



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
October 20, 1992

Thomas S. Moore, Esq.
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Frederick J. Shon
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

James H. Carpenter
Administrative Judge
Atomic Safety and Licensing
Board
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

In the Matter of
SAFETY LIGHT CORPORATION, et al.
(Bloomsburg Site Decommissioning and License Renewal Denials)
Docket Nos. 30-05980-ML/ML-2, 30-05982-ML/ML-2

Dear Administrative Judges:

Pursuant to the request of Mr. Robert Pierce of your office, enclosed are two documents referred to in License Condition 14 of U. S. Radium Corporation's License Amendment No. 40, which were inadvertently omitted as part of Exhibit 2 to the NRC Staff's "Motion for Summary Disposition as to NRC Jurisdiction Over USR Industries, Inc., USR Lighting, Inc., USR Chemical Products, Inc., USR Metals, Inc., and U.S. Natural Resources, Inc." (June 30, 1992). The enclosed documents are as follows:

1. Letter from O. L. Olson (U. S. Radium Corp.) to Robert Dube (AEC), dated July 23, 1969; and
2. License renewal application submitted by U. S. Radium Corp., dated April 25, 1969, with attachments thereto.

I regret any inconvenience the omission of these materials may have caused you.

Sincerely,

A handwritten signature in cursive script that reads "Sherwin E. Turk".

Sherwin E. Turk
Senior Supervisory
Trial Attorney

cc: Service List



UNITED STATES RADIUM CORPORATION
4150 OLD BERWICK ROAD / BLOOMSBURG, PA. 17815 / (717) 784-3510

1679

July 23, 1969

United States Atomic Energy Commission
Division of Materials Licensing
Isotopes Branch
Washington, D. C. 20545

Attn: Mr. Robert Dube

Gentlemen:

Enclosed are six (6) copies of an addition to the Health Physics program submitted with license renewal applications for licenses 37-00030-07, 37-00030-02 and an application for a new license.

These are additions, not replacements, which we should appreciate your inserting into the material sent to you as indicated above.

Thank you.

Sincerely yours,

UNITED STATES RADIUM CORPORATION

A handwritten signature in cursive script, appearing to read "O. L. Olson".

O. L. Olson
Director
Nuclear Division

OLO
jrn

Encs.

DUPLICATED
FOR DIV. OF COMPLIANCE

XIX-04

6.0 Entry requirements for Nuclear Division buildings.

6.1.1 Orientation.

6.1.2 Nuclear Division employees.

All Nuclear Division employees must receive a yearly orientation briefing by Health Physics concerning entry and emergency exit procedures, and the meaning of the various signs and symbols in use by the Division.

6.1.3 U.S. Radium employees other than Nuclear Division employees.

Any non-Nuclear Division employee of U. S. Radium must have received an orientation lecture similar to that in 4.1.1 within six months prior to the time of entry unless special authorization is granted by the Radiation Protection Officer.

6.1.4 Visitors other than U. S. Radium employees.

Visitors not employed by U. S. Radium will be admitted to Nuclear Division buildings only with special authorization by Health Physics, and 1) must be accompanied by U. S. Radium personnel who have received an orientation briefing within the last six months, or 2) themselves must receive an orientation briefing from Health Physics prior to entry.

6.1.5 Orientation records.

A record will be kept of those people who have received an orientation briefing by Health Physics.

6.1.6

Sign-in procedure.

All U. S. Radium employees other than Nuclear Division employees, and all visitors who are not employed by U. S. Radium, must sign the Entry Record sheet posted at the entrance of the building used by the visitor in question.

UNITED STATES ATOMIC ENERGY COMMISSION
APPLICATION FOR BYPRODUCT MATERIAL LICENSE

INSTRUCTIONS. - Complete Items 1 through 16 if this is an initial application or an application for renewal of a license. Information contained in previous applications filed with the Commission with respect to Items 8 through 13 may be incorporated by reference provided references are clear and specific. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail two copies to U.S. Atomic Energy Commission, Washington, D.C., 20545, Attention: Isotopes Branch, Division of Materials Licensing. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the License is subject to Title 10, Code of Federal Regulations, Part 30.

1 (a) NAME AND STREET ADDRESS OF APPLICANT (Manufacturer, firm, hospital, person, etc. Include ZIP Code.)
**United States Radium Corp.
4150 Old Berwick Rd.
Bloomsburg, Pennsylvania 17815**

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED (If different from 1 (a). Include ZIP Code.)

2 DEPARTMENT TO USE BYPRODUCT MATERIAL
Nuclear Division

3 PREVIOUS LICENSE NUMBER(S). (If this is an application for renewal of a license, please indicate and give number.)
37-00030-02 (renewal)

4 INDIVIDUAL USER(S) (Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)
**D.B.Cowan Mgr., Gas filling dept.
G.E.Widger Vgr, Isolite assembly dept.
I.W.Allan Mgr., Poil preparation dept.**

5 RADIATION PROTECTION OFFICER (Name of person designated as radiation protection officer if other than individual user. Attach records of his training and experience as in Items 8 and 9.)
J. D. McGraw

(a) BYPRODUCT MATERIAL (Element and mass number of each)	(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME (If sealed source(s), also state name of manufacturer, serial number, number of sources and maximum activity per source.)
Any byproduct material with Atomic Numbers between 3 and 83, inclusive.	100 millicuries each excepts:
	Carbon 14 0.5 curie
	Cobalt 60 50 curies
	Nickel 63 5 curies
	Krypton 85 1500 curies
	Strontium 90 100 curies
	Ruthenium 106 1 curie
	Cesium 137 250 curies
	Cerium 144 5 curies
	Promethium 147 100 curies
	Thallium 204 25 curies
Hydrogen 3	Any 40,000 curies
Polonium 210	Any 15 curies
Actinium 227	Any 1 curie
Neptunium 237	Any 0.01 curie
Americium 241	Any 32 curies

7 DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. (If byproduct material is for "burnup use," Supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)

a) Decontamination, clean-up and disposal of areas previously used for research, development and processing under this license.

b) Distribution to authorized recipients of material of value that are not radioactive scrap.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 (Use supplemental sheet if necessary)

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)		FORMAL COURSE (Circle answer)	
			Yes	No	Yes	No
a. Principles and practice of radiation protection	See Item 8 attachment.		Yes	No	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes	No	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes	No	Yes	No
d. Biological effects of radiation			Yes	No	Yes	No

9. EXPERIENCE WITH RADIATION (Actual use of radioisotopes or equivalent experience)

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
See Item 8 attachment.				

10. RADIATION DETECTION INSTRUMENTS (Use supplemental sheets if necessary)

TYPE OF INSTRUMENTS (Include make and model number of each)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm ²)	USE (Monitoring, surveying, measuring)
See Item 10 attachment.					

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE

See Item 11 attachment

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. (For film badges, specify method of calibrating and processing, or name of supplier.)

See letter USRC to Mr. R. E. Brinkman 5-20-65 (with attachment).

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS IN DUPLICATE

- 13. FACILITIES AND EQUIPMENT Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached (Circle answer) Yes No
See above letter (with attachment)
- 14. RADIATION PROTECTION PROGRAM Describe the radiation protection program including control measures. If applicable, attach test procedures where applicable, name, training, and experience of person to perform test, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.
See attached copy HSOP 27.
- 15. WASTE DISPOSAL If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.
Nuclear Engineering Corp, Waverly, Ky.

CERTIFICATE (This form must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PART 30, AND THAT ALL INFORMATION CONTAINED HEREIN, INCLUDING ANY SUPPLEMENTS ATTACHED HERETO, IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF:

Date April 25, 1969 **RECEIVED APR 29 1969** By: O. L. Olson
 UNITED STATES RADIUM CORP.
 Applicant named in Item 1
 O. L. Olson
 Director, Nuclear Division
 Title of certifying official

WARNING.—18 U. S. C., Section 1001, Act of June 25, 1948, Sec. 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.

68807



ORGANIZATION CHART

ITEM 9 ATTACHMENT

ITEM 8 ATTACHMENT

NUCLEAR PRODUCTS DIVISION

O. J. OISON
DIRECTOR

J. Melwender
Secretary

Quality
Control

Isolite
Assembly

Foils
Preparation

Gas
Filling

Phosphor
Application

Ivor Allen(1)

D. R. Cowan(1)

G. E. Widger(1)

J. D. McGraw(1)

Screening
Applications

Hand Painted
Applications

Measurements

Health
Phys.

(1)-(6)

D. Swank (3)

R. E. Rickert(3)

M. Slusser(3)

M. K. Carl(2)

E. Fisher(2)

(3)-(6)

F. Puckett(3)

M. Middleton(3)

C. Ferlin(2)

P. Welsh (5)

(3)-(6)

J. Rex(3)

C. Walter(3)

A. Tyson(5)

W. Peaver(5)

H. Houser(3)

H. Brewer(1)

J. McGurley(5)

H. Dildine(5)

D. Carl(5)

E. Harlins(3)

G. Hook(3)

T. Pruech(3)

A. Kille(3)

(1) Department Manager

(2) Technician

(3) Indicates a bargaining unit production worker

(4) Janitor

(5) Temporary position

(3)-(6) TO BE SELECTED

R E S U M E

J. David McGraw

I Personal

Home address: Lincoln Manor, Bloomsburg, Pa. 17815
Age: 27
Family status: Married with three children.

II Education

<u>Date (inclusive)</u>	<u>Degree/Field</u>	<u>School</u>	<u>Graduated</u>
9-59 to 6-63	B.S. in Chemistry	U. of Scranton	1963

III Work Experience

<u>Date (inclusive)</u>	<u>Company and Location</u>	<u>Job Title - responsibilities</u>
10-2-67 to present	U. S. Radium Corp. Bloomsburg, Pa.	Health Physicist. Initially responsible for installation and operation of stack and room air tritium monitors, liquid scintillation counter, alpha and gamma spectrometers. Presently responsible for administration of overall Health Physics program.
7-5-65 to 9-30-67	Applied Science Labs., State College, Pa.	Production supervisor. Responsible for all products of Carbon-14 labeled biochemicals. Responsible for all connected quality control and health physics services.
6-10-63 to 6-30-65	Norwich Pharmacal Co., Norwich, N.Y.	Analytical Chemist. Responsibilities included routine and non-routine chemical analysis of raw materials and finished pharmaceuticals. Some methods development.

III Work Experience

Date (inclusive)

Company and
Location

Job Title - responsibilities

Summers of 1961,
1962.

Dept. of
Pharmacology,
Yale School of
Medicine,
New Haven, Conn.

Lab. technician.
Carried out biological
pathway studies using Tritium
labeled substrates.

PERSONAL RESUME

Name: Olson, Orval Lenard

I. Personal

Home Address: 164 Martha Ave., Centerville, Ohio 45459
Age: 49 Birth Date: July 8, 1920
Birth Place: Volin, So. Dak.
Height: 5'7" Weight: 165 lbs.
Family status: Married
Dependents: Wife and three children.

II. Education

<u>Date(inclusive)</u>	<u>Degree/Field</u>	<u>Year Graduated</u>
9/1950-5/1951	- Biochemistry So. Dak. State College	-
1/1947-5/1950	B.A. Chemistry U. of So. Dak.	1950
Winter months- 1939, 40, 41	- Business Administration College, Mo. courses	-

III. Work Experience

<u>Date(inclusive)</u>	<u>Location</u>	<u>Job Title</u>
6-1-68 - 10-31-68	U. S. Radium Corp.	Health Physicist

Major Responsibilities

1. Reorganize Health Physics program at Bloatsburg plant to conform to A. E. C. license requirements.
2. Reorganize Health Physics program at Bloatsburg plant to reduce program cost.

III Work Experience (continued)

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
6-1-68 - present	U. S. Radium Corp.	Director, Nuclear Div.

Major Responsibilities

1. Recommend a reorganized division that can profitably produce products of radioisotopes.
2. Design a facility to produce radioisotope products in full conformance with applicable government regulations.
3. Assume responsibility for all U. S. Radium Corp. radioisotope development and production activities.

IV Work Experience with Monsanto Research Corporation -

8-29-66 - 5-31-68	Mound Laboratory, Miamisburg, Ohio	Senior Health Physicist
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Major Responsibilities

1. Advise the Manager, Health Physics, in all areas of health physics.
2. Advise the Manager, Health Physics, in the development of integrated data processing for health physics data.
3. Advise supervisors, Health Physics, regarding methods, techniques, procedures, modifications, facilities and equipment.
4. Advise supervisors, Health Physics, regarding the execution of an integrated data processing system for health physics data.
5. As required, prepare radiation safety hazard analysis reports for the Manager, Health Physics, including Maximum Credible Accident analysis and Safety Analysis Reports required by the :
6. As required, advise plant personnel on specific problems relating to health physics.
7. Participate in training programs to develop capabilities of Mound personnel in areas relating to health physics.

IV

Work Experience (continued) - Monsanto Research Corporation -

Specific Activities:

1. Recommend design of and calibration system for new film badge dosimeter at Mound Laboratory.
2. Wrote a manual of Health Physics performance specifications for facilities and equipment used to process radioactive materials.
3. Directed the development and installation of a data processing system for producing and maintaining personnel radiation exposure records.
4. Assist Manager, Health Physics in developing health physics budgets for fiscal years 1969 and 1970.
5. Gave two lectures to a training course for Health Physics certification examination. Course sponsored by the Cincinnati Radiation Society.

