NRC FORM 313
(7-86)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB
3150-0120
Expires 8-31-87

APPLICATION FOR MATERIAL LICENSE

42-28072-030-30125

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.

"OFFICIAL RECORD COPY"

APPLICATIONS FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

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:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIALS SAFETY SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
NUCLEAR MATERIALS SAFETY SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
NUCLEAR MATERIALS SAFETY SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

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 JURISDICTION.

1. THIS IS AN APPLICATION FOR (Check appropriate item)

[X] A. NEW LICENSE Irradiator License

[ ] B. AMENDMENT TO LICENSE NUMBER _____

[ ] C. RENEWAL OF LICENSE NUMBER _____

Note: Byprod. Mat'l Use Appl. submitted concurrently

2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip Code)

Surface Technology, Inc.
Building 200
One Kendall Square
Cambridge, MA 02139

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

Surface Technology, Inc.
Building 200
One Kendall Square
Cambridge, MA 02139

RECEIVED JUL 27 AM 8:12

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Mr. Timothy Surgenor

TELEPHONE NUMBER: (617) 494-8484

SUBMIT ITEMS 5 THROUGH 11 ON 8½ 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

See Attachment I.

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

See Attachment I.

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

See attached application sheets.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

See Attachment IV.

9. FACILITIES AND EQUIPMENT

See Attachments II, III

10. RADIATION SAFETY PROGRAM

See Attachment IV.

11. WASTE MANAGEMENT

See Attachment IV.

12. LICENSEE FEES (See 10 CFR 170 and Section 170.31)

FEE CATEGORY: 3E

AMOUNT ENCLOSED: $ 230.00

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, 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.

SIGNATURE-CERTIFYING OFFICER	TYPED NAME	TITLE	DATE
[signature]	Olaniyi Kaninde	Radiation Safety Officer	14 July '87

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS
[ ] < $250K
[ ] $250K - $500K
[ ] $500K - $1M
[ ] $1M - 3.5M
[ ] $3.5M - $7.5M
[ ] > $7.5M

b. NUMBER OF EMPLOYEES (Total for entire facility)

c. NUMBER OF EMPLOYEES (Total for outside contractors)

8801280543 870929
REG1 LIC30
20-28072-02 PDR

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION (Dollar and/or staff hours) ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? (NRC regulations permit it to protect confidential commercial or financial—proprietary—information furnished to the agency in confidence)

[ ] YES [ ] NO

107538 ML10

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
APP	Jul. 13	3E		[signature]
AMOUNT RECEIVED	CHECK NUMBER			DATE
$230	147			7/27/87

15 JUL 1987

SURFACE TECHNOLOGY, INC.

APPLICATION FOR USE OF RADIONUCLIDES

Instructions. Complete application and submit to Radiation Safety Officer. Authorization for use requires signed approval of Radiation Safety Officer.

Name of Applicant	Social Security Number of Applicant
Olanivi Kehinde	099-36-1623
Department & Supervisor	**Location where Isotopes will be used / stored**
RADIATION SAFETY OFFICER	R&D and Production Lab Areas (at STI HQ)

Radioactive material(s):

List chemical symbol and mass number of each	Form of Material (Chemical and/or Physical)	(Personal = 1/2 of Co.) Possession Limit (mCi)
P-32	Nucleotides	25 mCi
I-125	Protein, KI	25 mCi
S-35	Nucleotides, Amino Acids	75 mCi
H-3	Nucleotides, Amino Acids	50 mCi
C-14	Nucleotides, Amino Acids	10 mCi
Co-60	Sealed Source	(N/A)

Training and Education

Subject Covered	Course Yes	Course No	On-Job Training Yes	On-Job Training No	(Several, most recent listed) Institution	Date Completed
A. Principles and Practices of Radiation Protection	X		X		Harvard Med Sch.	1982
B. Measurements and Monitoring Techniques	X		X		" "	"
C. Mathematical principles for Calculating Activity	X		X		" "	"
D. Biological Effects of Radiation	X		X		" "	"

Experience (actual use of radioactive materials)

Isotope	Maximum Activity	Where Used	Duration of Use	Type of Use
P-32	8 mCi	MIT/Harvard Med Sch.	12 yrs/ 5 yrs (1970-82, 82-87)	labelling
I-125	0.1 mCi	" "		labelling
H-3	3 mCi	" "	"	assays & labelling
C-14	4 mCi	" "	"	stds & labelling
S-35	10 mCi	" "	"	labelling
Co-60	Sealed Source	" "	6 yrs / 5 yrs 300 hrs/250 hrs	tissue culture cell irrad.

I have read, understand, and agree to abide by Surface Technology's Radiation Safety Protection program.

Applicant Signature _____ Date: 14 July 1982

RSO Signature (Approval): _____ Date: 14 July 1982

107538

Attachment I.

Item 5. Licensed Material

Irradiator Manufacturer: AECL (Atomic Energy of Canada Limited)
413 March Road
P.O. Box 13500
Kanata, Ontario
Canada K2K 1XB

Irradiator Model Number: Gammacell 220

Element and Mass No.	Chemical/Physical Form	Max Activity to be On Hand at Any One Time
Cobalt - 60	Sealed Source (AECL Model C198)	7,290 curies (Includes 10% loading tolerance. Ordered activity = 7,200 curies.)

Item 6. Use of Licensed Material

The Cobalt - 60 will be used in the Gammacell 220 Irradiator for irradiation of tissue culture cells and other biological and pathological samples.

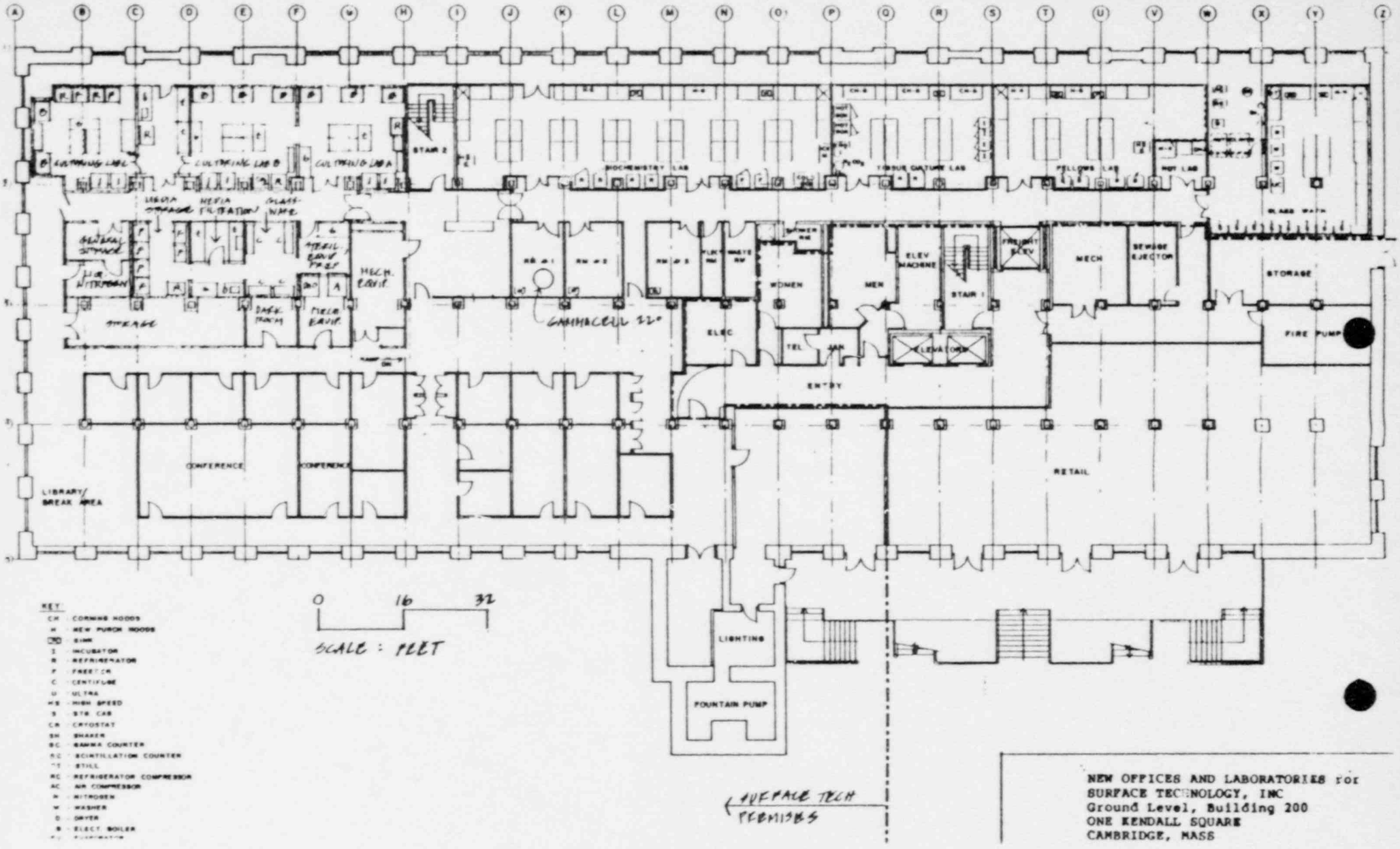
Attachment II.

