Sciences Accelerator Mass Spectrometer Advisory Board: 1990-1993
Review Panelist, Chemical Oceanography, National Science Foundation
Council of The Oceanography Society, 7/94 to present

PRINCIPAL RESEARCH INTERESTS

(1) Processes determining the distribution, transport and burial of selected chemical tracers (both particle-reactive and redox-sensitive) in the modern ocean;

(2) Applying knowledge gained through (1) above to interpret the sedimentary record of past changes in the deposition of these tracers to assess the ocean's response, in terms of biological and chemical conditions (e.g., productivity, particle flux, deep-water oxygen levels), to climate forcing over Pleistocene glacial-interglacial cycles;

(3) Production, remineralization and burial of organic carbon at ocean margins, with a particular view toward understanding the processes and conditions that determine the efficiency at which organic carbon is buried and preserved in ocean-margin sediments.

SELECTED PUBLICATIONS

Anderson, R. F. (1982). Concentration, vertical flux, and remineralization of particulate uranium in seawater. Geochim. Cosmochim. Acta, 46: 1293-1299.

Anderson, R. F., M. P. Bacon and P. G. Brewer (1982). Elevated concentrations of actinides in Mono Lake. Science, 216: 514-516.

Anderson, R. F. and A. P. Fleer (1982). Determination of natural actinides and plutonium in marine particulate material. Anal. Chem., 54: 1142-1147.

Bacon, M. P. and R. F. Anderson (1982). Distribution of thorium isotopes between dissolved and particulate forms in the deep sea. J. Geophys. Res., 87: 2045-2056.

Livingston, H. D. and R. F. Anderson (1983). Large particle transport of plutonium and other fallout radionuclides to the deep ocean. Nature, 303: 228-231.

Anderson, R. F., M. P. Bacon and P. G. Brewer (1983). Removal of ^{230}Th and ^{231}Pa from the open ocean. Earth Planet. Sci. Lett., 62: 7-23.

Anderson, R. F., M. P. Bacon and P. G. Brewer (1983). Removal of ^{230}Th and ^{231}Pa at ocean margins. Earth Planet. Sci. Lett., 66: 73-90.

Anderson, R. F. (1984). A method for determining the oxidation state of uranium in natural waters. Nuclear Instruments and Methods in Physics Research, 233: 213-217.

Simpson, H. J., R. M. Trier, Y. H. Li and R. F. Anderson (1984). Field experiment determinations of distribution coefficients of actinide elements in alkaline lake environments. In: NRC Nuclear Waste Geochemistry '83, eds. D. H. Alexander and G. F. Birchard. Nuclear Regulatory Commission, Washington, D. C. NUREG/CP-0052, pp. 336-242.

Simpson, H. J., R. M. Trier, A. L. Herczeg and R. F. Anderson (1985). Field experiment determinations of distribution coefficients of actinide elements in sulfate lake environments. Nuclear Regulatory Commission, Washington, D. C. NUREG/CR-4094, 60 pp.

Simpson, H. J., A. L. Herczeg, R. F. Anderson, R. M. Trier, G. G. Mathieu and B. L. Deck (1985). Mobility of radionuclides in high chloride environments. Nuclear Regulatory Commission, Washington, D. C. NUREG/CR-4237, 65 pp.

Santschi, P. H., U. P. Nyffeler, R. F. Anderson, S. L. Schiff, P. O'Hara and R. H. Hesslein (1986). Response of radioactive trace metals to acid-base titrations in controlled ecosystem experiments: Comparison of results from enclosure and whole-lake radiotracer additions. Can. J. Fish. Aquat. Sci., 43: 60-77.

Anderson, R. F. (1987). Redox behavior of uranium in an anoxic marine basin. Uranium, 3: 145-164.

Anderson, R. F., P. H. Santschi, U. P. Nyffeler and S. L. Schiff (1987). Validating the use of radiotracers as analogs of stable metal behavior in controlled ecosystem experiments. Can. J. Fish. Aquat. Sci., Vol. 44, Supplement No. 1: 251-259.

Herczeg, A. L., H. J. Simpson, R. F. Anderson, R. M. Trier, G. G. Mathieu and B. L. Deck (1988). Uranium and radium concentrations within and near the Delaware Basin, southeastern New Mexico. Isotope Geoscience, 72: 181-196.

Anderson, R. F., M. Q. Fleisher and A. P. LeHuray (1989). Concentration, oxidation state, and particulate flux of uranium in the Black Sea. Geochim. Cosmochim. Acta, 53: 2215-2224.