Lecture 1 - Health Physics in Fuel Element Processing plants 3-4-68

Lecture 2 - Health Physics in Radiochemical Laboratories 4-16-68.

V. Work Experience (continued) - Controls for Radiation, Inc. -

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
11-29-65 - 8-26-66	Goddard Space Flight Center.	Senior Health Physicist

Duties:

1. Assure compliance with the Code of Federal Regulations Title 10, parts 20 and 30 and assure compliance with pertinent Interstate Commerce Commission regulations.
2. Plan and supervise Health Physics programs involving radiation sources of many different isotopes. Consult with experimenters and recommend Health Physics precautions for their projects.
3. Supervise a film badge radiation monitoring program.
4. Recommend equipment needed for Health Physics activities at the Goddard Space Flight Center.
5. Produce reports on radiation incidents for the Goddard Space Flight Center Radiological officer and, when required, for the Atomic Energy Commission.
6. Write letters of request to the Atomic Energy Commission when changes to Byproduct Materials licenses are required.
7. Plan environmental surveillance program for Plutonium-238 - an isotope to be used in SNAP electrical generators on future space craft.
8. As assistant project manager, function as the responsible company representative when the project manager is absent.

V. Work Experience (continued) - Controls for Radiation Inc. -

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
3-30-64 - 11-26-65	Sandusky, Ohio	Health Physicist

Duties:

1. On a rotating shift, responsible for Health Physics activities and industrial safety activities.
2. Supervised technicians in routine sampling and survey programs to detect radioactivity.
3. Worked with engineers in planning and executing equipment changes that involved installation and removal of experiments from a 60 megawatt test reactor.
4. Worked with Scientists in carrying out activities in "hot laboratory" cells. Work in the "hot laboratory" included work with irradiated uranium samples.

VI. Work Experience with General Electric Co.

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
7-1-60 - 3-20-64	Hanford Atomic Products, Oper. Data Processing Dept.	Data Processing Analyst

Duties: Develop and maintain programs to process technical data on IBM 7090 computer. Detailed responsibilities included:

1. Assisted technical personnel to define data processing programs.
2. Determined the optimum data processing procedures.
3. Prepared cost and completion date estimates.
4. Coded the required computer programs to process data. Fortran and Share 9 PAC programming systems were used.
5. Planned all operating procedures and instructed computer operations personnel how to proceed.

This assignment resulted from a project that was intended to develop data processing systems for reactors which required personnel with reactor operation experience at the data processing center.

VI

Work experience (continued) - General Electric Co. -

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
4/1958 - 7/1960	Hanford Atomic Products Oper. Irradiation Processing Dept.	Reactor Operations Supervisor

Duties:

1. Supervise Operations and Maintenance personnel during the loading and unloading of fissionable materials in reactors.
2. Supervise crews of Operations and Maintenance personnel in cooperation with Maintenance supervision to accomplish repair and maintenance of reactors.
3. Had administrative responsibility for seven pile operators from February, 1959 to July, 1960.

12/1955 - 4/1958	Hanford Atomic Products Oper. Irradiation Processing Dept.	Radiation Monitor Supervisor
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Duties:

1. Maintain radiation safety for all personnel in four reactor areas.
2. Supervise up to 16 radiation monitors during reactor outage work.
3. Administrative responsibility for eight radiation monitors.

2/1954 - 12/1956	Hanford Atomic Products Oper. Research and Development Process Chemistry Oper.	Chemist
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Duties:

Provide assistance to Separations Plants by studying deviations of the chemical separations process from the planned flow sheet and recommending corrective action.

VI. Work Experience (continued) - General Electric Co. -

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
8/1953 - 2/1954	Hanford Atomic Products Oper. Research and Development Hot Semi Works Oper.	Engineer

Duties:

1. Work with a team of engineers to operate a Pilot Chemical Separations Plant.
2. Assist in developing reports from the data obtained.

7/1951 - 8/1953	Hanford Atomic Products Oper. Technical Services Equipment Development Operation	Engineer
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Duties:

Design laboratory equipment for analytical and research laboratories. Primarily gadgeteering type of development to provide many pieces of unique equipment needed to handle radioactive materials.

VII. Work Experience prior to General Electric

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
9/1950 - 7/1951	So. Dak. State College Experiment Station, Chemistry Dept. Brookings, So. Dak.	Chemist

Work experience: Provide routine chemical analysis to other departments at the college. Develop analytical methods required for specific studies.

8/1941-5/1944	Convair San Diego, Calif.	Armament mechanic
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Work experience: Analyze and repair new gun turrets for B-24 bombers.

VIII

Military Service

<u>Date (inclusive)</u>	<u>Service</u>	<u>Branch</u>	<u>Highest Rank</u>
5/1944-4/1946	Army	Air Force	Corporal

Special training or experience: Trained as Gunner on B-17 bomber crew.

IX

Miscellaneous Activities, Interests and TrainingMembership in Professional Societies, Clubs, Organizations

Health Physics Society

American Nuclear Society

Community Activities and Sports

One Design Class Sailboat racing

Pleasure sailing

Church activities

Hunting and fishing when available.

R E S U M E

Name Ivor William Allam
Address 15 Central Avenue, Carroll Park,
Ebensburg, Pennsylvania 17815
Born March 31, 1921
Ocean Falls, British Columbia, Canada
Citizenship Canadian
Wife Isabella Adelaide Salway Allam
Children None
Alien Registration Number A 10 606 568
Social Security Number 193-32-1869

Education

Junior matriculation	June 1938	Duke of Connaught High School, New Westminster, British Columbia
Senior matriculation	June 1939	Duke of Connaught High School, New Westminster, British Columbia
Special commercial course	June 1940	E. J. Trapp Technical School, New Westminster, British Columbia
Bachelor of Arts University of British Columbia	Second class honours in Chemistry June 1953 Vancouver, British Columbia	
Special "Radio- chemistry" course	1954	Conducted by Dr. A. P. Baerg and Dr. R. E. Jarvis, Atomic Energy of Canada Ltd., Chalk River, Ontario

Upon graduation from U.B.C., I was hired by Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada, as Junior Research Officer. I went through a four-month training period where I trained from two to four weeks in various sections of the plant, such as isotope separations, process chemistry, radiochemical analysis, reactor operations. While in reactor operations, I served for a month as "Information Access Operations Officer" on the decontamination of the NRX Reactor after the fuel rod rupture incident of December, 1952. At the end of the training period, I underwent a fairly comprehensive examination, then was assigned to the process chemistry section. My principal work over the four-year period until I left A.E.C.L. was on the ion exchange separation and purification of Plutonium. A number of in-plant reports were issued on this work and I understand a patent was applied for. I also conducted several investigations on purifying other isotopes by ion exchange. I built various pieces of apparatus for processing 100 gram quantities of Plutonium and for dissolving Plutonium/aluminum alloy booster rods and to my knowledge the only reportable incidents from this work was a period of high hand exposure, due to the necessity of operating stopcocks inside shielded areas.

I left A.E.C.L. in October, 1957 and entered the employment of U. S. Radium Corp., Bloomsburg, Pa. as a research chemist. Initially, I worked with Dr. C. Wright on filling light sources with Tritium, and on tritiation of organic and inorganic materials. Total Tritium inventory at this time was 50 curies. After about four months, Dr. Wright left and I continued working with gradually increasing amounts of Tritium. After satisfying myself that a Willbach type reaction would not yield tritiated organics of sufficiently high specific activity, I developed a catalytic tritiation technique which we applied to tung oil. This yielded a highly active material for exciting phosphors which was patented. After experimenting with existing vacuum metallizing techniques, I designed and built a special vacuum system in 1959. This combined a vacuum metallizing and Tritium impregnation system to manufacture Tritium in titanium clad sheet. This typically involved absorption of 200 to 300 curies per run and an inventory of 1000 curies. This system was modified and improved through the next seven years and by 1966 was handling about double the amount of Tritium. All the main production at this time was sheet material, usually .002" type 302 SS or .010" OFHC copper backed, though some coatings were applied to special backings, usually supplied by the customers. The sheet material was cut to provide full area active material, typically stainless backed gas chromatographic sources or copper backed neutron generator targets. We were troubled with an unavoidable lack of uniformity in the coating thickness, and encountering an increased demand for inactive edge material. I therefore designed and built a new larger, inactive, vacuum metallizing system incorporating a rotator. This made production of uniform coatings and

have edge materials comparatively simple. I proved it was possible to impregnate these units with Tritium, and modified and rebuilt the Tritium system to do this impregnation. This system typically has a pickup of 1000 curies/tun and involves an inventory of about 4000 curies of Tritium gas. In addition to the above work, I assisted in the design and building of special dryboxes, measurement apparatus, Tritium effluent removal systems, etc.

At varied intervals, as press of other duties permitted, I was also involved with other isotope radiation sources. I did a certain amount of development work associated with Cesium and Strontium sources. I developed a technique and apparatus for electrodeless Michel plating which I applied to production of Mischel-53 plated strips for such things as gas chromatography sources.

I am currently designing improved impregnation apparatus for Tritium on titanium sources, and expect to continue experimental work on the preparation of sources incorporating Tritium in other reactive metals.

RESUME

Donald B. Cowan

Education: I graduated from McGill University, Montreal, Canada in 1952 with a Bachelor of Science degree in chemistry.

Employment Record:

1957 to present U. S. Radium Corp.

For the first three months I worked directly under Dr. C. Wright. He trained me in the handling of Kr-85 and H-3 gas. After this training period was completed, I assumed responsibility for the handling of these radioactive gases. This included the design and construction, then maintenance of all the radioactive gas handling equipment, with the exception of tritium foil production equipment, that has been in use in this plant since 1957.

Since the completion of the original training period, I have been responsible for research in the following areas:

- 1) Kr-85 radiation and light source improvement, design and production.
- 2) H-3 light source improvement, design and production.
- 3) Starting in 1959, the investigation of methods of producing tritium activated phosphor, the evaluation of the resulting phosphors and then the production of tritiated phosphor.
- 4) Release control of tritium from processing equipment.

During this period, I trained the two technical research men that joined our group.

1951 to 1957 Iron Ore Company of Canada

I worked here as an analytical chemist from 1951 to 1954. In 1954, I was made Chief Chemist of the laboratories in the Schefferville area. As such, I was responsible for the sampling, preparing and analyzing of all ore produced and the preparation and analyzing of all exploration samples both iron and base metal. The research and development of new analytical methods such as x-ray spectroscopy was under my supervision. This entire operation involved the direct training and supervision of a forty-five man staff. Added experience gained was being responsible for the designing and setting up of five laboratories.

Miscellaneous Experience prior to 1951

One and one-half years as an analytical chemist with Canada Cement Co. and one year in sample preparation with International Nickel at their Sudbury, Ontario smelter.

RESUME

George E. Widger

I Personal

Home address: R.D. 2 Catawissa, Penna. 17820

Age: 40

II Education

	<u>Degree/Field</u>	<u>School</u>	<u>Graduated</u>
1942-1946		Catawissa High School	1946
1946-1950	B.S. Education	Bloomsburg State College	1950

III Work Experience

<u>Date (inclusive)</u>	<u>Location</u>	<u>Job Title</u>
1964 - present	U. S. Radium Corp. Bloomsburg, Pa.	Manager, Isolite Assembly

Major Responsibilities

1. Supervise assembly of aircraft self-luminous exit placards and other tritium activated self-luminous products.
2. Participate in the development of new and improved tritium activated self-luminous products.

1954 - 1963	U. S. Radium Corp. Bloomsburg, Pa.	Laboratory Supervisor.
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Major Responsibilities

1. Supervise production of radioactive metal foil products.

1952 - 1954	U. S. Radium Corp. Bloomsburg, Pa.	Laboratory technician
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Major Responsibilities

1. Produce radioisotope products as directed by laboratory management. Experience includes products with Strontium-90, Carbon-14 and Thallium-204.

PERSONAL RESUME

Robert E. Carl

I Personal

Address: 331 1/2 Old Service Rd., Bloomsburg, Pa. 17815
 Age: 36
 Height: 6 ft.
 Weight: 170 lbs.
 Family Status: Married
 Dependents: 3

II Education

Date (Inclusive)	Degree/Field	School	Year Graduated
1946 - 1950	Academic	High School	1950
1966	Mathematics	Bloomsburg State College	-
1968 - present	Physics	Williamport Community College	Presently attending

III Work Experience

Date (Inclusive)	Location	Job Title
1955 - present	U. S. Radium Corp.	Development Specialist
1951 - 1955	U. S. Marine Corps.	Sergeant

Major Responsibilities -

U. S. Radium Corp. - 13-3/4 years Health Physics, including environmental air, water and soil sampling and preparation. Quality control measurement of self-ionizing and radation sources. Repair and calibrate electronic equipment. Instrum. and supervise less qualified personnel.
 U. S. Marine Corps - 4 years military service. Motor vehicle dispatcher, directed and supervised approximately 10 personnel, maintained records and supplies for company vehicles.