Item 9. Facilities

A floor plan of the complete Surface Technology facility is attached. The laboratory areas in which radioisotopes will be used are indicated, as well as the location of the Gammacell 220 sealed source irradiator.

Features

1.	Floor covering:	Sealed tile or equivalent.
2.	Working surfaces:	Formica, epoxy coated stone or equivalent; absorbent, plastic-backed paper will be used at all times.
3.	Hoods:	Impervious surfaces; with minimum of 100 linear feet per minute air flow across the front of the hood opening with the windows at normal height.
4.	Iodination Facilities:	Iodinations will be done in a hood or mini-hood equipped with an adequate activated charcoal filter in the exhaust system.
5.	Security	The entire company facility within the Kendall Square development is separately secured on a 24 hour basis. Access during business hours is monitored by a receptionist who controls a lock-releasing control to the main entrance door. Evening access is controlled by key issued to certain company personnel. The lab areas are segregated from the office areas and only authorized personnel are allowed into the labs. The Gammacell 220 irradiator is kept in a locked room and keys are issued only to authorized users.



NEW OFFICES AND LABORATORIES for
SURFACE TECHNOLOGY, INC
Ground Level, Building 200
ONE KENDALL SQUARE
CAMBRIDGE, MASS

Attachment III.

Item 9. Radiation Detection Equipment and Calibration

Radiation Detection Equipment

1. Geiger-Mueller Survey Instrument.

   Model: Ludlum Model 3 or equivalent.

   Use: Monitoring the use of I-125, P-32, and Co-60.

   Range: 0.025 to 200 mr/hr.

   Calibration: to Ra-226. See following page for procedure.

   Check: Check source.

2. Liquid Scintillation Counting Spectrometer

   Model: Beckman LS3801

   Use: Experimental analysis and analysis of contamination smears and urine (bioassay) samples.

   Range: 100 cpm/sample to 1,000,000 cpm/sample.
   For tritium, 50 dpm/sample detectable limit.
   For C-14, I-125, P-32, 100dpm/sample detectable limit.

   Calibration: As required, by use of standard redionuclide sources, e.g., NEN cat. no. NES-202 or NES-203.

   Check: Daily, with one or more of the standard sources named above.

Attachment III (cont.).

Calibration Procedure

Geiger-Mueller Survey Meter

Vendor: Mr. Robert Johnson
Independent Consultant (and Harvard University Radiation Safety Officer)
Approved through Harvard University Broad License
(C.V. enclosed at the end of this Attachment.)

The survey instruments are calibrated routinely every six months using 50 mCi, 5 mCi, and 0.5 mCi Ra-226 gamma 'instrument calibration' sources. The exposure rate has been determined by the vendor, using ionization chambers whose calibration is traceable to the National Bureau of Standards. The typical procedure is as follows:

1. The instrument is placed in a free air uniform gamma field of the calibrator where the exposure rate corresponds to the mid-scale reading of the meter on a given range setting, and calibrated at the midpoint. The exposure rate is determined by a Victoreen R-chamber of an appropriate range.

2. The instrument is then placed in the gamma field at exposure rates corresponding to one third of the full scale and two thirds of the full scale reading. If the meter readings at either of these two points differ from the true exposure rate by more than 10%, the meter is adjusted by repeating steps 1. and 2. until the meter is within 10%.

3. Steps 1. and 2. are performed for all range settings of the instrument which can be calibrated with this source.

4. A calibration label is affixed to the instrument, specifying the ranges that have been calibrated and the date of calibration.

5. A certificate of calibration (sample sheet on following page) is provided for each instrument calibrated. Calibration certificates are kept at the company for a minimum of two years.

Attachment III (cont.)

CERTIFICATION OF CALIBRATION FOR SURVEY INSTRUMENTS

Instrument Data

Customer _____ Manufacturer _____

Model No. _____ Serial No. _____

Detector Type _____ Battery Replaced: Yes___ No___

Calibrator Source

Source 1._____ _____ Serial No._____

Source 2._____ _____ Serial No._____

Source 3._____ _____ Serial No._____

Detector Geometry

Beta Shield: Open___ Closed___
Radiation Field: Parallel___ Perpendicular___

Calibration Data

Max Range	Calculated Dose-Rate	Meter Reading	Source No.
1._____	_____	_____	_____
2._____	_____	_____	_____
3._____	_____	_____	_____
4._____	_____	_____	_____
5._____	_____	_____	_____

Remarks: _____

Certification Date

The above calibration was performed to manufactures' specifications when known.

Date of Calibration_____ Next Calibration Date_____

Calibrated by:_____

HF

CURRICULUM VITAE

NAME: Robert U. Johnson

DEPARTMENT: Environmental Health and Safety, University Health Services

TITLE: Director, Radiological Services and Assistant Radiation Safety Officer

DATE AND PLACE OF BIRTH: September 26, 1928, Beverly, Mass.

CITIZENSHIP: United States

HOME ADDRESS: 31 Chipman Road, Beverly, Mass.

ACADEMIC TRAINING:

Degree	Discipline	Institution	Date
----	Science	Beverly High School	1946
B.S.	Chemistry (Minor-Physics)	Northeastern University	1951

POSITIONS HELD:

Director, Radiological Services & Assistant Rad. Safety Officer	University Health Services Cambridge, Mass.	1959---
Assistant Radiation Safety Officer	Mass. General Hospital Boston, Mass.	1963---
Acting Radiation Safety Officer	Mass. General Hospital	1965-1966
Radiation Safety Officer	Boston Bio-Medical Research Inst. Boston, Mass.	1969---
Radiochemist	U.S.A.E.C. Raw Materials Development Lab (Nat'l Lead Company) Winchester, Mass.	1954-1959

MISCELLANEOUS

Laboratory Instructor	New England Roentgen Ray Society	1964---
Consultant	Mass. Nuclear Incident Advisory Team	1963---
	Cambridge Nuclear Co.	1961-1971
	Boston University	1971---
	Children's Hospital Medical Center	1971---
U.S. Army	Classification & Assignment Sgt. (Korean Veteran)	1951-1954
Professional Affiliation	Health Physics Society (Nat'l & Local Chapters)	
	Boston Medical Physics Society	
	Conf. on Radiological Health	

Member, Radioisotope Committee — Harvard University, Mass. General Hospital, Retina Foundation, Boston Biomedical Research Institute, Children's Hospital Medical Center, Peter Bent Brigham Hospital (ex officio), Beth Israel Hospital.