Anderson, R. F., A. P. LeHuray, M. Q. Fleisher and J. W. Murray (1989). Uranium deposition in Saanich Inlet sediments. Geochim. Cosmochim. Acta, 53: 2205-2213.

Anderson, R. F., Y. Lao, W. S. Broecker, S. E. Trumbore, H. J. Hofmann and W. Wolfli (1990). Boundary scavenging in the Pacific Ocean: A comparison of ^{10}Be and ^{231}Pa. Earth Planet. Sci. Lett., 90: 287-304.

Anderson, R. F. and M. Q. Fleisher (1991). Uranium precipitation in Black Sea sediments. In: E. Izdar and J. W. Murray, eds., Black Sea Oceanography, Kluwer Academic Publishers, The Netherlands, pp. 443-458.

Lao, Y., R. F. Anderson, W. S. Broecker, S. E. Trumbore, H. J. Hofmann and W. Wolfli (1992). Increased production of ^{10}Be during the Last Glacial Maximum. Nature, 357, 576-578.

Lao, Y., R. F. Anderson, W. S. Broecker, S. E. Trumbore, H. J. Hofmann and W. Wolfli (1992). Transport and burial rates of ^{10}Be and ^{231}Pa in the Pacific Ocean during the Holocene period. Earth Planet. Sci. Lett., 113, 173-189.

Lao, Y., R. F. Anderson and W. S. Broecker (1992). Boundary scavenging and deep-sea sediment dating: constraints from excess ^{230}Th and ^{231}Pa. Paleoceanography, 7, 783-798.

Lao, Y., R. F. Anderson, W. S. Broecker, H. J. Hofmann and W. Wolfli (1993). Particulate fluxes of ^{230}Th, ^{231}Pa and ^{10}Be in the northeastern Pacific. Geochim. Cosmochim. Acta, 57, 205-217.

Anderson, R. F., M. Q. Fleisher and P. M. Manley (1993). Uranium-series tracers of mud wave migration in the Argentine Basin. Deep-Sea Research-II, 40, 889-909.

Anderson, R. F., M. Q. Fleisher, P. E. Biscaye, N. Kumar, B. Dittrich, P. Kubik and M. Suter (1994). Anomalous boundary scavenging in the Middle Atlantic Bight: Evidence from ^{230}Th, ^{231}Pa, ^{10}Be and ^{210}Pb. Deep-Sea Res-II, 41, 537-561.

Crusius, J. and R. F. Anderson. Redistribution of ^{137}Cs, $^{239+240}Pu$ and ^{210}Pb in six small lake basins due to sediment focusing. Paleolimnology, in press.

Crusius, J. and R. F. Anderson. Evaluating the mobility of ^{137}Cs, $^{239+240}Pu$ and ^{210}Pb from their distributions in laminated lake sediments. Paleolimnology, in press.

Edited Documents

Bacon, M. P. and R. F. Anderson (1990). Isotope Tracers, Report of a U.S. JGOFS Workshop on Radiochemistry. U.S. JGOFS Planning Report Number 12, U.S. JGOFS Planning Office, Woods Hole, MA, 116 pp.

4. Vita of John Marra

VITAL STATISTICS. Date of Birth: [redacted] present position: Doherty Senior Research Scientist, Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y. 10964

EDUCATION

B.S., Zoology Oregon State University 1968
Ph.D., Oceanography Dalhousie University 1977

POSITIONS AND EXPERIENCE:

Commissioned Officer, USN, Honorable Discharge 1968-1972
Graduate Research Assistant, Dalhousie University 1972-1977
Teaching Assistant, Dalhousie University1976
Post-Doctoral Fellow, Lamont-Doherty 1977-1979
Research Associate, Lamont-Doherty 1979-1983
Research Scientist, Lamont-Doherty 1983-1986
Senior Research Scientist, Lamont-Doherty 1986-1987
Doherty Senior Res. Scientist, Lamont-Doherty 1987-present
lecturer, Dept. Geological Sciences, Columbia University, 1990-present
Associate Director for Oceans and Climates, Lamont-Doherty1991-1992

PROFESSIONAL SOCIETIES:

American Society of Limnology and Oceanography
American Geophysical Union
Sigma Xi
The Oceanography Society

PUBLICATIONS (last two years only):

1995 Primary production in the North Atlantic Ocean: Scaling, measurements, and optical determinants. Phil. Trans. Royal Society Lond. B 348, 153-160 (J. Marra).