ITEM 10 ATTACHMENT

RADIATION DETECTION INSTRUMENTS

HEALTH PHYSICS MANUAL

APPENDIX I

INSTRUMENTS

Type	No.	Radiation detected	Sensitivity	Window thickness	Use	Calibration
Triton 955 with recorder (β)-compensated ion chamber	3	Tritium (can also be used for γ monitoring)	1×10^{-6} $\mu\text{Ci/ml}$ Tritium $\gamma - 0.005$ mr/hr	-	monitoring	Permanent calibration at factory. Checked initially and after repair with Triton CL-1 calibrator.
Triton 805 (β)-compensated ion chamber	1	same as 955 above	1×10^{-6} $\mu\text{Ci/ml}$ Tritium $\gamma - 0.005$ mr/hr	-	monitoring	same as 955
Triton 755B with recorder (β)-compensated ion chamber	2	same as 955 above	2×10^{-6} $\mu\text{Ci/ml}$ Tritium $\gamma - 0.01$ mr/hr	-	monitoring	same as 955
Cary 401 Vibrating Reed electrometer with ion chamber and recorder	3	Tritium	1×10^{-6} $\mu\text{Ci/ml}$ Tritium	-	monitoring	Calibrated upon installation and after repair with Matheson Co. calibrated Tritium/Nitrogen mixture. Same as Cary 401.
Cary 330 Tritium air monitor with ion chamber and recorder	1	Tritium	2×10^{-6} $\mu\text{Ci/ml}$	-	monitoring	Same as Cary 401.
Brüel-Keiser 435 detector with PA224 and custom internal proportional counter	1	Tritium	4.5×10^{-4} μCi	-	measurement	Calibrated quarterly with Matheson Co. Tritium-P10 standard gas mixture.

APPENDIX I

INSTRUMENTS

Type	No.	Radiation detected	Sensitivity	Window thickness	Use	Calibration
Radio-Atomic 435 meter with Pa224 and Alpha accessories 2 inch internal proportional counter.	1	alpha, beta, gamma	2×10^{-5} uCi (9×10^{-4} uCi for Tritium)	-	measurement	Calibrated monthly with appropriate standards from Appendix II.
Radio-Atomic 430A voltmeter with Custom pump and Custom 2 inch internal proportional counter.	1	alpha, beta, gamma	2×10^{-5} uCi (9×10^{-4} uCi for Tritium)	-	measurement	same as above.
Electro-Scintronics EM-200 with Pacite 64 tube.	1	beta-gamma, gamma	0.05 mr/hr 50 cpm	3.5 Mg/cm ² 0.85 mm/cm ²	survey	Same as above.
Electro-Scintronics EM-200	1	alpha	50 cpm	0.85 mm/cm ²	survey	Same as above.
Electro-Scintronics Corp. 1029	1	alpha, beta, gamma	2×10^{-5} uCi	-	measurement	Calibrated daily with appropriate standards from Appendix II.
Electro-Scintronics Corp. 1034	1	alpha, beta, gamma	2×10^{-5} uCi	-	measurement	Same as above.
Electro-Scintronics Corp. 1034 Liquid scintillation counter with 3-C 303A scint.	1	alpha, beta	2×10^{-5} uCi	-	measurement	Same as above.

APPENDIX I

INSTRUMENTS

Type	No.	Radiation detected	Sensitivity	Window thickness	Use	Calibration
Packard model 3380 large channel reduced geometry liquid scintillation counter with model 54h absolute activity analyzer.	1	alpha, beta	$1 \times 10^{-5} \text{ Ci}$	-	measurement	Same as above
Packard model 116 (6) channel analyzer with $3'' \times 3''$ NaI(Tl) crystal	1	gamma	to be determined	-	measurement	Same as above

ITEM 11 ATTACHMENT

CALIBRATION STANDARDS

APPENDIX II
Standards List

<u>Source</u>	<u>Activity</u>	<u>Concentration</u>	<u>Type</u>
* 15544	Ra ²²⁶ gamma	10.0 mCi	needle
* 13528	Ra ²²⁶ gamma	2.0 mCi	needle
R-3	Ra ²²⁶ gamma	85.6 uCi	Ag-foil-Ag
R-4	Ra ²²⁶ gamma	28.0 uCi	Ag-foil-Ag
R-5	Ra ²²⁶ gamma	5.2 uCi	Ag-foil-Ag
R-6	Ra ²²⁶ gamma	1.0 uCi	Ag-foil-Ag
R-7	Ra ²²⁶ gamma	0.9 uCi	Ag-foil-Ag
-	Co ⁶⁰ beta-gamma	0.15uCi	needle
-	Co ⁶⁰ beta-gamma	0.1 uCi	needle
-	Cs ¹³⁷ gamma	10.0 uCi	Sandia-metal
58	Sr ⁹⁰ beta	50.0 uCi	631-2
61	Sr ⁹⁰ beta	50.0 uCi	.631-2
** Amr 23	Am ²⁴¹ alpha	0.1 uCi	disc
R-240	Sr ⁹⁰ beta	2.16 x 10 ⁻² uCi	disc
** B14-73	C ¹⁴ beta	0.125uCi	disc
MX-10630/ PDR-27	Ra ²²⁶ gamma	7.0 uCi	Rod
** 4904-A-117	Am ²⁴¹ alpha	1.03x10 ⁻⁴ uCi	disc
** SN-1387	U ²³⁸ alpha	2.64x10 ⁻³ uCi	disc
** CT-100 #GS1039	gamma spectrometry set (Saird Atomic)	exempt quantity	Rod
* No. 6 USR	U ²³⁸	2 x 10 ⁻³ uCi	disc
** AIC	mixed source set	exempt	disc
** #1115	H ³	exempt	Liq. Scin.
** #10144	H ³	exempt	"
** #16014	C ¹⁴	exempt	"
** #10144	C ¹³⁵	exempt	"

* calibrated by NBS
** calibrated by manufacturer

Sources

Activity

Concentration

Type

Assorted light standards:

H³

10.0 C total

Sr90

200 uCi total

Ra226

150 uCi total

Kr85

5.0 C total

HP SOP 27

LABORATORY SAFETY

AND OPERATING

RULES

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LABORATORY SAFETY AND OPERATING RULES

(These rules are supplemental to Plant Rules)

It is the responsibility of each individual who has any contact with radioactive materials or radiation to abide by these rules which are written primarily for minimizing any personal exposure.

The following references shall be used as guides:

National Bureau of Standard Handbooks:

- 27 - Safe Handling of Luminous Compounds
- 42 - Safe Handling of Radioisotopes
- 48 - Control and Removal of Contamination in Laboratories
- 54 - Protection against Radiation from Radium 226, Cobalt 60, Cesium 137.
- 59 - Permissible Dose from External Sources of Ionizing Radiations.
- 63 - Protection against Neutron Radiation up to 30 million volts.
- 69 - Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radio-nuclides in Air and in Water for Occupational Exposure.
- 80 - A Manual for Radioactivity Procedures. Chapter 4, Article 433, Pennsylvania Regulation for Radiation Protection.

Title 10, Code of Federal Regulations, Parts 10, 20, 30, 71.

Title 46, Code of Federal Regulations, Parts 71-79, 197.

Atomic Energy Commission Licenses:

37-30-2	GL-112	GL-165
37-30-3	GL-117	GL-237
37-30-6	GL-122	G-253
37-30-7	GL-124	
XB 30-7-168	GL-126	



O. L. Olson
Radiological Safety Officer

W. E. Umstead
Manager
Bloomsburg Division

I. Visitors

- A. All visitors must register at the reception desk in the lobby before entering and upon leaving the Lab.
- B. Visitors will be furnished appropriate personal dosimeters.
- C. Visitors must wear protective apparel.
- D. Visitors must be escorted by the hosting lab. personnel who will insure that visitors comply with the rules applicable to them.

(2)

II. Entrance and Exit

- A. All entries into the Lab will be made through the door located to the east of the conference room.
- B. All exits will be made in reverse pattern to the above.
- C. All other doors are for emergency exit or special purposes and will not be used for short-cut traffic.

III. Personnel Exposure

- A. The average maximum permissible dose for the whole body must not exceed 150 mrem/week of the following exposures which are additive.
 - 1. Milliroentgens of X or gamma radiations.
 - 2. Millireps of beta and/or gamma radiations.
 - 3. Millirems of neutron radiation.
 - 4. Millirems of internal beta radiation as produced by tritium.

- B. Where dose reserves have greatly diminished through accumulative occupational exposure so as to conflict with the basic equation; $\text{Dose} = 5(N-18)$ rems/year (where N equals the individual's age in years at his last birthday), the average maximum permissible whole body dose must vary according to individual history and may be considerably less than 100 mrem/week. Individuals so effected will be advised and must take special precautions to further minimize their exposures.

- C. The average maximum permissible dose for hands-forearms and feet-ankles must not exceed 1400 mrem/week of additive and combined exposures from X, gamma, beta and neutron radiations.

- D. The average maximum permissible dose from internal exposure to tritium must not exceed 90 mrem/week.

- E. Internal doses resulting from exposures to isotopes other than tritium are based on maximum allowable body burdens and are determined by bioassay. Tolerances are go-no go, and exceeding a tolerance requires work restriction until the body burden value reappears in the go range.

IV. Protective Apparel

A. Clothing

1. All personnel handling solid or liquid forms of radioactive material must change to coveralls.
2. All personnel handling mixed forms of radioactive material, gaseous, solid or liquid, must change to coveralls.
3. Personnel handling only gaseous forms of radioactive material may wear Lab coats provided that they are not required to enter areas where solids or liquids are processed.
4. Visitors, and non-operating personnel not otherwise specified, may wear Lab coats or coveralls.
5. All personnel will wear properly marked clothing.
6. The clothing will be properly stored after use in the appropriate hanger space.

IV. Protective Apparel (continued) -

B. Overshoes

1. All personnel entering a restricted area provided with a rubber change station must wear rubber overshoes, or old street shoes which are to be worn and retained only in a designated Lab section.
2. Traffic from one Lab section to another will necessitate additional rubber changes at each respective change station.
3. All personnel will wear properly marked rubbers, or shoes.
4. The rubbers, or shoes, will be properly stored after use in appropriate storage bins.

C. Safety Face Shields

Safety face shields will be worn by all personnel handling sources filled to greater than 1 atmospheric pressure with radioactive gases.

IV. Protective Apparel (continued) -

E. Gloves

1. Rubber Gloves

Rubber gloves should be worn whenever possible and must be worn during the following operations:

- a. Powder grinding
- b. Compact die filling
- c. Removal of compact from die
- d. Cleaning of compact and die
- e. Rolling compact
- f. Compact handling:
 - i. Weighing
 - ii. Measuring
 - iii. Cutting
 - iv. Setting up welds
- g. Foil handling:
 - i. Rolling
 - ii. Stripping
 - iii. Plating
 - iv. Cutting
 - v. Measurement
 - vi. Installation
- h. Tube breaking
- i. Liquid transfers
- j. Compounding:
 - i. Buretting
 - ii. Filtering
 - iii. Digesting - precipitation
 - iv. Screening - blending
 - v. Weighing
 - vi. All powder transfers
- k. All manipulation of radioactive gas handling apparatus and equipment.
- l. All cleanup and decontamination operations.

IV. Protective Apparel (continued) -

E. Gloves (continued)

2. Welding Gloves

Welding gloves will be used when handling glass housings filled to higher than 1 atmosphere of pressure with radioactive gases.

F. Respirator Masks

Respirator masks must be worn during all operations not performed within hoods or dryboxes where there is a possibility of a dust hazard. Particularly

1. Weighing and handling of beryllium powder
2. Transferring loaded dies and pressing compacts
3. Pressing compacts
4. Cleaning up spills.

V. Personnel Monitoring

A. Film Badges

1. All personnel working in the laboratory or any other radiation area will wear film badges.
 - a. The film badges will be picked up at the storage area at start of shift and re-stored at the end of shift.
 - b. Film badges are not to be misplaced or laid down in any radiation area.
 - c. Film badges are not to be taken home or lost.
 - d. When wearing a lead apron, film badges are to be worn underneath the apron.
2. All visitors will wear film badges or pocket chambers.

B. Finger Rings

All personnel handling radioactive materials, under conditions where the hand dose might exceed the whole body dose and especially the following, must wear finger ring dosimeters.

1. Handling-rolling compacts and foils made of:
 - a. Strontium 90
 - b. Americium 241
 - c. Lead 210
2. All glove box operations, not supplied with remote manipulators, where the following isotopes are processed:
 - a. Strontium 90
 - b. Ruthenium 106
 - c. Cesium 137
 - d. Cobalt 60
 - e. Lead 210
 - f. Americium 241
 - g. Promethium 147
3. Finger rings will be worn underneath any gloves that may be required for the operation.

V. Personnel Monitoring (continued) -

C. Pocket Chambers

- 1.. All personnel working in radiation areas will wear pocket chambers.
 - a. The pocket chambers will be picked up at the storage area before entering the radiation areas.
 - b. They will be replaced in the storage area at the end of the shift unless they are collected by Health Physics.
 - c. Pocket chambers must not be misplaced or laid down in any radiation areas.
 - d. They are not to be taken home or anywhere out of the U.S. Radium Bloomsburg facilities.
 - e. When wearing a leaded apron, they are to be worn underneath the apron.
2. All visitors shall wear pocket dosimeters in any radiation area.

D. Survey Meters

1. Personnel working in radiation areas will utilize available alpha and beta-gamma survey meters to:
 - a. Insure against inadvertent internal or external exposure.
 - b. Keep radiation levels to a minimum.
 - c. Aid in controlling removable and fixed contamination to below prescribed tolerances.