ADDITIONAL POSITIONS: Radiation Safety Consultant:

a. Micro-Dynamics Inc. Woburn, Mass. 01801
b. Millipore Filter Corp. Bedford, Mass. 01730
c. Gamma Diagnostic Laboratories, Attleboro Falls, Mass. 02763
d. KOR, Cambridge, Mass. 02140
e. Nuclear International Co. Waltham, Mass. 1974--1980 (Business Terminated)
f. Veterans Administration Hospital, West Roxbury, Mass.

Attachment IV.

Items 8, 10, 11. Radiation Protection Program

The attached Radiation Safety Guide covers all aspects of the company radiation protection program in detail. Please refer to the table of contents for specific items.

Examination Questions and Answers

Sample questions from the Radiation Safety Training exam and the correct answers are given on the following pages. A grade of 70% is passing. Individuals who fail the exam are given specific instruction in the areas of their deficiencies and re-tested within one week.

Course Instructor

The present course instructor is Mr. Robert Johnson, an independent Radiation Safety Consultant to Surface Technology. Mr. Johnson's C.V. was presented in the previous Attachment (III).

Leak Tests on Gammacell 220 Irradiator

Leak tests on the sealed source irradiator will be performed every six months by Mr. Johnson, with written reports of the results forwarded to the company Radiation Safety Officer. Refer to the Radiation Safety Guide (Attachment IV) for specific procedures.

Attachment IV.

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Attachment IV (cont.)

Sample Exam Questions

1. Define the following terms:
   A. Half Value Layer
   B. Rem
   C. ALARA
   D. "Caution" Radioactive Materials Sign
   E. Γ Factor
2. What are the three basic factors to minimize personal exposure when working with radioactive materials ?
3. A 137 Cs source is determined to be 30 mCi. The Γ is 3.3 R/hr/mc/cm and its half value layer in lead is 0.65 cm.
   A. What is the unshielded dose rate from the 30 mCi source at 40 cm ?
   B. How much lead must be used as shielding to reduce the dose rate to 2 mr/hr at 40 cm ?
   C. Calculate the additional distance necessary to reduce the dose rate to 2 mr/hr rather than using shielding.
4. NRC regulations require wipe tests of sealed sources at six month intervals. The permissible level of contamination on the wipe is 5×10^{-3} µCi. A wipe indicates 110 counts per minute at 20 % counting efficiency. Is this within the permissible limit ? If not, what corrective action should be taken ?
5. Describe a thorough survey of the irradiator indicating the dose rates at various locations. Give the rationale for the instrumentation utilized and the points at which you would measure the dose rates.

Answers

1-A. The thickness of lead necessary to reduce the dose rate by a factor of two.
1-B. Abbreviation for Roentgen Equivalent Man
Absorbed Dose (Rads) x Quality Factor = Dose Equivalent (Rem)
1-C. As Low As Reasonably Achievable. Term coined by the NRC, the basic factor for maintaining low exposures and releases, and by which any dose exceeding 10% of the permissible dose requires an investigation.
1-D. Required to be posted in rooms or areas in which radioactive materials are used or stored in an amount exceeding the quantities expressed in 10-CFR-20, Appendix "C".
1-E. The basic factor for calculation of gamma dosage in R/hr/mCi/cm. Calculated from the energies of the gamma rays of the particular radionuclide and the disintegration scheme.
2. Time, distance, and shielding.
3-A. 61.9 mr/hr.
3-B. 4.947 HVL or 3.216 cm.
3-C. 222.5 cm.
4. 110 c/m @ 20% efficiency = 550 d/m = 0.000248 µCi, which is less than 5% of permissible.
5. An ion chamber will give the dose rates in mr/hr at various points, but for low levels, a geiger counter could be used. A diagram would be drawn of the irradiator, the room, and the neighboring areas, showing the scale used. Measurements would be made at the sides, top, and back (if accessible) of the irradiator and at any point where someone might be situated. Measurements must also be made at the ceiling of the room below the source, the floor of the room above the source, and the walls of rooms adjoining. All measurements should be below 2 mr/hr within the room and 10% of this figure outside.

SURFACE TECHNOLOGY, INC.

RADIATION SAFETY GUIDE

14 JULY 1987

Approved:

Olaniyi Kehinde
Radiation Safety Officer
Director of Technical Operations

Table of Contents

INTRODUCTION

All uses of radioactive material at Surface Technology, Inc. are controlled by the radiation protection program.

> NO WORK WITH SOURCES OF IONIZING RADIATION CAN BE INITIATED UNLESS AUTHORIZATION HAS BEEN OBTAINED FROM THE RADIATION SAFETY OFFICER.

All uses of ionizing radiation (except ultra-violet radiation) in Massachusetts are controlled and regulated by the U.S. Nuclear Regulatory Commission (NRC). Surface Technology, Inc. has received a license from the NRC to use limited amounts of radioactive material in biological research. We have established a radiation safety program to give the necessary assurances to the NRC as well as the company management that all potentially hazardous sources of radiation will be used safely.

This guide describes the organization of the program and specifies the regulations, policies and procedures and practices which are to be followed in using radiation sources at Surface Technology. The guide was presented to the NRC as describing the Surface Technology radiation safety program. It was accepted as such and so referenced in the license subsequently issued. Consequently, the guide is a legal document governing all uses of radiation at Surface Technology.

It is Surface Technology's policy to encourage the use of radiation where appropriate, but always with the insistence that there be no unwarranted radiation exposure; thus, due regard must always be given to the safety and welfare of the radiation workers and thje general population as well as to the protection of Surface Technology property and liability. The Surface Technology operational policy places ultimate responsibility on the person who is supervising the use of radiation sources. These supervisors can satisfy their responbilities by adhering to this guide and by requesting assistance from the Radiation Safety Officer (RSO) when there are questions or suspected problems.

This guide is organized in the following manner:

Section I - General description of the Surface Technology Radiation Safety Program, Organization and Responsibilities

Section 2 - Detailed Procedures and Practices

1. Description of the Surface Technology Radiation Safety Program

There are three levels of authority in the radiation safety program:

The Radiation Safety Officer (RSO)
The RSO together with the management of Surface Technology establishes the radiation safety policy such that:

1. Unwarranted radiation safety exposures of Surface Technology employees and general public are avoided.

2. Compliance with all the federal and state regulations is assured.

3. Surface Technology property and liability are protected.

Specifically, the RSO meets these responsibilities by routinely monitoring all uses of radioactive material to ensure that: (a) each use is by or under the supervision of a properly authorized supervisor, (b) that the appropriate personnel and environmental monitoring equipment is being used and (c) that radioactive material is properly secured against unauthorized removal when not is use.

The Supervisor
The supervisor is a person permitted by the RSO and NRC to use radiation sources. (S)he has primary responsibility for the radiation safety associated with each source under his/her control. He must ascertain that each person under his supervision using these sources is properly trained and aware of the attendant hazards (see Training Requirements). He must also assure that use of the sources conform to all the safety conditions of this authorization and those of this guide.

The Supervised User
These individuals must use the sources of radiation only under the direction of a supervisor. They must follow those procedures and practices established by the supervisor. All users are required to attend a Radiation Safety Training Program before they begin work (see Training Requirements).