Production and respiration in the 1989 North Atlantic spring bloom: an analysis of irradiance-dependent changes. Deep-Sea Res. 42, 553-576 (J. Kiddon, M. Bender, J. Marra).

Primary production, water column changes and the demise of a *Phaeocystis* bloom at the ML-ML site in the northeast Atlantic Ocean. J. Geophys. Res. 100, 6633-6643 (J. Marra, C. Langdon, C. Knudson).

Measurements of net and gross O_2 production, dark O_2 respiration and ^{14}C assimilation at the ML-ML mooring in the northeast Atlantic Ocean. J. Geophys. Res. 100, 6645-6653 (C. Langdon, J. Marra, C. Knudson).

Bio-optical variability associated with phytoplankton dynamics in the North Atlantic during spring and summer of 1991. J. Geophys. Res. 100, 6621-6632 (M. Stramska, T.D. Dickey, J. Marra, A. Plueddemann, C. Langdon and R. Weller)

The vertical structure of the upper ocean during the Marine Light-Mixed Layer Experiment. J. Geophys. Res. 100, 6605-6619 (A.J. Plueddemann, R. Weller, M. Stramska, T.D. Dickey, and J. Marra).

Calculated quantum yield of phytoplankton at high latitudes. J. Geophys. Res. 100, 6655-6653 (K.L. Carder, Z. Lee, J. Marra, R. Steward, M. Perry).

Bioluminescence and optical variability in the ocean: An overview of the Marine LIght-Mixed Layers program. J. Geophys. Res. 100, 6521-6525 (J. Marra).

1996 Estimating primary production at depth from remote sensing. Applied Optics 35, 463-474 (Z.P. Lee, K.L. Carder, J. Marra, R. Steward and M.J. Perry).

Biogeochemical Cycling in the Ross Sea: An introduction. J. Geophys. Res. 101, 18,453-18,454 (J. Marra).

Phytoplankton stocks and production as indicators of vertical mixing in the Indonesian Seas. Deep-Sea Res. (in press) (C. Kinkade, J. Marra, C. Langdon, C. Knudson, A.G. Ilahude).

An ENSO-related interannual variability in the productivity of the Indonesian Seas. Limnol. Oceanogr. (in press) (C. Langdon, J. Marra, C. Kinkade and A.G. Ilahude)

Primary production and irradiance during an intermonsoon cruise to the Arabian Sea, November, 1995. SPIE Ocean Optics XIII, Vol 2963 (in press) (J. Marra, R.T. Barber, C. Trees, Z. Johnson and C. Kinkade.)

Estimation of some biological characteristics of ocean waters using optical data. J. Geophys. Res. (submitted) (V. Volynsky, J. Marra and C. Knudson)

Analysis of diel variability in chlorophyll *a* and particulate attenuation. J. Mar. Res. (submitted) (J. Marra)

One-year moored observations of the Arabian Sea Monsoons. EOS (submitted) (D. Rudnick, R.A. Weller, C.C. Eriksen, T.D. Dickey, J. Marra, C. Langdon).

Curriculum Vitae: Raymond Nicholas Sambrotto

Lamont-Doherty Earth Observatory
of Columbia University
Palisades, NY 10964
(914) 365 8402 (Voice); -8150 (Fax)
[redacted]

Personal Data:
[redacted]

Education:

Ph.D.	University of Alaska (Biological Oceanography)	1983
M.S.	State University of New York at Buffalo (Environmental. Sci.)	1977
B.A.	State University of New York at Buffalo (Biology)	1973

Professional Background:

1996 - pres.	Research Scientist Scientist, Lamont-Doherty Earth Observatory of Columbia University.
1984 - 1996	Associate Research Scientist, Lamont-Doherty Earth Observatory of Columbia University.
1992 - pres.	Adjunct Professor, University of Connecticut, Stamford Campus
1990 - pres.	Adjunct Professor, Fairleigh Dickinson University
1986 - 1988	Assistant Program Director, Biological Oceanography Program, U. S. National Science Foundation.
1986	Adjunct Assistant Professor, Teacher's College, Columbia University.
1984	Postdoctoral Associate, Institute of Marine Science, University of Alaska.
1978 - 1983	Research Assistant, Institute of Marine Science University of Alaska.
1978	Environmental Chemist Trainee, New York State Dept. of Environmental Conservation.
1976 - 1977	Research Associate, Ecological Resource Fund, Buffalo, NY.
1976 - 1977	Teaching Assistant, State University of New York at Buffalo.
1973 - 1975	Research Assistant, Dept. of Biochemistry, State University of New York at Buffalo.