E. Room Air Monitors

1. Portable or fixed room air monitors shall be used continuously in all areas where airborne contamination concentrations may exceed 1/10 of the appropriate permissible concentration.
 - a. The room air monitors shall be sensitive enough to measure 1/10 of the permissible concentration of the isotopes being used in the area and shall be calibrated for those isotopes.
 - b. The monitor shall be equipped with an audible alarm which will activate at a preset level.
 - c. The alarm shall be set to activate at the permissible concentration of the least tolerated isotope used in the area.

VI. Control of Radioactive Materials

- A. All incoming radioactive stock materials are to be transferred to proper storage vaults and the change in inventory recorded.
- B. All transfers of radioactive materials from storage vaults to Lab facilities have to be cleared with the Lab manager's office, after which:
 - 1. The transfer will be made under existing S.O.P.
 - 2. The change in inventory recorded.
 - 3. The new depository properly marked or labeled with:
 - a. The isotope
 - b. The quantity or intensity
 - c. The current date of measurement of intensity.
- C. All intra-lab transfers have to be made in adequately shielded leakproof or spillproof tote containers properly marked as to isotope, intensity and date of measurement.
- D. All radioactive materials not in process or not required for immediate use will be:
 - 1. Properly marked.
 - 2. Transferred in a proper container to appropriate storage vault.
 - 3. Proper inventory changes recorded.
- E. All radioactive materials processed as a product will be:
 - 1. Leak tested, or quality control tested as required by licensing conditions.
 - 2. Packed and shipped in compliance with proper federal regulations.
 - 3. Noted with respect to change in inventory records.
- F. All radioactive materials to be disposed as solid waste will be:
 - 1. Properly packaged so as to not exceed 150 mrad/hr at the surface.
 - 2. Properly marked or labeled with,
 - a. Isotope
 - b. Intensity
 - c. Beta-gamma radiation levels.
 - d. Dated
 - e. Stored in designated area.

VI. Control of Radioactive Materials (continued) -

G. Radioactive gas disposal

1. Some radioactive gases may be disposed via stack discharge within limits determined by Health Physics. Such disposal must be satisfied by a notification form showing:
 - a. Time and date
 - b. Hood location
 - c. Isotope and quantity
 - d. Person responsible for disposal and
 - e. Whether the release was controlled or accidental.
2. Radioactive gases exceeding stipulated limits must be treated as though they were solid wastes.

H. Liquid waste disposal

No contaminated liquid wastes are permitted to be dumped into sinks except that resulting from soap and water cleansing of hands, gloves and rubbers.

1. Contaminated water will be solidified in plaster of paris or mitrocel and treated as solid waste material.
2. Contaminated mineral or organic solvents will be transferred to I.C.C. approved containers preliminary to further approved methods of packaging.
3. Contaminated acids or bases will be:
 - a. Neutralized
 - b. Solidified in plaster of paris or mitrocel and then disposed as solid waste.

VII. Control of Radiation Levels in Restricted Areas

A. In-process radioactive materials

1. Must be shielded beta-gamma wise so as to not exceed 100 mrad/hr at anytime at the surface of the outermost containment.
2. Must be adequately shielded in relation to factors of time and distance to minimize personal exposure.

B. In-process radioactive materials - temporarily in storage.

1. Radioactive materials in storage for any period longer than one hour must be adequately shielded so as to:
 - a. Not exceed 5 mrad/hr at the surface of the outermost containment.
 - b. Not exceed 0.6 mrad/hr at an obverse wall facing on an unrestricted area.

C. Radioactive materials stored in vaults.

1. The radiation level at the surface of any storage container must not exceed 100 mrad/hr.
2. The radiation level at the surface of outermost containment, a room wall, building wall, or permanent fence or barricade facing onto an unrestricted area, etc., must not exceed 0.6 mrad/hr.

VIII. Control of Radioactive Contamination

A. Tolerances for removable contamination in restricted areas are based on the following conditions:

1. The smear or wipe is to be taken of an optimum surface area of 100 cm² or approximately 16 square inches.
2. Alpha wipes are to be counted using surface barrier solid state detector. NOTE: If gamma radiation is associated with the Alpha emission, wipes can be counted in a scintillation well counter.
3. Tritium wipes are to be counted in liquid scintillation counter.
4. Other beta-gamma or beta emitters are to be counted in the liquid scintillation counter or using a Geiger-Mueller tube.
5. Wipe counts are to be converted into disintegrations/minute by appropriate conversion factors before recording.

B. The tolerances or permissible levels are as follows:

1. Interior surface of open process boxes and hoods:

NOTE: These are guideline values only to minimize contamination in other work areas.

- | | |
|---------------------------------------|--------------------------------|
| a. Alpha emitters: | 20,000 dpm/100cm ² |
| b. Strontium-90: | 20,000 dpm/100cm ² |
| c. Tritium: | 500,000 dpm/100cm ² |
| d. Other beta or beta-gamma emitters: | 50,000 dpm/100cm ² |

2. All other accessible surfaces:

- | | |
|---------------------------------------|-------------------------------|
| a. Alpha emitters: | 2,000 dpm/100cm ² |
| b. Strontium-90: | 2,000 dpm/100cm ² |
| c. Tritium: | 50,000 dpm/100cm ² |
| d. Other beta or beta-gamma emitters: | 5,000 dpm/100cm ² |

3. Protective apparel, clothing, gloves & footwear (At time of entering change room.):

- | | |
|---------------------------------------|------------------------------|
| a. Alpha emitters: | 200 dpm/100cm ² |
| b. Strontium-90: | 200 dpm/100cm ² |
| c. Tritium: | 5,000 dpm/100cm ² |
| d. Other beta or beta-gamma emitters: | 500 dpm/100cm ² |

VIII: Control of Radioactive Contamination (continued)

4. Dry box gloves:

a. Surfaces contacting in-process radioactive materials:
Contamination build-up not to exceed 25 mrad/hr.

b. Surfaces contacting the skin:

- | | |
|----------------------------------|------------------------------|
| i. Alpha emitters: | 100 dpm/100cm ² |
| ii. Strontium-90: | 100 dpm/100cm ² |
| iii. Tritium: | 2,500 dpm/100cm ² |
| iv. Other beta or beta-gamma em. | 250 dpm/100cm ² |

5. Manufactured articles: All products being shipped on order shall comply with the license conditional limit of not more than 0.005 microcuries/article for Alpha emitters and not more than 0.05 microcuries/article for Beta or Beta-gamma emitters. NOTE: This condition shall also apply for other articles transferred to unrestricted areas with the additional condition that the "wiped" area shall not exceed 100cm².

C. Tolerances for removable contamination in unrestricted areas. Same conditions hold as for restricted areas in VIII A. above.

D. The tolerances or permissible levels are as follows:

1. All surfaces in unrestricted areas:

- | | |
|--------------------------------------|------------------------------|
| a. Alpha emitters: | 200 dpm/100cm ² |
| b. Strontium-90: | 200 dpm/100cm ² |
| c. Tritium: | 5,000 dpm/100cm ² |
| d. Other beta or beta-gamma emitters | 500 dpm/100cm ² |

E. Tolerances for non-removable contamination in restricted areas are as follows:

1. Restricted areas, all surfaces except interior surfaces of open process boxes, hoods, and dry boxes.

- | | |
|------------------------------------|--|
| a. Alpha emitters | 10,000 dpm/100cm ² |
| b. All beta or beta-gamma emitters | 1.0 mrad/hr at 1 cm from surface with not more than 7mg/cm ² absorber |

2. Dry box gloves

Gauntlet gloves, measured outside of process boxes, shall not exceed 25 mrad/hr at surface contact.

3. Articles transferred to Unrestricted areas

- | | |
|------------------------------------|--|
| a. Alpha emitters | 1,000 dpm/100cm ² |
| b. All beta or beta-gamma emitters | 0.1 mrad/hr at 1 cm from surface with not more than 7mg/cm ² absorber |

VIII. Control of Radioactive Contamination (continued)

F. Tolerances for non-removable contamination in unrestricted areas are as follows:

1. All surfaces in unrestricted areas:

- | | |
|-------------------------------------|--|
| a. Alpha emitters: | 1,000 dpm/100cm ² |
| b. All beta or beta-gamma emitters: | 0.1 mrad/hr at 1 cm from surface with not more than 7mg/cm ² absorber |

G. Preventive measures

1. In-process operations

- a. All processing operations are to be performed over a protective barrier, i.e., sheet paper, plastic film, rubber pad etc. auxiliary to the substrate work surface. The barrier material is to be disposed of immediately after processing.
- b. After disposing of the barrier material, the substrate surface is to be wiped several times with cleaning media. Resultant trash is to be immediately disposed of as waste.
- c. Waste materials must be considered as radioactive sources and must be placed into paper bags, polyethelene, or metal containers which must be sealed, monitored, and labeled before further transfer out of the area.
- d. All articles to be taken out of process enclosures must first be decontaminated to the applicable tolerance for the next progressive step, or be transferred within a contamination-free, properly marked tote container.

VIII. Control of Radioactive Contamination (continued)

G. Preventive measures (continued)

2. Area contamination checks

- a. Personnel are required to perform daily smear tests of surfaces such as table tops, floors, etc.
- b. Smear check sheets must be turned in to the Health Physics office daily.

3. Personnel contamination checks

- a. All personnel working in an operational facility equipped with a monitor will check hands, clothing, and feet before leaving area.
 - i. Contaminated hands, gloves, and rubbers or shoes are to be decontaminated immediately.
 - ii. Contaminated clothing is to be taken to the change room, placed into a marked bag and clean clothing obtained.
- b. All personnel entering the change room on their way out of the Lab. will check hands, clothing, and feet before entering the inactive side of the change room barrier.
 - i. Contaminated hands, clothing, or rubbers or gloves are to be decontaminated immediately.
 - ii. Contaminated clothing is to be handled in the manner outlined in 3.a.ii above.
- c. No protective apparel worn in the Lab. will be permitted in the locker room.
- d. All personnel leaving the Lab. will make a final check for foot contamination before entering the stair-hall. Any contamination detected there will require returning to the change room for confirming check and decontamination.

VIII. Control of Radioactive Contamination (continued)

H. Control of airborne radioactivity

1. Hood ventilation

- a. Personnel are not to work in hoods where the frontal air displacement is less than an average of 100 lineal feet per minute.
- b. The linear dimensions of the frontal openings are to be permanent and unauthorized changes will not be permitted.
- c. Personnel will check flow meters for safe limits before commencing work in hoods so-equipped.
- d. Personnel will not work in hoods where radioactive gases are processed unless the hood is equipped with permanent, transparent frontal barriers which will separate the breathing zone from any radioactive gas concentrations.
- e. No tampering with adjusting dampers will be tolerated.

2. Glove box ventilation

- a. Personnel are not to work in glove boxes having a suction less than 1/2-inch water gauge.
- b. Personnel are to check flow meters for safe limits before working in glove boxes so-equipped.
- c. Personnel are not to tamper with adjusting dampers without Health Physics authorization.

3. Screening machine

- a. Personnel are not to work on a screening machine unless the enclosure over the machine is supplied with an exhaust portal having a suction of at least 1/2-inch water gauge.
- b. The air displacement at frontal openings of the enclosure during machine operation shall not be less than 10 lineal feet per minute.
- c. Personnel are not to tamper with frontal openings of the enclosure without Health Physics authorization.

IX. General Safety Considerations

- A. Handkerchiefs must not be used in restricted areas. Disposal tissues are provided.
- B. Eating and smoking are prohibited in restricted work areas.
- C. No pipetting of radioactive solution by mouth is to be tolerated under any circumstances.
- D. Fingernails should be closely trimmed.
- E. Hands should be frequently and thoroughly washed and scrubbed, particularly before leaving the Lab.
- F. Bio-specimens for radiological assay shall be furnished on request.

X. Emergency Procedures:

A. Reporting incidents

In the event of any accidental spill, gas release, or contamination incident, the following procedure should be instituted immediately:

1. The department head must be notified at once.
2. The department head, or his designee, must notify Health Physics. Phones should be used when possible so as to minimize spread of contamination.
 - a. The department head should advise Health Physics as to the nature of the radioactive material and the condition of the incident.
 - b. The department should alert other areas in his section as to the incident.
3. Health Physics will oversee proper protective and decontamination procedures.

X. Emergency Procedures (continued) -

B. Minor spills involving no gamma radiation exposure.

1. Notify all other persons in the room at once.
2. Confine the spill immediately, prevent spread.
 - a. Liquid spills:
 - i. Don protective gloves if not already being worn.
 - ii. Drop absorbent paper on the spill.
 - b. Dry spills:
 - i. Don protective gloves.
 - ii. Dampen area thoroughly with wet paper towels.
3. Permit only the minimum number of people necessary to deal with the spill into the area.
4. Decontaminate.
5. All persons involved in the spill and cleanup are to be monitored.
6. No personnel are to resume work in the area until a final survey is made and approval of the Radiological Safety Officer is secured.
7. A complete history of the accident and subsequent activity related thereto must be prepared for the records.

X. Emergency Procedures (continued) -

C. Major spills involving radiation hazard to personnel.

1. Notify all persons not directly connected to the spill to vacate the room at once.
2. If the spill is liquid, and the hands are protected, right the container and dispose the gloves.
3. If the spill is on skin, flush thoroughly.
4. If the spill is on clothing, discard all outer protective clothing at once.
5. Vacate the area as soon as possible.
6. Take immediate steps to decontaminate effected personnel.
7. Decontaminate the area. Personnel performing the decontamination must be adequately protected.
8. All personnel involved in the spill are to be monitored to determine the adequacy of decontamination.
9. No work is to be resumed in the area until a survey is made and approval of the Radiological Safety Officer is secured.
10. A complete history of the accident and subsequent activities related thereto must be prepared for the records.