2. Radiation Regulations, Policies, Procedures and Practices

a. *Federal Regulations*

The Nuclear Regulatory Commission has established "Standards for Radiation Protection" 10CFR20 (see Appendix for a copy). These standards must be strictly adhered to during all uses of by-product material. The NRC also has adopted regulations which assure that workers will be advised of the sources of radiation being used, the hazards, the safety precautions in effect, etc. at the place of employment. These rights are present in "Notice of Instructions and Reports to Workers; Inspections" 10CFR19 (see Appendix for a copy).

b. *Surface Technology Policies and Procedures*

The management of Surface Technology recognizes both the NRC regulations and company policy of preventing unnecessary exposures to radiation as the basic criteria for establishing the radiation safety policies and procedures. The principal means by which the company assures the safe use of sources of radiation are:

1. To require that a person be authorized to use or supervise the use of radiation sources.

2. To require that the acquisition of radiation sources be approved by the RSO and that all receipts and transfers, including disposal of radioisotopes, be channeled through the RSO.

Specific procedures and practices have been established for most routine or recurrent situations to assure compliance to the regulations and company policy. For unusual situations, the RSO will interpret the existing regulations, policies and procedures to establish guidelines.

These are the established procedures and practices:

1. Authorization to Use Radioisotopes (Appendix 1)
2. Training of Workers (Appendix 2)
3. Use of Radioisotopes (Appendix 3)

c. *Professional Standards*

The RSO also uses as operational guides the published data and recommendations of professionally recognized national and international committees and organizations concerned with health physics or radiation protection, examples of which are:

1. National Council on Radiation Protection (NCRP)
2. International Committee on Radiation Protection (ICRP)
3. International Atomic Energy Agency (IAEA)
4. Health Physics Society (HPS)

APPENDIX 1

Authorization to Use Sources of Radiation

An individual can use or possess a source of radiation only after (s)he is authorized. To be authorized, an individual must be able to present evidence of proper training and experience. An application must be submitted to the RSO and the RSO must approve the application and forward it to the NRC. A formal written authorization must be obtained from the RSO before work can begin.

The authorization will be reviewed and updated when the company NRC license is submitted for renewal. If an authorized supervisor wishes to use sources of radiation different from those for which his group has been authorized, if he wishes to increase the possession limits or change the experiemental conditions, he must receive an amendment to his authorization before the change can be put into effect. The RSO will evaluate requests for amendment and, as necessary, inform and request approval from the NRC for amendments to the company license.

A copy of the application for authorization to use radionuclides is on the next page.

SURFACE TECHNOLOGY, INC.

APPLICATION FOR USE OF RADIONUCLIDES

Instructions. Complete application and submit to Radiation Safety Officer. Authorization for use requires signed approval of Radiation Safety Officer.

Name of Applicant **Social Security Number of Applicant**

Department & Supervisor **Location where Isotopes will be used / stored**

Radioactive material(s):

List chemical symbol and mass number of each	Form of Material (Chemical and/or Physical)	Possession Limit (mCi)

Training and Education

Subject Covered	Course Yes | No	On-Job Training Yes | No	Institution	Date Completed
A. Principles and Practices of Radiation Protection				
B. Measurements and Monitoring Techniques				
C. Mathematical principles for Calculating Activity				
D. Biological Effects of Radiation				

Experience (actual use of radioactive materials)

Isotope	Maximum Activity	Where Used	Duration of Use	Type of Use

I have read, understand, and agree to abide by Surface Technology's Radiation Safety Protection program.

Applicant Signature _____ Date:_____

RSO Signature (Approval):_____ Date:_____

APPENDIX 2

TRAINING OF WORKERS

Individuals using radioisotopes under an NRC license have certain rights as prescribed in 10CFR19 "Notices, Instructions and Reports to Workers; Inspections" (see Appendix 4). In accordance with Part 19, a copy of the Surface Technology license and a copy of the Notice posted in radioisotope areas to advise persons in those areas where work is being done and to describe the documents and regulations pertinent to that work are included in this Appendix.

Surface Technology has designed its training program to assure that all persons working in or frequenting areas of radioisotope usage are aware of the attendent hazards. All persons using radioisotopes or frequenting areas where radioisotopes are used must attend a Radiation Safety Training Program consisting of material as shown in the outline appearing in this appendix. The RSO shall keep records of attendance at these orientations.

The training program consists of 8 hours of instruction and a written examination. There will be two portions to the training program: 1. A portion targeted for all prospective users of radioisotopes within the company dealing with both the scientific background of radiation and safe procedures for personal use and 2. A portion targeted for ancillary personnel (custodial, security, maintenance, etc.) describing the practical aspects of working in a radiation area -- understanding signage, basic work and emergency procedures, and commonly used equipment and areas, etc.

The RSO shall determine at the time of application for authorization amendment or renewal if the training and experience of the user is adequate or if addtional training or experience is required. All company personnel handling radioisotopes will attend both portions of the radiation orientation and must take and pass the exam. Ancillary personnel will attend the second portion of the orientation lecture when beginning work with the company and annually thereafter.

Personnel who need to operate the sealed source irradiator will, in addition to taking the training program, be given a minimum of 4 hours of RSO-supervised operation training on the instrument before being allowed to run the instrument alone.

Radiation Safety Training Program Outline

1. Why are we here?
   a. Regulations
   b. Orientation to Surface Technology Radiation Safety Program

2. All uses of radiation require a license

3. Description of Surface Technology licenses

4. Licenses require Surface Technology to assure safe use through:
   a. Organization
   b. Facilities and Equipment
   c. Evaluation
   d. Control
   e. Services

5. Radioactivity and radioactive decay

6. Interaction of radiation with matter

7. Dosimetry (Roentgen, the Rad, the Rem)

8. Bioeffects:
   a. Somatic
   b. Genetic

9. Regulations - based on ICRP and NCRP recommendations
   a. 10CFR20
   b. 10CFR19
   c. Radiation Protection Guides
      8.10 As low as reasonably achievable
      8.13 Pregnant Women
   d. Posting
   e. Privacy Act; NRC Forms 4 and 5

Radiation Safety Training Program Outline (Con'd)

10. Surface Technology Radiation Safety Program
    a Management Responsibility
    b. Radiation Safety Officer
    c. Evaluation
    d. Compliance
    e. Services

11. Laboratory Practices
    a. External hazards, including X-rays
    b. Internal hazards
    c. Surveys
    d. Instrumentation-which do you use?
    e. Records
    f. Waste disposal
    g. Labelling and marking
    h. Storage
    i. Restriction of access
    j. ALARA-As low as reasonably achievable
    k. Emergency Procedures (posted)

12. Specific Isotope Usage and Procedures
    a. Tritium (H-3)
    b. Carbon-14
    c. Phosphorous 32
    d. Iodine 125
    e. Cobalt 60 - Design & Operation of the Gammacell 220 Irradiator
    f. Concept of MPC and regulatory requirements
    g. Radiation Exposure Artifacts
    h. Care of Personnel badges
    i. Ordering radioisotopes
    j. Marking of waste containers
    k. Changes in experimental procedure
    l. Hesitancy to ask for help; where to get help
    m. Rules for use of radioisotopes

CAUTION

Work with sources of radiation is being carried out in this area.

In accordance with the United States Nuclear Regulatory Commission Regulation 10CFR19.ll, the following documents relating to the work are available to you from the Radiation Safety Officer.

1. 10CFR20 - which describes the Nuclear Regulatory Commission Standards for Radiation Protection which must be adhered to in the use of sources of radiation.