Current Research Interests:
Ecology and large scale biology of ocean plankton; nutrient dynamics of plankton systems, particularly plankton growth and surface layer carbon dynamics and possible climate system feedback. The structure of marine food webs and the impact of human perturbations on biological production; prediction of marine ecological systems based on remotely sensed data and computer simulations.

Oceanographic Cruise Experience:

R/V *T.G. Thompson*	Bering Sea	1979
R/V *Acona*	Aleutian Islands	1979
R/V *T.G. Thompson*	Bering Sea	1980
R/V *T.G. Thompson*	Bering Sea	1981
R/V *Oshoro Maru* (joint Japan-US)	North Pacific	1982
R/V *Alpha Helix*	N. Bering/ Chukchi Sea	1983
R/V *Akademik Korolev* (USSR-US)	Bering Sea	1984
R/V *Knorr*	WHOI - Bermuda	1987
R/V *Akademik Korolev* (USSR-US)	Bering Sea	1988
R/V *Endeavor*	North Atlantic	1989
R/V *Cape Hatteras*	Georges Bank	1990*

Oceanographic Cruise Experience: (cont.)

R/V *Walford*	NY Bight	1993*
R/V *Endeavor* 248	Georges Bank	1994
R/V *T.G. Thompson*	Arabian Sea	1995
M/V *Skogafoss*	NW Atlantic	1995*
USS *Pogy*	Arctic Ocean	1996*

* Chief scientist

5 Most Relevant Publications:

1994 Sambrotto, R. N. and C. Langdon. Water column nitrogen and oxygen in relation to dissolved inorganic carbon on Georges Bank during April. *Continental Shelf Research*. **14**(6):765-790.

1993 Sambrotto, R. N., G. Savidge, C. Robinson, P. Boyd, T. Takahashi, D. Chipman, D. Karl, C. Langdon, D. Chipman, J. Marra, and L. Codispoti. Elevated consumption of carbon relative to nitrogen in the surface ocean. *Nature*. **363**, 248-250.

1993 Sambrotto, R. N., J. H. Martin, W. W. Broenkow, C. Carlson and S. E. Fitzwater. Nitrate utilization in surface waters of the Iceland Basin during spring and summer of 1989. *Deep-Sea Research*, **40**, 441-457.

1992 Langdon, C., R. N. Sambrotto and I. Bitte. In-situ sampler-incubator for simultaneous biological rate measurements via tracers and net chemical change. *Limnology and Oceanography*, **37**, 1823-1830.

1986 Sambrotto, R.N., H.J. Niebauer, J.J. Goering, and R.L. Iverson. The relationship among vertical mixing, nitrate uptake, and growth during the spring phytoplankton bloom in the southeast Bering Sea middle shelf. *Continental Shelf Research*. 5(1/2): 161-198.

5 Other Significant Publications:

1990. Muller-Karger, F.E., C.R. McClain, R.N. Sambrotto and G.C. Ray. A comparison of ship and CZCS mapped distribution of phytoplankton in the southeastern Bering Sea. *Journal of Geophysical Research*. 95(C7): 11,483-11,499.

1988 Whitledge, T.E., R.R. Bidigare, S.I. Zeeman, R.N. Sambrotto and others. Biological Measurements and related chemical features in the Soviet and U.S. regions of the Bering Sea. *Continental Shelf Research*. 8(12): 1299-1320.

1986 Sambrotto, R.N., and C.J. Lorenzen. Phytoplankton and Primary Production. Chap. 9; pp. 249 - 284. In: D.W. Hood and S.T. Zimmerman [eds.]. *The Gulf of Alaska: Physical Environment and Biological Resources*. Univ. of Washington Press: Seattle.

1985 Sambrotto, R.N. Patterns of phytoplankton nutrient utilization and their dependence on physical processes in the eastern Bering Sea area: Mechanisms of yearly variation. pp. 268-280. In: W.S. Wooster [ed.]. *El Nino North: Nino Effects in the Subarctic Pacific Ocean*.Washington Sea Grant: Seattle.

1984 Sambrotto, R.N., J.J. Goering, and C.P. McRoy. Large yearly production of phytoplankton in the western Bering Strait. *Science*. 225:1147-1150.