X. Emergency Procedures (continued) -

- D. Accidents involving airborne radioactive materials and other toxic fumes and vapors.
 1. Notify all persons to vacate the room immediately.
 2. If possible to hold breath and close valve of causitive system, the operator should do so, and then vacate the room.
 3. All suspected or known releases of radioactive gases or inhalations thereof should be reported at once.
 4. The room should be closed and posted or guarded to prevent unnecessary access thereto.
 5. The hazard must be evaluated and necessary safety devices procured and used for safe re-entry.
 6. The cause of the incident must be rectified and necessary modifications made to prevent re-occurrence.
 7. Decontaminate the area if necessary.
 8. Perform a survey of the area before permitting work to be resumed.
 9. Monitor all persons for suspected contamination.
 10. A complete history of the accident and related factors to be prepared for the records.

X. Emergency Procedures (continued) -

E. Injuries to personnel.

1. Wash wounds immediately, if possible, under running water and while spreading open the wound.
2. Report to the plant nurse and/or doctor for further treatment.
3. Report all accidents (wounds, overexposure, ingestion and inhalation) to the Radiological Safety Office as soon as possible.
4. No person so injured is to return to work without the approval of the Radiological Safety Office.
5. A complete history of the accident and subsequent activities related thereto must be prepared for the records.

XI. Radiological-Medical Requirements

A. Physical Exams

1. Personnel working in a restricted area more than three months per year will be given a complete physical examination at least once per year.
2. Personnel working intermittently in a restricted area, but for less than an accumulative three-month period per year will be given a complete physical examination at least every two years.
3. Hand examination and fingerprinting will be performed on personnel who process and handle hard beta and/or gamma emitting isotopes to determine possible radiation damage to the fingers.
 1. Hand examinations will be performed twice per year.
 2. Fingerprinting will be performed at least once per year.

C. Urine Samples

1. Tritium analysis
 - a. Urine samples will be collected weekly from all personnel working in a tritium restricted facility. These urine samples will be subjected to counting in a liquid scintillation counter.
 - b. Weekly urine samples showing concentrations not exceeding 28 microcuries per liter will be continued on a weekly basis.
 - c. Weekly urine samples exceeding a concentration of 28 microcuries per liter shall require daily urine samples until a reduced level is observed. (NOTE: Individuals showing concentrations greater than 28 microcuries per liter of urine shall have their work habits studied and shall require breathing zone samples to determine cause of excess concentrations. If urine levels do not decrease to below 28 microcuries per liter within one week after start of daily sampling, these individuals shall not be allowed to continue working with radioactive materials.
2. Alpha analysis
 - a. Specific urinalysis will be performed at least quarterly on personnel handling Americium-241.
 - b. Specific urinalysis will be performed at least quarterly on personnel handling Polonium-210.
 - c. Individuals showing continually increasing concentrations shall have their breathing zone records and work habits examined to determine cause for excessive concentrations.

XI. Radiological-Medical Requirements (continued)

C. Urine samples (continued)

2. Alpha analysis (continued)

- d. Individuals showing concentrations above the applicable tolerance will be removed from work with radioactive materials and subjected to physical examination and other possible medical care.
- e. Analyses of any isotope may be required more frequently than specified above in the event of an incident or suspected overexposure.

3. Beta Analysis

- a. Gross beta urinalysis will be performed at least quarterly on personnel working with any beta emitting isotope other than tritium.
 - i. Analyses indicative that the least tolerated is excessively present will require an immediate bioassay and analysis specific to one or more isotopes.
- b. Analysis of any isotope may be required more frequently than quarterly in the event of an incident or suspected overexposure.

D. Whole body counting

- 1. All personnel working with Americium-241 will be whole body counted at least twice a year.
- 2. All personnel working routinely with any gamma-emitting isotope will be whole body counted at least twice a year.
- 3. Whole body counting will be performed on personnel more frequently than twice a year in the event of an incident or suspected excessive body intake.

XI. Radiological-Medical Requirements (continued) -

B. Whole body counting (gamma)

1. Personnel routinely processing any gamma emitting isotope will be whole body counted for body burden at least once a year.
2. Whole body counting will be performed on personnel more frequently in the event of an incident or suspected excessive bodily intake.

- 4.0.0 Bioassay Program
- 4.1.0 Sampling Program - Tritium
- 4.1.1 All personnel routinely working in a Magenta Area in which tritium is stored or handled will be bioassayed for Tritium each Monday.
- 4.1.2 All personnel not routinely working in a Magenta Area will be bioassayed for tritium as dictated by the nature and frequency of their exposure to tritium as determined by the Health Physicist.
- 4.2.0 Sample Treatment - Tritium
- 4.2.1 Decolorization
1. To each sample, add 3-5 gm. activated charcoal. Slurry.
 2. Filter through Whatman No. 1 filter paper. Filtrate should be clear and colorless. If necessary, repeat charcoal addition and filtration.
- 4.2.2 Counting
1. Pipette 3 ml. of decolorized urine into a polyethylene counting vial.
 2. Add 17 ml. SC#1.
 3. Count in Packard Model 3380 liquid scintillation counter with Model 544 Absolute Activity Analyzer. Teletype printout is in DPM per sample.
- SC#1 = 15 gm PPO,
250 mg POPOP,
40 gm Naphthalene,
dissolved in 500 ml 1/3/3 Xylene/dioxane/cellosolve

4.2.3 Calculation

$$\frac{\text{DPM} \times 10^3}{2.22 \times 10^2 \times 3} = \text{uCi/L}$$

4.3.0 Sampling Program - Promethium-147

To be determined.

4.4.0 Sample Treatment - Promethium-147

To be determined.

ITEM 13 ATTACHMENT

FACILITY SKETCHES

ITEM 14 ATTACHMENT

RADIATION PROTECTION PROGRAM

NUCLEAR FACILITY

HEALTH PHYSICS PROGRAM

XIV-CH7B

0.0.0 Zone Definitions

White Zone - area in which the contamination levels do not exceed any of the following limits:

- a) Direct radiation to a major portion of the body not greater than 2 mr/hr.
- b) Airborne contamination not greater than the levels stated in 10 CFR 20.203(d).
- c) Fixed alpha contamination not greater than 1000 dpm/100 cm².
- d) No removable contamination above background.

Yellow Zone - an area in which the contamination levels do not exceed those of White Zone limits, but there exists a potential hazard of radiation or contamination due to materials in process, storage or transit.

Magenta Zone - an area in which any of the contamination levels exceed those of a White Zone, but in which the occupants will not be exposed to contamination levels exceeding any of the following limits:

- a) Direct radiation to a major portion of the body not greater than 5 mr/hr.
- b) Airborne contamination not greater than 10 CFR 20 Appendix B, Table I.
- c) Fixed alpha contamination not greater than 10,000 dpm/100 cm².

- d) Removable alpha contamination not greater than 2000 dpm/100 cm².
- e) Removable Tritium contamination not greater than 50,000 dpm/100 cm².
- f) Removable beta-gamma contamination not greater than 5000 dpm/100 cm².

Red Zone - any area in which any of the contamination levels exceed those of the limits of a Magenta Zone. Entry to a Red Zone must be authorized by the Health Physicist. A Red Zone will normally be returned to a lower radiation level status except where a Red Zone may be appropriate for non-occupied storage.

1.0.0 Monitoring Programs

1.0.1 When the specified limits of any radiation area are exceeded, immediate action is to be taken as specified in the Health Physics Manual.

1.1.0 Airborne Contamination.

1.1.1 Room Air Samples

Each room in Magenta Zones will be continuously monitored for airborne contamination where the Magenta status is due to other than direct radiation.

1.1.2 Breathing Zone Samples

Breathing zone samples of operators at all new operations will be taken to determine the presence of any airborne contamination. Thereafter, the operation will be breathing zone sampled at least once a quarter.

1.2.0 Surface Contamination

1.2.1 Daily Smear Surveys

Each room in Magenta Zones will be surveyed for removable surface contamination every working day by taking a number of smears, as defined in the Health Physics Manual, at random locations in each room. The number of smears will be determined by the type of operation, amount of radioactivity, past contamination history of the operation, and judgment of the Health Physicist.

1.2.2 Monthly Smear Surveys

Each room in Yellow and Magenta Zones will be given an extensive smear survey once during each calendar month.

1.2.3 Quarterly Smear Surveys

Each room occupied by Nuclear Division personnel in White Zones will be given a smear check once each calendar quarter.

1.3.0 Direct Radiation

1.3.1 Storage

All sources will be marked, stored and leak checked according to the applicable sections of 10 CFR.

1.3.2 Monitoring

Once each quarter, all storage areas for sources of direct radiation will be monitored.

1.4.0 Airborne Effluent

1.4.1 Stack Effluent

The building stack will be monitored continuously for $^3\text{H}_1$, $^3\text{H}_2$ and $^3\text{H}_{\text{sub}}$ by means of a filter, impinger and ion chamber sample train.

1.4.2 Environmental Surveys

Once each quarter, environmental surveys will be carried out as specified by the Health Physicist.

1.5.0 Liquid Effluent

1.5.1 Potentially Contaminated Water

All potentially contaminated aqueous effluent will be trapped in a catch tank, assayed to determine the level of radioactivity, and released to the Susquehanna River after appropriate treatment to meet all applicable government regulations.

1.5.2 Potentially Contaminated Organic Liquids

All potentially contaminated organic solutions will be assayed to determine the level of radioactivity and either 1) shipped as radioactive waste, or 2) neutralized, diluted, and discharged as per 1.5.1, dependent upon the level of contamination, and the chemical nature and toxicity of the compounds involved.

2.0.0 Bioassay Program

2.1.0 Weekly Bioassay for Tritium

All personnel normally assigned to zones posted as Magenta due to tritium contamination will be bioassayed for tritium on a weekly basis with the samples being treated and measured as set forth in the Health Physics Manual.

2.2.0 Non-Weekly Bioassay for Tritium

All persons not routinely working in the active area will be bioassayed for tritium as dictated by the nature and frequency of their exposure to tritium as determined by the Health Physicist.

2.3.0 Bioassay for Promethium-147

Prior to work with Promethium-147, a suitable feces Promethium assay program will be adopted.

3.0.0 Ventilation Air Control

3.1.0 Work Stations - Tritium

3.1.1 Ventilation

All work stations where unconfined Tritium or tritiated phosphors or material are handled will have protective air flow by means of fume hood or glove box type devices.

3.1.2 Filtration

Exhaust air from each of the work stations will initially be filtered by a dust-stop type filter element. The air from each such filter will be sampled in the initial installation to determine the need (if any) for more extensive filtration at that point.

3.1.3 Pressure Differential Indication

Each glove box will be equipped with flow meter, vacuum gauge, or some other such device to give visual indication of the reduced pressure inside the glove box.

3.2.0 Work Station - Promethium-147

3.2.1 Ventilation

All work with Promethium-147 will be carried out in glove boxes.

3.2.2 Filtration

All Promethium-147 glove boxes will be equipped with one stage of inlet filtration 80% efficient for 0.3 micron particles and one stage of exhaust filtration 95% efficient for 0.3 micron particles.

3.2.3 Pressure Differential Indication

Same as 3.1.3 above

3.2.4 No work with Promethium-147 will be performed in areas not conforming to 3.2.1, 3.2.2 and 3.2.3 above.

3.3.0

Adjustment of Ventilation System

Air flow in the building ventilation system at all work stations will be measured, adjusted, and balanced quarterly.

3.4.0 Emergency Exits

Except in the case of an emergency, all crash doors will be opened only after receiving approval of the Radiation Safety Officer, with separate approval being necessary for each such opening.

3.5.0 Evacuation Alarm System

3.5.1 Control of Alarm System

A building evacuation alarm system will be connected to emergency exit doors by a switch that will sound the alarm automatically when the door is opened.

A manual switch to sound the alarm will be located at all normal exits.

3.5.2 Emergency Ventilation

The above alarm system will be connected to an emergency ventilation control, such that actuation of the alarm will cause ventilation exhaust from the Yellow Zone to change from a recirculating system to a non-recirculating system. Under the emergency air flow, all air will pass through the building once and exhaust via the effluent stack.

4.0.0

Control of Shipping and Receiving of Radioactive Materials.

4.1.0

Receiving

All incoming shipments of radioactive material will be monitored for contamination before, during and after unpacking.

4.2.0

Shipping

All outgoing radioactive materials will be monitored and smear checked before shipping.

5.0.0 Records

Records of all above mentioned surveys, air samples, bioassays, monitorings, etc., will be kept in accordance with the applicable sections of 10 CFR and Ch. 4, Art. 33 PDH Rules and Regulations.

6.0.0 Health Physics Training Program

All personnel will attend a quarterly Health
Physics information-training meeting.

JOB DESCRIPTIONS

BARGAINING UNIT EMPLOYEES

RADIOACTIVE GAS SYSTEM'S OPERATOR -

Purpose of Gas Systems Operator

The purpose of this classification is to perform routine operations that put radioactive gases into specially designed containers. It is important that the incumbent be capable of performing routine operations as instructed and be able to react as instructed to unusual and emergency situations to prevent jeopardy to operating licenses which could result from the escape of radioactive gases.