2. 10CFR19 - which describes the Nuclear Regulatory Commissions Regulations pertaining to notices, instructions, and reports to workers and inspections of radiation activities.

3. Regulatory License and Applications - which specify the special conditions under which radiation work must be carried out.

4. STI Radiation Safety Guide - which specifies Surface Technology radiation safety policies and procedures.

5. STI Authorization - under which the work in this area is being carried on.

Maintenance Staff

Procedures for Handling Equipment in Labs Using Radioactive Materials

1. Any device which has a radiation symbol on it (except X-ray producing machines) might be contaminated with radioactive material. Before you work on or around such a device, contact the Radiation Safety Officer (RSO) so that the device may be checked for safety.

2. Equipment within or servicing a radioisotope laboratory which may be contaminated by radioactive material includes hoods, exhaust blower motors, pumps, drain pipes, ventilation ducts, etc. Call the RSO to check before beginning work on any such equipment.

3. If you think you may have gotten some radioactive material on your skin or clothing, wash it off as soon as possible, and then call the RSO so that he can assure you that all the contamination has been removed. Do not leave the general area until you have been checked. Do not panic! The risk is quite low.

4. If you have questions, call the RSO.

Custodial Staff Instructions

What to do About Radioactive Materials

1. Rooms which have the radiation symbol shown on doors or on equipment may contain radioactive materials. You should be careful when working in these rooms. You can sweep, mop, and wax the floors and remove the waste which is not labelled with the radiation symbol, just as in any other room.

2. Any container (box, bottle, carton, etc.) which has radioactive material in it will have the radiation symbol on it. You should not touch these containers. If the contents of these containers are spilled, DO NOT TOUCH THEM OR ATTEMPT TO CLEAN THEM UP. Tell your supervisor or the Radiation Safety Officer (RSO).

3. DO NOT empty any waste container which has the radiation symbol on it.

4. DO NOT empty any waste container which has waste material, such as boxes or bottles, with the radiation symbol in it. Tell your supervisor about it.

5. DO NOT eat, drink, smoke or apply cosmetics in any lab or in any room which has the radiation symbol on its door.

6. In an emergency, or if you have a y questions, ask your supervisor or the RSO for help.

APPENDIX 3

USE OF RADIOISOTOPES

The authorized supervisor is responsible for seeing that the users of radioisotopes under his authorization comply with all the governmental regulations, the specific conditions and limitations of his authorization, and the procedures and practices outlined in this appendix. He ascertains that all persons who use radioisotopes under the coverage of his authorization are supervised, properly trained and experienced, aware of the attendant hazards, and observe the procedures of this guide.

Training and Experience

See Appendix 2 of this guide.

Receipt, Transfer and Disposal of Radioactive Material

The RSO must approve all intended receipts and subsequent transfers of radioisotopes. All radioisotopes must be shipped to this address:

Surface Technology, Inc.
One Kendall Square, Building 200
Cambridge, MA 02139
Attn: Radiation Safety Officer

A purchase order must be used to order radioisotopes. It must be signed by the RSO before distribution. The NRC license number and Authorized Supervisor's name must be typed on the purchase requisition beneath a description of the radioisotope ordered. A purchase requisition cannot be used to confirm a radioisotope order unless the authorized user obtains prior verbal approval from the RSO. Radioisotopes cannot be ordered on a blanket order without approval from the RSO.

All radioisotopes are checked for contamination and their receipt is recorded for legal purposes by the RSO or his designate. The radioisotope is then delivered to the authorized supervisor. See Appendix 4 for procedures and forms.

If an authorized supervisor wants to: (a) move the radioisotope to a location other than those specified on his authorization, or (b) transfer an isotope to another authorized person, he must first obtain approval from the RSO.

Receipt, Transfer and Disposal of Radioactive Material (Con'd.)

All radioactive material must be disposed of through procedures approved by the RSO. Only those small amounts of liquid radioactive waste allowed by law may be disposed of down the drain of designated sinks. Liquid waste must be placed in a properly labelled plastic container. Solid waste must be placed in a properly labelled container lined with a plastic bag. Liquid scintillation vials should be kept separate. All radioactive waste will be packaged according to the waste vendor's specifications for removal to the disposal site.

Radiation Surveys

The RSO conducts routine radiation and contamination surveys of all laboratories. The user must supplement these routine surveys as follows:

RADIATION SURVEYS ARE TO BE MADE BY THE USER AFTER EACH EXPERIMENTAL RUN OR AT THE END OF DAY RADIOISOTOPES ARE USED IN ORDER TO DETERMINE THE EXTENT OF RADIOACTIVE CONTAMINATION AND TO ASCERTAIN THAT ALL WASTE AND STOCK MATERIAL HAS BEEN STORED OR PROPERLY DISPOSED OF.

The RSO survey is conducted biweekly when millicurie amounts of radiation are in use and monthly whenever microcurie amounts are used. All labs are surveyed with an appropriate calibrated survey meter. Wipe tests are taken on all bench tops, hood ledges, sink areas, storage and waste disposal areas. Surveys will also check for proper labelling, signage, and adherance to rules and regulations by users.

When material is known to have been spilled or become airborne, wipe test surveys of the affected area should be made. Such tests can be made with filter paper or squares of any absorbent paper, and the wipes counted with an appropriate counting instrument. The RSO should be called if a researcher has reason to believe his work has resulted in gross contamination or constitutes an emergency situation. (See Emergency Procedures below.)

No levels of removable contamination are acceptable. Users with contaminated work areas will be given 24 hours to decontaminate their area afterwhich a follow-up survey will be made. Fixed contamination (if and when discovered) will be shielded to background for the duration of iostope activity.

All radiation survey reports will be maintained by the RSO for inspection by the NRC.

Storage of Radioisotopes

Radioisotopes must be stored to permit access only to the authoree and those whom he designates. Each area and room where radioisotopes are stcred must be posted with a radioactive material sign. Radiation levels around storage areas should be measured. If radiation doses could exceed five (5) millirem per hour in an occupiable area, the area must be posted with a radiation area sign. Proper signs can be obtained from the RSO.

See Appendix 5 for Radioisotope Inventory Form.

Records

Each user should maintain a radioisotope log to record the receipt use and disposal of all radioisotope he(she) receives. This is a government regulation. The log should also be used to record the date and results of radiation and contamination surveys, even when the results are negative. This log is subject to inspection by the NRC. See Appendix 5 for examples of these logs.

Other records required by federal law are kept by the RSO.

Restriction of Radioisotopes Areas

Access to areas where radioisotopes are stored and used must be restricted to those persons cognizant of the associated hazards. Tnis is a government regulation.

Radioactive Waste

Radioactive waste must be disposed of through procedures appoved by the RSO. No waste is to be washed down drains, incinerated, or otherwise disposed without prior clearance from the RSO. A copy of the detailed procedures for waste disposal is given in Appendix 4.

Movement of Radioisotopes

Radioisotopes are not to be moved from authorized places of storage and used without the prior approval of the RSO.

Emergency Procedures

A radiation emergency occurs when a set of circumstances results in hazardous radiation levels, hazardous concentrations of airborne radioisotopes, or gross contamination of property. Examples of radiation emergencies and actions to be taken are:

a. Personnel Contamination
   1) Remove contaminated clothing.
   2) Wash contaminated skin with mild soap and water. Do not use abrasives.
   3) Call the RSO. After hours, refer to the emergency call list.

b. Spill of radioisotope where radioisotope does not become airborne
   1) Wipe up with absorbent paper using a blotting motion so you do not spread contamination.
   2) Dispose of contaminated paper in radioactive waste container.
   3) Call the RSO. After hours, refer to the emergency call list.

c. Volatilization of liquid or dispersal of solid radioisotope outside a ventillated enclosure
   1) If possible, keep contamination localized by closing doors and restricting access to area.
   2) Leave the area.
   3) Call the RSO. After hours, refer to the emergency call list.

d. Fire in radioisotope area.
   1) Treat fire in normal manner.
   2) Call the RSO. After hours, refer to the emergency call list.