Radiation Safety Office

854-4442

Columbia University
Environmental Health and Safety Department
Radiation Safety Office

Application for authorization to use Radioactive Materials

This application is for: _____ New License _____Amendment

Please type all information

Date:_____

1. Name of Applicant: _____
2. Title of Applicant: _____
3. Department: _____
4. Location of Laboratory: _____
5. Extension: _____
6. Radionuclides for which permission is required (amount is the maximum possession limit).

Element	Chemical form	Amount of Activity (mCi)	Type of Radiation	Half life of Radionuclides

7. Describe purpose for which these by product materials are to be used. Be specific, such as amount of radioactive material to be used per experiment, and how many experiments are to be carried out per week or month.

8. List Radiation Detection instruments in your possession.

9. Specify method of personnel monitoring (film badges, dosimeters, etc.); Describe your Radiation Safety Program for your laboratory including control measure and protection of radioactive areas.

10. Facilities and equipment: Describe Laboratory Facilities e.g. remote handling equipment, storage containers, shielding, fume hoods, etc.

11. Waste disposal: Indicate the form of waste and how you propose to dispose of the waste. Estimate the maximum amount and type of activity to be dispose of per day or week.

12. Records: In accordance with article 175, section 114 of the Radiological Health Code of the City of New York, you will be required to supply records of the procurement, utilization and disposal of all radionuclides. The radiation safety office will be surveying your laboratory's working and storage area for any possible radioactive contamination. The survey and wipe test will be performed monthly.

At sea, the survey and wipe test will be performed monthly by the R.I. or his/her staff. G.H.

13. Training: Describe your training in the use of radionuclides and your previous experience in the use of radioactive material(indicate amounts used, type of use, where and with whom experience was gained, giving name and address.

14. Attachment: Please attach
a - A resent curriculum vitae
b - a diagram of your laboratory indicating where radioactive materials will be used and stored

Please forward completed application to :

George Hamawy
Radiation Safety Officer
289 Engineering Terrace
Tel: (212) 854-4442

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Radiation Safety Training Session

Session Outlines

Radiation Characterization:

* Non-Ionization Radiation.
* Ionizing Radiation.

  Electromagnetic.
  Particulate.

* Radioactive decay.

* Unites of Activity.
* Unites of Radiation Exposure.

Effects of Radiation and Exposure Limits:

* Sources of information
* Radiation exposure effects
* Radiation exposure limits (ALARA)
* The responsibilities and the rights of radiation workers.

Principals of Radiation Protection:

* External Exposure.
* Internal Exposure.

Radiation Detection:

* Geiger Counter
* Liquid Scintillation Detectors

Radioactive Waste:

* Solid Waste
* Liquid Waste

Responsibility of individuals to report unsafe acts or conditions .

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

Auditing requirement and record keeping.

Emergency Response

Questions and Answers.

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
ENVIRONMENTAL AND OCCUPATIONAL HEALTH

Radiation Safety Refresher Course Outlines

1) Principles of radiation protection: a reminder.

2) Responsibilities and rights regarding film badges and radiation exposure records.

3) The do's and don'ts regarding radioactive waste.

4) Responsibility of individuals to report unsafe conditions: a reminder

5) Any changes in regulations regarding radiation safety.

6) Questions and answers.

398 Engineering Terrace Mail Code 2215 500 West 120th Street New York, NY 10027 212-854-8749/4442 Fax 212-316-4937

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03620
STATUS CODE: 3
FEE CATEGORY: _____
EXP. DATE: 0
FEE COMMENTS: _____
DECOM FIN ASSUR REQD: _

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED
APPLICANT/LICENSEE: COLUMBIA UNIVERSITY
RECEIVED DATE: 970205
DOCKET NO: 3034376
CONTROL NO.: 124215
LICENSE NO.:
ACTION TYPE: NEW LICENSE

2. FEE ATTACHED
AMOUNT: ~~_____~~
CHECK NO.: ~~_____~~

3. COMMENTS

SIGNED M.A. Perkins
DATE 2/5/97

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED /✓/)

FEE EXEMPT

1. FEE CATEGORY AND AMOUNT: Ex 3M No fee (A)(4)

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:
AMENDMENT _____
RENEWAL _____
LICENSE ✓

3. OTHER _____
_____

SIGNED _____
DATE _____

RECEIVED BY LFDCB
Date 2/25/97 (97)
Log Gr. 11
By BB
Date Completed 2/25/97

97 FEB 18 AM 8:03