Qualifications for Radioactive Gas Systems Operator

Education:

This classification requires a formal education to the college sophomore level in mathematics and natural sciences.

Specific Qualifications:

In addition to a general capability to perform routine duties, this classification requires 1) the ability to perform routine operations as instructed without deviation, 2) the ability to react to unusual and emergency situations according to emergency plans, 3) the ability to handle delicate items routinely without breaking them, 4) the ability to maintain orderly, legible records.

Experience Qualifications:

This classification requires the incumbent to have previous radioactive gas systems operating experience or a minimum of six months experience working as a Health Physics technician.

Specific Duties of Radioactive Gas Systems Operator

1. Perform routine operation of radioactive gas systems equipment.
2. Move radioactive materials as directed by supervision to, through and from gas systems work areas.
3. Perform routine record keeping that is incidental to gas systems operations.
4. Take corrective action and alert supervision immediately when any malfunction of gas system equipment is suspected or detected.
5. Maintain work areas in clean and safe condition.

HEALTH PHYSICS TECHNICIAN -

Purpose of Health Physics Technician

The purpose of this classification is to perform routine duties as assigned by the Radiological Safety Officer or his designate as part of the plant radiation protection program.

Qualifications for Health Physics Technician

Education:

This classification requires a formal education to the college sophomore level in mathematics and natural sciences.

Specific Qualifications:

This classification requires, in addition to a general capability to perform routine duties 1) the ability to maintain accurate, legible, and orderly records, 2) the ability to assist members of management in conducting radiation protection training meetings, 3) the physical ability to perform radiation surveys in difficult locations such as roofs, pipe tunnels, basements, and attics. This requirement is not intended to eliminate handicapped persons per se, but to emphasize the need for these abilities.

Specific Duties of Health Physics Technician

1. Perform routine radioactive surface contamination surveys.
2. Perform routine airborne radioactive contamination surveys.
3. Perform routine direct radiation surveys.
4. Perform routine radiation protection program record keeping including routine calculations required to develop the records.
5. Assist the Radiological Safety Officer or his designate in conducting radiation protection training meetings for plant personnel.
6. Perform special radiation surveys for direct radiation, surface contamination, and airborne contamination as instructed by the Radiological Safety Officer or his designate.
7. Perform routine radio-bioassay analysis.
8. Perform special radio-bioassay analysis as instructed by the Radiological Safety Officer or his designate.
9. Perform routine radiation sample counting as required to obtain data from samples obtained during routine radioactive surface and airborne contamination surveys.
10. Maintain work areas in clean and safe condition.

SAFETY ANALYSIS REPORT

**SAFETY ANALYSIS REPORT
OF FINAL DESIGN
RADIOISOTOPE PROCESSING FACILITY
UNITED STATES RADIUM CORPORATION
Bloomsburg, Pennsylvania**

March 3, 1969

**O. L. Olson, Director
Nuclear Division**

INTRODUCTION

This Safety Analysis Report follows an earlier* report that described a radioisotope processing facility as it was proposed in the initial stages. The present report describes the facility as it will be constructed.

The original proposal provided a new building with an area of 5,000 square feet. The final design provides an additional 1,000 square feet to assure space for all radioisotope processing performed at the Bloomsburg location.

Product manufacture and incidental development work will be performed in the newly constructed building. Solid waste packaging and liquid effluent processing will be performed in buildings currently in use for these purposes.

* Safety Analysis Report for Proposed Radioisotope Processing Facility, O. L. Olson, Health Physicist.

PURPOSE OF FACILITY

The primary purpose of this facility is to provide the desired control of radioisotopes so that processing activities can be performed without unwarranted radiation hazard to persons in the facility or in the surrounding environment.

GENERAL DESCRIPTION OF FACILITY

The Nuclear Facility consists of three designated buildings:

- 1) A new 6,000 square foot building specifically designed for processing tritium and promethium-147. Current plans do not call for promethium-147 processing beyond small, product explorations.
- 2) An existing concrete block building for packaging solid, potentially contaminated waste.
- 3) An existing liquid effluent processing building which is operated under Pennsylvania Public Health Department I.W. permit #16212.

The entire facility is located at 4150 Old Berwick Road, Bloomsburg, Pa. Building and equipment of the Nuclear Facility will be controlled by the Nuclear Division.

DESCRIPTION OF RADIOISOTOPE PROCESSING BUILDING

Structure

The building selected is a modular, clear span, steel building set on a concrete slab. Inner walls are non-load bearing with steel studs covered with standard one-half inch dry wall sheets.

All materials used in the building will be equal to or exceed safety specifications of state and local construction codes.

Air Conditioning

Air conditioning is designed in two separate units, one for each of the two radiation zones of the building. In the yellow zone*, an electric powered heat pump system conditions and recirculates the air in a manner that is standard for well ventilated work areas. An emergency damper system is provided that permits immediate change to a non-recirculating system with the air exhausting via the effluent stack. During normal operation, the small volume of exhaust from the yellow zone is exhausted via the effluent stack.

Air conditioning of the magenta zone will be accomplished by an electric powered system that conditions incoming air and passes it through the building without recirculation. The air will be exhausted via the effluent stack.

* Radiation zone definitions are given in Health Physics program.

Ventilation

All ventilation exhaust ports have flow controls so the ventilation can be balanced between areas of the building, between individual rooms, and between room exhaust ports and fume hoods and/or glove boxes in the room.

A pressure differential will be maintained such that the yellow zone pressure is below outside pressure, and the magenta zone pressure will be below the yellow zone.

All doors to the outside will be "normally closed" to maintain the building air balance and to reduce air conditioning cost.

Intake air will be filtered to reduce the dust load as required for product quality. Exhaust air will be filtered "at the source", no filter bank is planned for the building exhaust plenum. Space is provided for a filter bank upstream of the main exhaust blower should it become desirable to install one.

Building Surface Contamination Control

Control of surface contamination will be accomplished by providing work station equipment and work procedures designed to minimize the generation of surface contamination.

Protective clothing will be utilized to restrict the movement of radioisotope surface contamination.

Entrance to and exit from the magenta zone will be through change rooms where protective clothing change procedures will be followed to prevent movement of surface contamination out of the area.

Control of Contaminated Liquid Effluent

Contaminated aqueous liquid lines will drain to the existing liquid waste disposal processing facility for appropriate monitoring and processing.

Contaminated organic liquids will be absorbed on an absorbent, then packaged and disposed of as solid waste.

All potentially contaminated liquids will be analyzed for radioisotopes prior to release to the environment to assure that all liquid effluent releases conform to applicable regulations.

Control of Direct Radiation Hazards

Bremsstrahlung radiation from tritiated foils will be the only significant source of direct radiation in this facility. Appropriate handling procedures and, where required, radiation shielding will be provided.

The radiation hazard from bremsstrahlung is not a major problem. In AERE-M1169, it is shown that bremsstrahlung from a tritiated titanium foil is 1.8 mrad/hr/Ci at 10 cm. These targets have a nominal 4 curies of tritium with a range of 2 to 10 curies for special orders.

EVALUATION OF RADIATION HAZARD TO ENVIRONMENT

Airborne Radioactive Effluents - Routine

The point source equation used to describe tritium dispersion from the stack is found in Meteorological Aspects of Air Pollution, a manual used for course #411 presented by the Cincinnati office of the Environmental Science Services Administration.

$$C = \frac{Q}{\pi u \sigma_y \sigma_z} e^{-\frac{H^2}{2\sigma_z^2}} e^{-\frac{Y^2}{2\sigma_y^2}}$$

As used here, the symbols are defined as follows:

- C = concentration of tritium at selected location - uCi/cc
- Q = rate of tritium emission - Ci/sec.
- u = mean wind speed - M/sec.
- σ_y = standard deviation in the crosswind direction of the plume concentration distribution - M.
- σ_z = standard deviation in the vertical of the plume concentration distribution - M.
- H = height stack outlet above ground - M.
- Y = crosswind distance - M.

For this analysis, the height of plume rise above the stack is ignored. This additional height of plume above ground level would be significant, especially for analysis involving incidents of short time duration.

To obtain values for σ_y and σ_z , it is necessary to select an atmospheric stability category from Table I and distance downwind to the point of interest. With these data, reference is made to Figure 1 to determine values for σ_y and σ_z .

TABLE I

Key to Stability Categories

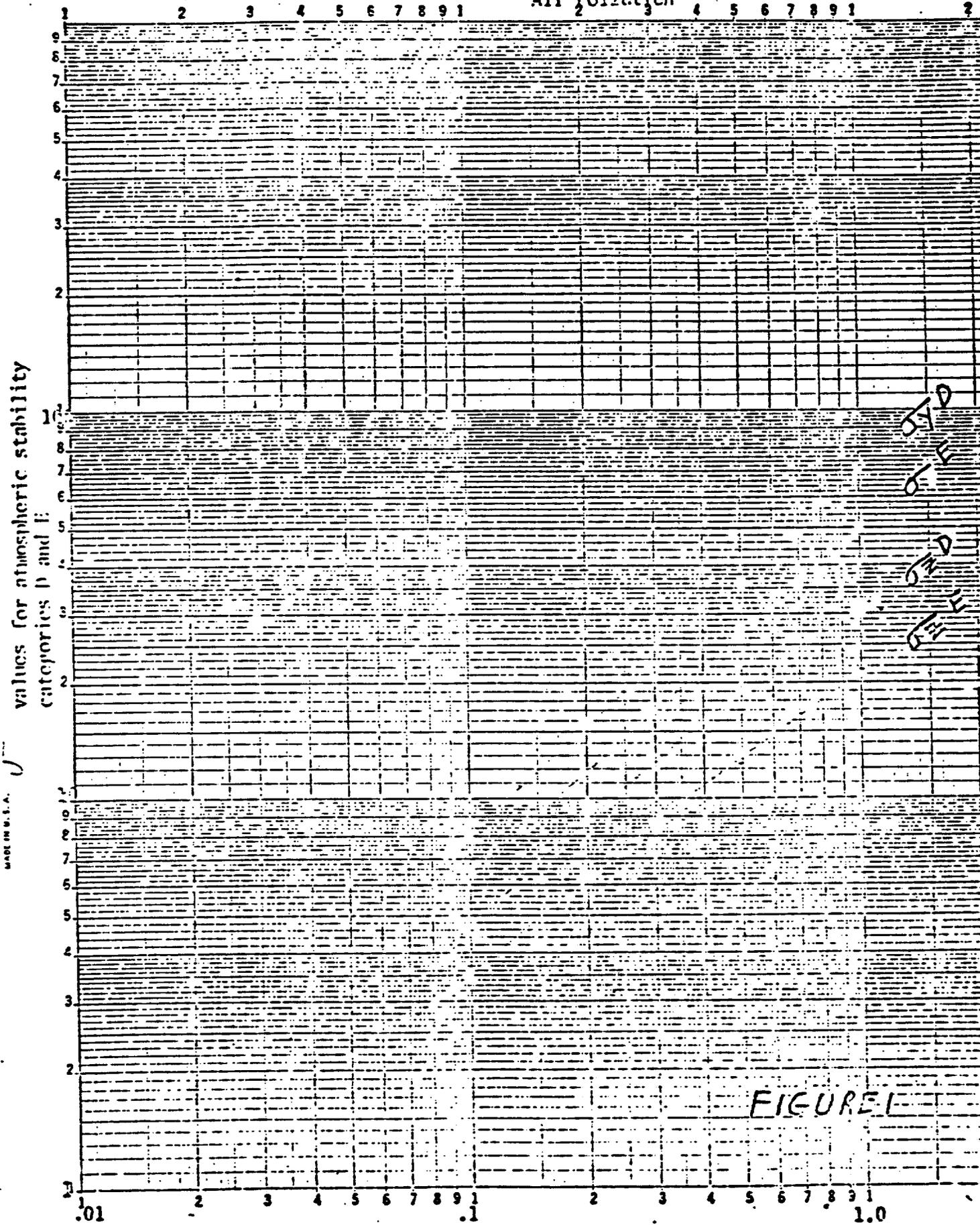
Surface Wind Speed (at 10m) m/sec	<u>Insolation</u>			<u>Night</u>	
	Strong	Moderate	Slight	Thinly Overcast or $> 4/8$ Low Cloud	$< 3/8$ Cloud
< 2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	D	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

The neutral category, D, should be assumed for overcast conditions during day or night.

WIND DIRECTION DEVIATION VS DISTANCE

DOWNWIND FROM STACK - from Meteorological Aspects of

Air Pollution



NEUFEL & ESSER CO., N. Y. NO. 3701214
 Instruments 8 x 31 cycles
 MADE IN U.S.A.