ALWAYS USE COMMON SENSE IN HANDLING RADIATION EMERGENCIES, AND CALL THE RSO AS SOON AS PRACTICAL. DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

STI RADIATION SAFETY OFFICER: _____

DAYTIME PHONE: _____

WEEKEND AND EVENINGS: Refer to the emergency call list.

A more detailed procedure can be found below.

Personnel Monitoring

The RSO determines the need for personnel dosimetry during the authorization evaluation or evaluation of amendment requests.

STI requires all personnel using or routinely exposed to radioisotopes to wear film badges. Badges are supplied and analyzed monthly by R. S. Landauer, Jr. & Co., 39 Milltown Road, East Brunswick, NJ, 08816. Monitoring reports are returned to the RSO, who reviews them alone with an independent radiation safety consultant to assure that exposures are maintained within acceptable levels.

The authorized supervisor has the responsibility to assure that all persons who use radioisotopes or work in his(her) area wear appropriate radiation dosimeters when required.

Radioisotope Laboratory Design

The design and furnishings of a laboratory must be commensurate with the hazards presented by the radioisotope and its condition of use. Each laboratory must, therefore, be evaluated individually by the RSO in light of its intended use. In practical terms, some possible requirement are that:

a. Bench tops or other surfaces on which radioisotopes will be used must be stainless steel or covered with a permanently impervious surface.

b. Floors must be covered with an impervious material; properly waxed, vinyl asbestos tiles are normally acceptable.

c. Walls must have a smooth, crack-and hole-free surface.

d. Proper room ventiliation and adequate radioisotope storage must be provided.

Rules for Working with Radioactive Materials

A set of laboratory rules found to be very useful in reminding laboratory workers of good radiation safety practices is found below. Copies of these pages should be posted in each laboratory by the RSO. Each authorized supervisor should assure that these instructions are kept prominently displayed in work areas.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

ROUTINE PROCEDURES

Eating, drinking, smoking	Eating, drinking, smoking or using cosmetics is not permitted in this laboratory.
Wash hands	Wash hands after handling any radioactive material before going about other work. Always wash before handling objects which go into the mouth, nose, or eyes. Keep fingernails short and clean.
Pipetting	Never pipette anything, even water, by mouth.
Protective Clothing	Always use rubber or plastic gloves when handling radioisotopes. Lab coats should be worn in the lab and left in the laboratory.
Confine the Activity	Always work over trays lined with absorbent material. Keep and transport radioactive materials doubly contained.
Spills	Notify the Radiation Safety Officer of all spills except those of a very minor nature.
Labelling	Label radioactive material with your name, date, isotope and quantity of isotope.
Before Leaving	Before leaving the laboratory, clean up and monitor your work area and yourself.
*Disposal of **Liquid** radioactive waste*	Liquid radioactive materials should be disposed of through the Radiation Safety Officer. They should be held in plastic containers or in metal containers if the material is incompatible with plastic. The quantity of isotope, the isotope name, date, and the user's name should be recorded in a log kept with the container. No radioactive material should be disposed of via the sink without approval from the RSO or group supervisor.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

ROUTINE PROCEDURES (Con'd.)

*Disposal of **Solid***

Solid radioactive waste should be placed in plastic-lined boxes or containers. The quantity being disposed of, date, user and the isotope should be recorded in the waste log kept with the container.

Counting Room

Take only prepared samples into the counting room. No potentially contaminated material or apparatus is permitted in the counting room. This includes lab coats.

Hoods

Materials which could become airborne must be stored and used in a hood. Hood ventilation should be left "ON" at all times.

Food

Never keep or store beverages or food in radioisotope labs, in refrigerators or freezers with radioisotopes.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

EMERGENCY PROCEDURES

Be prepared for an emergency by mentally rehearsing the following:

EXTREME HAZARDS

Hazards such as high radiation levels or the possibility of airborne contamination from dry or volatile radioactive materials.

Evacuate — Evacuate the laboratory immediately; close the door and lock it.

Call RSO — Call the RSO immediately. If you have to leave the area to do so, remove your shoes if you suspect contamination and do not touch anything unnecessarily.

OTHER HAZARDS

Hazards such as spills or suspected spills of radioactive material where the material does not become airborne.

Keep Calm — Keep calm, use common sense, protect people, do not spread contamination (always assume you are contaminated until a survey proves otherwise).

Confine Contamination — Localize the spill. Right tipped container; drop absorbent material on the spill. Damp down a dry spill.

Do not track contamination about the laboratory. Call, do not go for help, if possible!

Close door, and where possible adjust the ventilation to prevent spread of airborne material.

Check shoes before leaving the area of a cleaned up spill.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

EMERGENCY PROCEDURES (Con'd.)

Protect Personnel

Remove contaminated clothing and wash contaminated parts of the body with detergent.

Be especially thorough in flushing out wounds.

Warn other workers.

Decontaminate

If thorough washing with detergent does not remove contamination from body, consult the RSO.

You will be expected to perform the major work of decontamination of the area of your spill. The RSO will survey for contamination and advise on procedures and assist as necessary.

All suspected contaminated persons and areas must be monitored after decontamination and before work is resumed.

IN ALL EMERGENCIES, EXCEPT VERY MINOR SPILLS OF RADIOACTIVE MATERIALS, THE RSO SHOULD BE CALLED AS SOON AS POSSIBLE.

DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

APPENDIX 4

SPECIAL PROCEDURES

Laboratory Survey Procedure

1. Laboratory contamination surveys should be done on a routine periodic basis with the period determined by the level of activity. They should be done often enough so that the possibility of contamination is minimized.

   Surveys should be done by anyone using radioactive material immediately after the completion of an experimental procedure.

2. A survey data notebook should be kept, containing layouts of the laboratories indicating the points at which the wipes were made and data tables containing the results of the counting of the wipes.

3. Wipes are made using filter paper moistened with water or if necessary, another solvent for the material in use. Approximately 100 square centimeters of surface should be wiped.

4. Penetrating radiation, e.g. P-32, I-125, can be monitored with the G-M survey instrument.

SURFACE TECHNOLOGY, INC.

LABORATORY SURVEY RECORD

Room: _____ Supervisor: _____

Radionuclides Used: _____

See room plan on reverse side for key to locations.

Survey Date	Surveyer	Contamination		Radiation Field	
		Location	dpm/wipe	Location	mR/hr.

Instructions

1. On the reverse side sketch a plan of the lab indicating by number the locations at which the wipes are taken.

2. Contamination surveys shall be done using absorbent filter paper (moistened with an appropriate solvent if necessary). Wipe approximately 100 cm^2 of surface area. Count the wipes in the LSC (open channel). An Activity of 200 dpm/wipe or greater indicates significant contamination. Contaminated areas must be cleaned immediately and the area resurveyed.

3. Radiation surveys (if necessary) should be performed with a properly operating, calibrated G. M. survey instrument. An exposure rate in excess of 0.1 mR/hr in areas frequently occupied by humans should be shielded.

Leak Testing Procedure for Sealed Source Irradiator

Performed every six months by an independent radiation safety consultant. As instructed by the Gammacell 220 Operation Manual, leak testing is carried out by inserting a swab into the sample chamber and wiping both upper and lower panels of the chamber. In addition, there are two removable panels in the rear of the irradiator which, when unscrewed, expose pneumatic rods which are also swabbed and counted for contamination. The counting will be done in accord with approved procedures.