FIGURE 1

Km Downwind from Stack

Plume Centerline Tritium Concentration
vs Distance Downwind From Stack

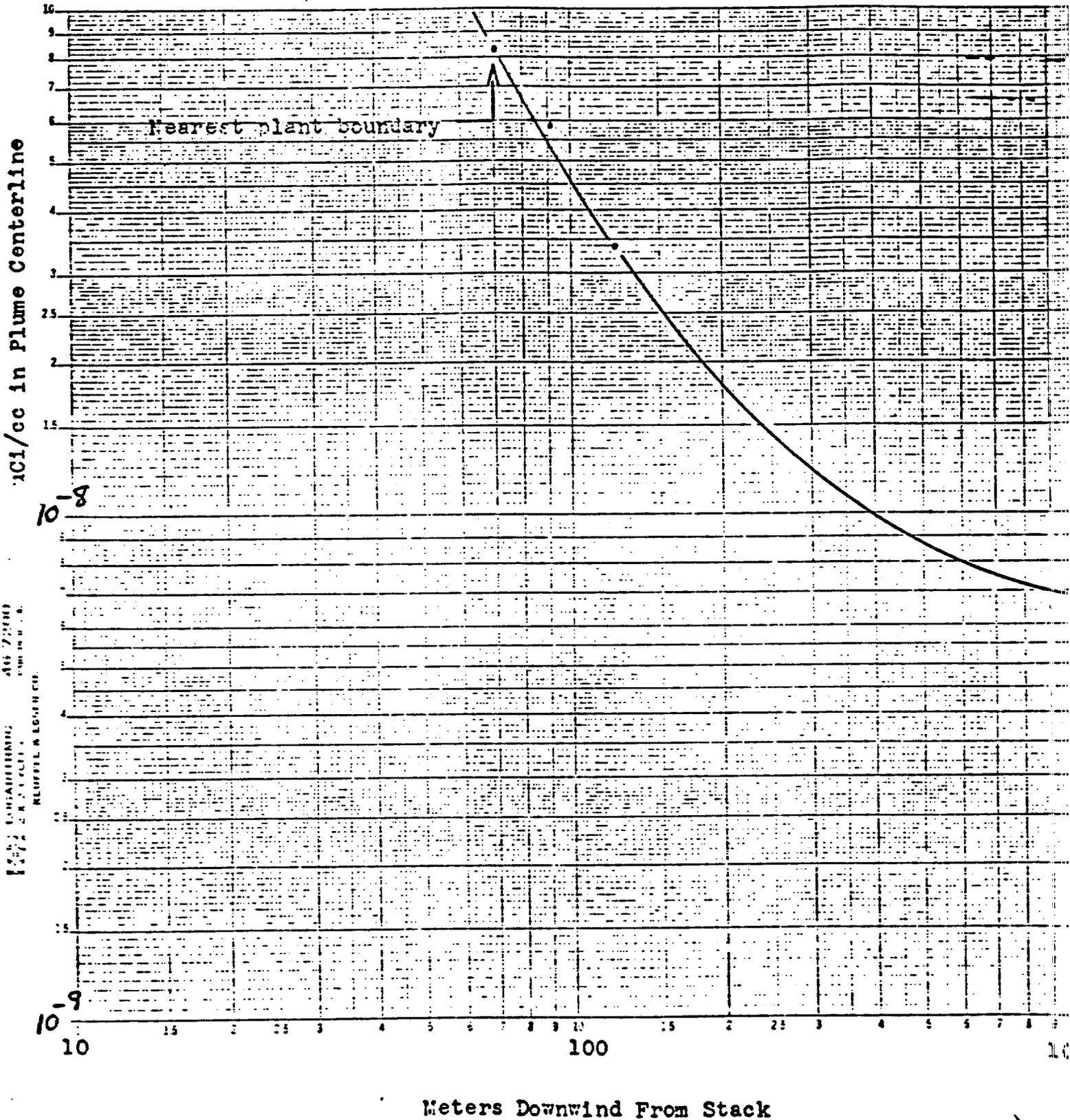


FIGURE 2

DATA FOR FIGURE 2

Plume Centerline Tritium Concentration
vs Distance Downwind from Stack

Distance Downwind

<u>feet</u>	<u>meters</u>	<u>σ_y</u>	<u>σ_z</u>	<u>uCi/cc Tritium</u>
232	70.7	5.9	3.9	8.3×10^{-8}
300	91.4	7.5	4.3	5.9×10^{-8}
400	121.9	9.7	5.7	3.4×10^{-8}
984	300.0	22.0	12.5	6.9×10^{-9}

$$C = \frac{Q}{\pi u \sigma_y \sigma_z}$$

$$\pi = 3.1416$$

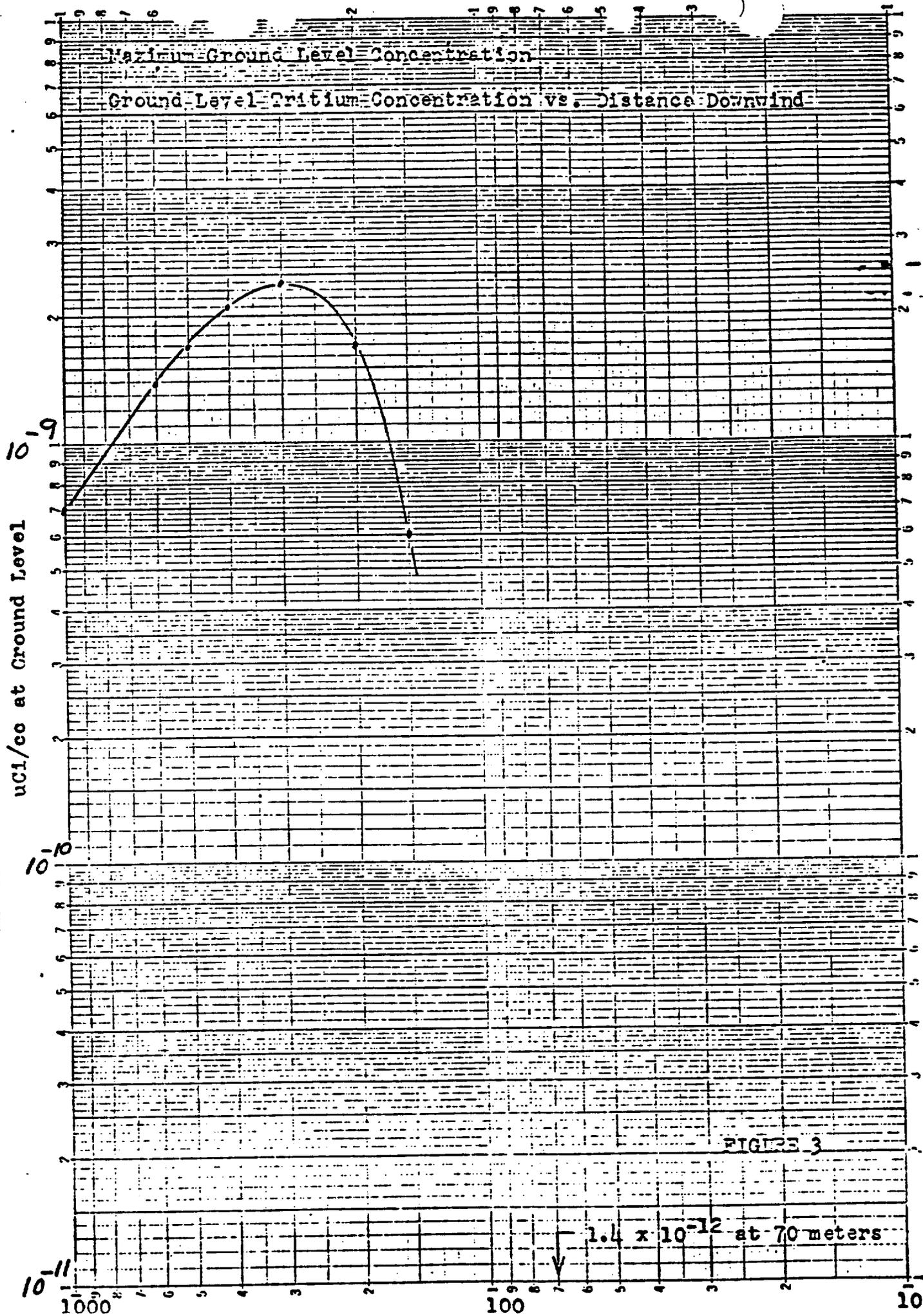
$$u = 4.47 \text{ mi/hr} = 2 \text{ m/sec.}$$

$$Q = 370 \text{ Ci/yr.} = 1.2 \times 10^{-5} \text{ Ci/sec.}$$

LOGARITHMIC
2 X 5 CYCLES
KEUFFEL & ESSER CO.

46 7320

MADE IN U.S.A.



DATA FOR FIGURE 3

Ground Level Tritium Concentration vs. Distance Downwind

$$C = \frac{Q}{\pi \mu \sigma_y \sigma_z} e^{-\frac{H^2}{2\sigma_z^2}}$$

$Q = 1.2 \times 10^{-5}$ Ci/sec.

$\mu = 2$ m/sec.

$H = 60$ feet = 18.3m

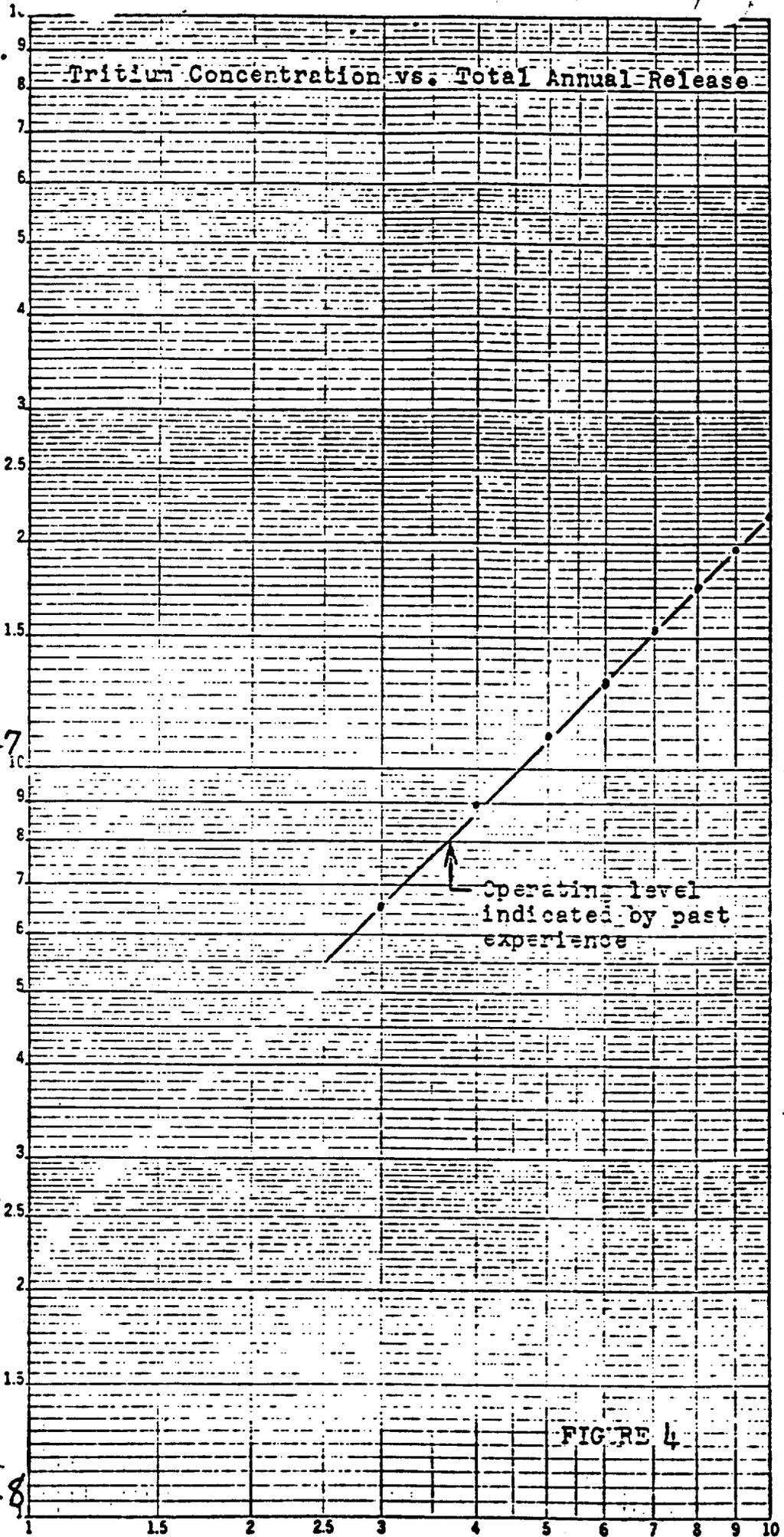
<u>Distance</u>				$e^{-\frac{H^2}{2\sigma_z^2}}$	<u>Tritium Conc. on Ground</u>
<u>M</u>	<u>Ft.</u>	<u>σ_y</u>	<u>σ_z</u>		
70	230	5.9	3.9	1.679×10^{-5}	1.3935×10^{-12}
100	328	8.1	4.7	5.156×10^{-4}	1.4799×10^{-12}
150	492	11.8	6.8	.0268	6.0×10^{-10}
200	656	15.5	8.9	.1211	1.7×10^{-9}
300	984	22.0	12.5	.3429	2.4×10^{-9} ←
400	1312	29.5	16.0	.5204	2.1×10^{-9}
500	1640	36.5	19.0	.6292	1.7×10^{-9}
600	1968	43.0	22.0	.7079	1.4×10^{-9}
1000	3280	70.0	31.0	.8401	7.0×10^{-10}

LOG LOGARITHMIC 46 7080
2 K CYCLES
MORSE & CURRIE CO.