Operation of the Gammacell 220 Sealed Source Irradiator

A. Only personnel authorized by the RSO will will be given keys to the irradiator room and allowed to operate the irradiator.

B. All operating procedures will conform to the operating manual. Users must be familiar will all instructions in the manual.

C. Film badges must be worn by all persons entering the irradiator room.

D. The irradiator room must be locked after each use of the irradiator is complete.

E. The irradiator will be inspected prior to each use by the user as to the functioning of the warning lights and interlocks. Check results must be logged into the logbook.

F. Users will record all use in the logbook, report there any unusual incidents, and sign the book after each use.

G. A survey must be taken during operation to ensure that the exposure levels are in conformity with posted limits during normal operating conditions.

H. In event of any equipment failure or warning, refer to the Emergency Procedures given on the following page.

Emergency Procedures for the Gammacell 220 Sealed Source Irradiator

In event of any unusual occurence, immediately notify the Radiation Safety Officer, whose office and home phone numbers are posted in the room along with a list of back-up emergency personnel and their numbers. ALL unusual incidents must be recorded in the irradiator use logbook.

1. Check the dose rate with the survey meter to ensure that exposure levels do not exceed 2 mR/hr.

IF EXPOSURE EXCEEDS 2 MR/HR: EVACUATE THE ROOM, LOCK THE DOOR, POST A WARNING SIGN, AND NOTIFY THE RSO. THE RSO WILL SURVEY THE AREA OUTSIDE THE IRRADIATOR ROOM AND DETERMINE IF FURTHER AREA RESTRICTIONS ARE NECESSARY TO RESTRICT THE EXPOSURE AREA TO 2 MR/HR.

2. Check electric curcuits to determine status of electrical power. If the power appears to be on but the warning lights are not functioning, check the bulbs.

3. Notify RSO of findings.

Radioactive Material Receipt and Opening Procedure

Package Receipt

1. Do not accept a radioisotope shipment that is damaged.

2. A contamination survey must be made within three (3) hours after receipt of a radioactive material shipment (within 18 hours if the delivery is after hours).

3. Radioactive material shipments should be separated from the non-radioactive shipments upon receipt. The Radiation Safety Officer should be notified immediately.

4. The date and time of the receipt should be recorded on the delivery form.

Package Opening

1. Wear gloves and protective clothing when opening the package.

2. Wipe the outside shipping container surface and count the wipes to check for contamination (see note below). Record the results.

3. Using the G. M. survey meter, measure the radiation levels at the surface of the container and if necessary at one meter from the surface. Record the results.

4. Open the package, and take wipe of the successive layers of containment, down to the vial containing the radioisotope (or the outside of the package if it is sterile wrapped). Count these and record the results. If there are no counts above background, container may be discarded in regular trash; otherwise container must be discarded with soild radiation waste.

5. Record any signs of damage to the package or to the vial.

6. If there is contamination or an excessive radiation level check the NRC regulations (10CFR20.205) to see if the NRC or the shipper must be notified.

7. The wipes should be counted in the Liquid Scintillation counter.

Delivery of Radioisotope to User

Do not leave the package unattended; deliver it immediately to the user so that it may be stored correctly. If the user cannot be found, contact the supervisor of the lab where delivery was to be made for proper disposition.

SURFACE TECHNOLOGY, Inc.

Radioisotope Receipt and Delivery

Radioactive Material_____ P.O. #_____

Activity_____ Date of Receipt_____

Location of Use_____

Contamination Survey (counts per minute)

Radiation Levels (mR/hr)

Date and Time of Delivery to User_____

User Signature_____

Guidelines for Iodine-125 Iodinations (and Tritium Experiments of >45 Millicuries)

Iodine-125 emits 27-3l keV X-rays and a 35 keV gamma. Approximately 2 mm. of lead are required to completely attenuate I-125 in quantities typically used for iodinations. Iodine in the unbound state volitilizes readily and is efficiently taken into the body by inhalation or absorption through the skin. Approximately 30 percent of the activity taken in remains the the thyroid with an effective half life of about 40 days. Thus, the predominant concern on handling unbound iodine should be given to minimizing the contact with body.

1. Always work in a well-ventiliated hood. Preplenum activated charcoal imprenated filters are recommended. A lucite inner hood (mini-hood) with a charcoal filter may be used. Surface Technology provides a stainless steel isotope fume hood which is equiped with a continuous air sampler (Eberline RAS-1) installed in the duct system to evaluated release to the environment. The sampling cartridge will be evaluated semi-monthly initially. If data indicates minimal release, cartridges will be changed monthly. Charcoal filters will be installed in the duct if release data indicate that greater than 25% of the permissible level (> 2×10^{-11} µc/cc averaged over the sampling period) is being released. The sampling cartridges will be counted and evaluated by an independent radiation safety consultant. All reports will be forwarded to the RSO.

   The cartridges themselves will be counted on a thin-crystal scintillation detector attached to a multichannel analyzer which has been calibrated for I-125.

   Any tritium labelling experiments of greater than 45 mc will be sampled by pumping the effluent through a liquid collection system and counting an aliquot in a liquid scintillation counter. This result will also be compared to a materials balance performed by the investigator. All persons handling tritium will, in accordance with regulation, submit urine samples for bioassays within 48 hours.

2. Prepare a detailed written procedure for the iodination and submit it to the RSO for his approval. The procedure should be designed to minimize the opening of any vials through the use of syringe injection of material through septum topped vials. All containers of the radioactive material should be sealed in some manner, e.g., rubber stoppers, plastic cups or parafilm.

3. Conduct a dry (cold) run of the procedure to minimize the chance for error when the activity is used.

4. A baseline bioassay (either urine analysis, or preferably, a thyroid exam) should be done on anyone participating in the procedure. See reference 2 below.

5. Wear a personnel radiation dosimeter.

6. Wear the proper protective clothing, safety glasses and two layers of protective gloves. Iodine diffuses rapidly through vinyl and rubber so replace the outer layer immediately when it becomes contaminated. Keep the inner pair free of contamination.

7. Have a properly operating Geiger Muller survey instrument on and readily available for quick contamination checks. Be careful not to contaminate the instrument itself. The instrument will not detect very low levels of contamination but will be useful for higher levels.

8. Avoid handling the vials directly. Use remote handling devices such as tongs or forceps.

9. To decontaminate equipment or surfaces use a solution of 0.1M NaI, 0.1M NaOH, and 0.1M $Na_2S_2O_3$ in order to efficiently remove the contamination without releasing Iodine to the atmosphere.

10. All waste should be sealed in double layers of plastic and disposed of immediately.

11. If exhaust filters are not used, the activity concentration of the exhaust must be monitored to assure compliance with NRC regulations concerning the release of Iodine-125 to the environment. See 10CFR20.103.

12. Clean and check all the working surfaces and equipment for contamination immediately after the procedure is finished. Take contamination wipes and count them with your samples. The survey instrument is useful for this work, but should not be used to perform the final check.

13. IT CANNOT BE EMPHASIZED TOO STRONGLY THAT NEAT, CAREFUL WORK HABITS WILL MINIMIZE BOTH CONTAMINATION PROBLEMS AND UNNECESSARY EXPOSURE TO PERSONNEL.

References

1. New England Nuclear Corp. Pamphlet: "Iodine-125 Guide to Safe Handling".
2. U.S. NRC Regulatory Guide 8.20 "Applications of Bioassay for I-125 and I-131".

Handling Procedures for Millicurie Quantities of Phosphorus-32

Phosphorus 32 emits a distribution of energetic beta particles, up to a maximum energy of 1.7 Mev, which can travel as far as 7 meters in air. The absorbed dose rate close to containers of millicurie quantities of P-32 is on the order rads/min. A significant fraction of P-32 entering the body deposits in the bone structure. The maximum permissible bone burden is 6 microcuries.

The following procedures should offer a guide to using sources of P-32 in excess of one millicurie.

1. Prepare a written set of procedures and submit them to the RSO for approval prior to the run.

2. Avoid handling the vial directly. Use remote handling tools, such as tongs or special holders when handling the source containers.

3. Use low density shielding (e.g. a minimum of 0.25 in. of plexiglass) to absorb the beta particles without generating significant amounts of X-rays by an interactive process called Bremsstrahlung. Heavy materials (high atomic number) should not be used close to the source because the Bremsstrahlung process is much more efficient for these materials. However, a small amount of lead on the outside of a plastic shield will absorb the Bremsstrahlung X-rays efficiently.

4. Wear Safety glasses to protect eyes from splashes and unnecessary radiation when working with more than 10 mCi.

5. Wear two sets of gloves; strip the outer pair off and replace if they become contaminated. Keep the inner pair clean at all times.

6. Have immediately available a properly operating G. M. detector for use in detecting contamination and radiation fields.

7. Wear personal dosimeter and finger dosimeters. The finger dosimeters are important because they will monitor the dose given to the fingers which the body dosimeter will not see.

8. Have your supervisor or the RSO observe during your first procedure.

9. After each procedure, survey the area with both the G. M. and wipes to eliminate any contamination.

Radioactive Waste Handling Procedures

Radioactive waste from experiments is taken from lab bench receptacles and put in the properly labeled 10 gallon galvanized cans located throughout the labs. When these cans are full, it is the responsibility of the Group Safety Coordinator to see that this radioactive waste is properly bagged, labeled and taken to the waste storage area. Experiments involving large amounts (200 micro curies) of radioisotope should be bagged, labeled and taken directly to the waste disposal area.

It is advised that each group leader make a duty roster of names for radioactive waste removal. In this way each scientist shares in the disposal burden and also shares in maintaining a safe environment.

SPECIFIC GUIDELINES FOR BAGGING WASTE

Persons handling radioactive waste should wear film badge, disposable gloves, and a lab coat. Persons should avoid working over the uncovered waste, since an uncovered direct path from a concentrated radioactive surface is not attenuated.

Make sure that dry waste is bagged in heavy duty polyethylene bags, the bags are tightly sealed, and labeled as the contents. Labels are available at the waste disposal area.

The label should have the following filled out:

Category: On the back of the form are the possible categories. Label the tag 1 - 7 (see below) as it pertains to the co. .ants. Liquid waste should be absorbed with absorbent material. This absorbent can be obtained from the RSO. Double the bags for scintillation vials. Cocktail can dissolve the bag.
Isotope: Enter isotope or isotopes in bag ^{32}P, ^{125}I, ^{35}S, ^{3}H or ^{14}C.
Chemical Name: dATP, dCTP, nucleotide, methionine, leucine, etc.
Activity (UA): Estimate on the high side the amount of activity in the bag.
Date: Enter today's date
Dept.: List your lab group/department
Bldg.: Enter 'Surface Technology' and room number.
Packed By: Person who filled the bag, and their extension.

DISPOSAL CATEGORIES

There are seven categories of radioactive waste recognized at Surface Technology. Waste must be bagged separately by category and labeled accordingly.

1) **^{3}H and ^{14}C Liquid Scintillation Vials.** Vials of these isotopes which have less than 100,000 cpm per vial on average. Double bag with no more than 200 20cc vials or 400 10cc vials per bag. This volume is about half of a 10 gallon can. (Disposal cost: $130/30 gallon barrel.)

2) **Liquid Scintillation Vials - Other Isotopes**. Double bag, no limit to number of vials per bag. (Disposal cost: $245/30 gallon barrel.)

3) **^{125}I and ^{131}I Solid Waste.** Bag all solid waste together, both burnables and non-burnables. Waste is stored until it decays to background. (Disposal cost: $90/30 gallon barrel.)

4) **Paper and Plastic (Burnable) Solid Waste**. Includes ^{32}P, ^{35}S, ^{3}H, and ^{14}C. Bag these isotopes together, but no metal or glass. (Disposal cost: $90/30 gallon barrel.)

5) **^{32}P and ^{35}S Non-Burnable Solid Waste**. Bag these isotopes together but exclude paper and plastics. Barrels are stored until decayed and disposed of in garbage. (Disposal cost: $90/30 gallon barrel.)

6) **^{3}H and ^{14}C Non-Burnable Solid Waste**. Bag together but exclude paper and plastic. (Disposal cost: $245/30 gallon barrel. Shipped out of state.)

7) **Liquid Waste**. Most aqueous waste can be disposed of down a properly labeled and designated lab sink at the following rates per day. Amounts disposed must be recorded at the sink and total per sink per day cannot exceed unity (i.e., 50% of daily limit for ^{32}P and no more than 50% of daily limit for ^{125}I). See list below.

Isotope	Daily Limit Per Sink
^{35}S	100uCi
^{32}P	10uCi
^{3}H	1mCi
^{14}C	100uCi
^{125}I	1uCi

If the aqueous waste is significantly higher than the daily limits, they can be stored in separate containers (separated by isotope) and taken to the disposal storage area.

****NOTE****Use of absorbent for liquid ^{3}H or ^{14}C generates solid waste which is very bulky and must be shipped out of state at $245 per barrel, so avoid this method of disposal whenever possible.

BE SURE TO ASK IF YOU HAVE ANY QUESTIONS ABOUT PROPER ISOTOPE HANDLING PROCEDURES.

THE WASTE DISPOSAL AREA IS REGULATED AND INSPECTED BY THE NRC. VIOLATION OF ANY OF THESE DISPOSAL PROCEDURES COULD RESULT IN THE SHUTDOWN OF THE DISPOSAL AREA AND RESTRICTIONS ON FUTURE COMPANY USE OF ISOTOPES!

SURFACE TECHNOLOGY, Inc.

Radioactive Material Inventory

Radioactive Material_____ User_____

Date Received_____ P.O. #_____

Date	Activity Used	Activity Remaining	Used by

SURFACE TECHNOLOGY, Inc.

Radioactive Waste Inventory

Disposed of empty container:_____ User:_____

Date	Radioisotope	Activity	User

TOTALS: (To be completed when the radioactive waste is shipped.)

Radioisotope	Total Activity (mCi)

APPENDIX 5

NUCLEAR REGULATORY COMMISSION REGULATIONS AND GUIDES

10CFR20

10CFR19

Regulatory Guide 8.10

Regulatory Guide 8.13

BETWEEN: C. James Holloway, Chief
License Fee Management Branch
Office of Resource Management

030-30125

John E. Glenn, Chief
Nuclear Materials Safety & Safeguards Section B
Division of Radiation Safety and Safeguar

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED

Applicant/Licensee: Surface Technology Inc.

Application Dated: 7/14/87

Control No.: 107538

License No.: New Application

2. FEE ATTACHED

Amount: 230.00

Check No.: 147

3. COMMENTS

Irradiator License

Signed Foster

Date 7/21/87

B. LICENSE FEE MANAGEMENT BRANCH

1. Fee Category and Amount: 3E $230

2. Correct Fee Paid. Application may be processed for:

Amendment _____

Renewal _____

License ✓

Signed S. Kimberley

Date 7/27/87

REGION I FORM 213
(MARCH 1987)