Average Tritium Concentration in Plume Center
over Nearest Plant Boundary uCi/cc

10^{-7}

10^{-8}



DATA FOR FIGURE 4

Tritium Concentration vs Total Annual Release

$$C = \frac{Q}{\pi u \sigma_y \sigma_z}$$

$$\pi = 3.1416$$

$$u = 2 \text{ m/sec.}$$

$$\sigma_y = 5.9$$

$$\sigma_z = 3.9$$

ref. Fig 1 σ_z for D at 70 meters
reads 3.3-3.4
∴ the C values given
should be multiplied by
1.19

Annual Release Ci

Ci/sec.

In Plume Centerline

uCi/cc at 70m downwind

300	9.5×10^{-6}	6.57×10^{-8}
400	1.3×10^{-5}	8.99×10^{-8}
500	1.6×10^{-5}	1.11×10^{-7}
600	1.9×10^{-5}	1.31×10^{-7}
700	2.2×10^{-5}	1.53×10^{-7}
800	2.5×10^{-5}	1.75×10^{-7}
900	2.8×10^{-5}	1.97×10^{-7}
1000	3.2×10^{-5}	2.19×10^{-7}

The equation is made up of three terms.

The term $\frac{Q}{\pi u \sigma_y \sigma_z}$ gives the concentration of tritium along the plume centerline. By selecting σ_y and σ_z for a distance downwind from the stack, one obtains the concentration at that point.

The term $e^{-\frac{H^2}{2\sigma_z^2}}$ is used to obtain the concentration of tritium on the ground directly under the plume centerline.

To find the tritium concentration on the ground at some point to either side of the plume centerline, one multiplies the first two terms by $e^{-\frac{y^2}{2\sigma_y^2}}$. This term is seldom used when maximum concentrations are required. Following a high level effluent release, it would be used to describe the total area exposed to specified concentrations.

For this evaluation, a mean wind speed of 2 meters/second and atmospheric stability Category D were used in all calculations. These were selected after a review of annual Meteorological Data for the Williamsport, Pa. area. Williamsport lies in a valley with similar terrain and directional orientation as the Bloomsburg area. The Bloomsburg plant is 30 miles from the weather station that collected the data. As can be seen in the attached Local Climatological Data, the 1967 mean annual wind speed was 8.1 miles per hour. The lowest average for a single month was 6.8 miles per hour. The data show that 2 m/sec (4.47 miles per hour) is a very conservative estimate.

The total tritium released via stacks for all operations in 1968 was 366 curies. For this evaluation (370 Ci/yr is assumed unless otherwise stated. Significant reduction in tritium losses were achieved through improved procedures. It is expected that this trend will continue in the new facility.

Atmospheric stability Category D is appropriate for long term averages. For short term analysis, the category would have to be chosen according to the weather for the period of time involved.

Figure 4 shows that the tritium concentration crossing the nearest plant boundary would have to exceed the predicted 370 Ci/yr. by a factor of 2.5 to reach the limiting 2×10^{-7} uCi/cc. Referring back to the equation for ground level concentrations, it can be seen that concentration on the ground is proportional to the emission rate Q. If Q were 2.5 times the predicted 370 Ci/yr. or 920 Ci/yr., the maximum ground level concentration would be $2.5 \times 2.4 \times 10^{-9}$ or 6×10^{-9} which is below the $1/3$ of 2×10^{-7} uCi/cc specified by 10 CFR 20.106(e). The limiting concentration is, therefore, 2×10^{-7} uCi/cc limit which applies to activity crossing the plant boundary line.

Maximum ground level concentration and its location are shown on Figure 3. The values given make no allowance for variation in wind direction which would, of course, reduce the total exposure at any specified location.

Concentrations in the plume centerline out to 1000 meters from the stack are shown on Figure 2. Considering the $1/3$ of 2×10^{-7} level indicated by 10 CFR 20.106(e), it can be seen on Figure 2 that the plume centerline would be down to that level within 10 meters after crossing the nearest plant boundary. In other directions, this level would be reached within plant boundaries.

MAXIMUM CREDIBLE ACCIDENTDefinition of maximum credible accident

For this report Maximum Credible Accident is defined as the event which could release the greatest amount of tritium to unrestricted areas in 24 consecutive hours. For purposes of this report, "Acts of God" are not included in the evaluations to determine the maximum credible accident. Fire originating within the building is included in the determination of maximum credible accident.

Description of maximum credible accident

The maximum credible accident in this facility would be the release of the total tritium from a tube manifold of the gas filling equipment. Such an accident could release 400 curies of tritium which would be carried by the ventilation exhaust system out through the exhaust stack.

In the previous Safety Analysis Report, a release of the total working volume of tritium was defined as the maximum credible accident. A review of the situation leads to the conclusion that this was unrealistic in that several coincidental events would have to occur simultaneously to bring this about. Consequently, the release of 400 Ci of tritium from the tube filling manifold of the tritium gas filling equipment is now considered the maximum credible accident.

For this to occur would require a break of tube being filled or the manifold itself to bring coincidental with the operator's absence from the equipment. Operator absence during tube filling will be a disciplinary offense.

Evaluation of maximum credible accident

Evaluation of the release of 400 Ci can be made as follows:

- 1) The release would be a continuous source release of short duration because the activity would all be released via the exhaust stack.
- 2) The release time would be 10 minutes which is the air change rate in the gas filling room in which this accident would occur.
- 3) 400 Ci/10 minutes would be .67 Ci/sec. for 10 minutes or 4.6×10^{-3} Ci/sec. averaged over 24 hours.
- 4) Referring to Figure 3, it can be seen that under average conditions the 24 hour average the emission rate for the accident divided by the emission rate for Figure 3 times

the maximum ground level concentration shown on
Figure 3.

$$4.6 \times 10^{-3} \text{ Ci/sec.} \quad / \quad 1.2 \times 10^{-5} \text{ Ci/sec.} \quad \times \quad 2.4 \times 10^{-9} = 9.2 \times 10^{-7} \text{ uCi/cc}$$

- 5) The highest ground level concentration would occur with non-inversion low wind speed conditions. By changing the wind speed to 1 meter per second for the case indicated in Item 4 above, these conditions are met. The net effect of reducing the wind speed is to double the ground level concentration so the 9.2×10^{-7} uCi/cc becomes 1.8×10^{-6} uCi/cc for the maximum credible ground level 24 hour average.

OPERATION OF TUBE FILLING EQUIPMENT

Description of equipment

This system consists basically of an ultra high vacuum system to remove the air from the tubes to be filled. A tritium supply section with a uranium tritide container as the source of tritium for filling the tubes and a high sensitivity bellows type pressure gauge. A "pull-back" section which utilizes a uranium container to remove the tritium from the system and from the unused portion of the tubes that have been filled. There are cross-over lines connecting the pull-back section and the fill section. The tritium is reclaimed by heating the uranium pull-back container and absorbing the released tritium on the uranium tritide supply container.

The system is a semi-automatic Sorption and Ion pumped system that consists of three modules designed to operate under a single exhaust hood. A central tritium supply section and pull-back section are used for all three modules. Each module fills and seals a group of forty tubes on a manifold per cycle. Each module is expected to cycle three times per shift for a total of three hundred and sixty filled tubes.

The sorption pump absorbs and holds all pumped gases with the exception of helium while it is at liquid nitrogen temperature. The gases, as they are removed during the reactivation of the sorption pump,

are scrubbed to remove any tritium present, before release to the exhaust hood. The ion pump collects and permanently holds all pumped gases.

A single operator's attendance is required at each module during loading, start of the automatic pumping sequence, the duration of the fill cycle, the start of the sealing operations, and the start of the pull-back and pump sequence. The system is designed so that in the event of a leak during the tritium fill cycle or the sealing operation on any module, all valves are automatically closed except the valve to the pull-back sections which opens and retracts the tritium into the uranium container. This emergency pull-back procedure may be manually activated by the operator at any time that it is necessary. The system is designed so that all valves may be manually operated or bypassed when necessary.

The sealing of the glass tubes is accomplished by focused infrared radiation. The tubes are annealed by the unfocused radiation that is emitted by the lamps.

A tritium air monitor installed in the hood exhaust system alerts the operator to any release of tritium, also at a pre-set level initiates the emergency pull-back sequence as previously described. The system is designed to be fail safe. In event of a power failure or a compressed air failure, all the automatic valves will close. Manual bypass valves may then be opened to return the tritium to the uranium container, if necessary.

This system has been designed to encompass high quality materials of construction, most modern techniques of assembly, and safe and easy operation and maintenance.

DISCUSSION OF POTENTIAL RADIATION HAZARD
FROM OPERATION OF LUMINOUS TUBE FILLING EQUIPMENT.

Accidental release of tritium from new fill system

There are four possible points of accidental release of tritium from the new fill system. These are listed in the order of probability of occurrence, the first being the most frequent.

- 1) A leak at the glass to metal seal. Our experience in 3 years operating the existing system shows that this would never exceed 10 mCi per hour and that the duration at this level would never be longer than 5 minutes.
- 2) Complete rupture of a tube while on the manifold. There will be an estimated 400 Ci of tritium in this section at less than atmospheric pressure. The operating schedule of this system is such that the operator must be present while the tritium is in this section. It cannot be visualized how it would be possible to lose in excess of 50 Ci with the emergency procedure that will be set up.
- 3) Leaks in the gas handling section of the system. The release rate would never exceed 5 mCi per hour with a maximum duration of 10 minutes.
- 4) Operator error. This is very unlikely to occur, due to the system fail safe automation. If an operator or the automation of the system failed, the tritium would either be contained in the ion pump or trapped in the sorption pump. A special emergency procedure will be set up to strip this absorbed tritium from the sorption pump, if this should occur.

Table II if all scrubbing of effluent tritium at the glovebox failed. In a new design, the capacity of the glovebox effluent scrubbing system would be redesigned to a capacity to capture tritium leaks at the glovebox outlet port.

As was explained under Description of Equipment, tritium which is flushed from the equipment as an inevitable consequence of processing is captured by a molecular sieve-copper oxide system.

New equipment would be designed to provide "tritium capture" capacity to reduce the release hazard as much as reasonable cost will allow.

CONTINUOUS EFFLUENT STACK MONITORING

Description of equipment

The effluent stack will be monitored by a train of monitors that includes a particulate filter, an ionization chamber, and a water impinger. The particulate filter will be counted daily in a proportional counter; the water impinger sample will be counted daily in a liquid scintillation counter; the ionization chamber output will be recorded continuously on a chart recorder.

The ionization chamber will be a 14.8 liter Applied Health Physics unit feeding the signal to a Cary 401 vibrating reed electrometer which activates a recording pen on a Honeywell chart recorder.

Discussion of effluent stack monitoring

The effluent stack will be monitored continuously - 24 hours a day. As currently planned, the monitoring equipment will have a nominal sensitivity of 1×10^{-6} $\mu\text{Ci/cc}$ for tritium in air. It will be sampling a stack flow at a location in the stack to produce a representative sample of stack effluent.

An instantaneous alarm system adjustable to predetermined levels will be attached to the monitoring system.

Experience has shown that the ratio of tritium activity as particulate, water soluble, and gas is fairly constant. It is possible, therefore, to integrate tritium effluent recorded by the ionization chamber and calculate the total tritium effluent from all three types.

OPERATING PROCEDURES

PREPARATION OF TRITIUM
TARGETS AND FOILS

1.0 Preliminary to be performed prior to start of
daily operations.

1.1 Adequate gloves must be worn at all times.

- 1.3 Check main Tritium scrubber.
- 1.3.1 Furnace must be on and CuO tube at operating temperature, prior to start of vacuum manipulations.
- 1.3.2 Desiccating columns must show blue (anhydrous) bands.
- 1.3.3 Check that all lines and connectors are in place.

- 1.4 Check uranium pot tritium scrubber.
- 1.4.1 If tritium is to be manipulated that day, heat up furnace round CuO tube to operating temperature.
- 1.4.2 Desiccating columns must show blue (anhydrous) bands.
- 1.4.3 Air pump must be operating to pull air over uranium pots then through reactor and dryers.

- 2.0 Initial vacuum manipulations.
- 2.1 Refer to log book to determine status of system, check and note position of all valves.

2.2

Turn on all vacuum gauges and record all readings obtainable, including manometer.

2.3

Check that all pumps are operating and that cooling water is flowing.

- 2.4 Progressively open valves and pump the various portions of the system not suspected of containing gaseous tritium.
- 2.4.1 Note speed of above operation and vacuum attained. If any section seems abnormally slow, determine and remedy cause before proceeding.

2.5

Any gas that could contain tritium values should be exposed to pyrophoric uranium and all reactive material removed prior to pumping.

2.6

By checking the current and recorded pressures, one can rapidly determine if the system is clean and leak free. It must be clean and leak-free before any impregnation can be started.

3.0 Loading for impregnation.

3.1 Bring materials and targets selected for impregnation from the inactive area.

3.1.1 Turn on argon at cylinder valve.

- 3.2 Arrange the impregnator load so it will fit impregnator selected.
- 3.2.1 Whenever possible, titanium coated faces should contact one another.
- 3.2.2 The impregnator load must incorporate a withdrawal wire whenever possible.
- 3.2.3 Arrangement and handling must be such as to minimize the possibility of contaminating the load with grease etc.

3.3 Transfer the impregnator load into the impregnator drybox.

3.3.1 To minimize possibility of contamination, the load should be enclosed in a disposable cover and rest on a clean disposable material.

3.4

Isolate the impregnator selected, together with the minimum manifold required, then backfill with argon to slightly below one atmosphere.

- 3.5 Open impregnator, load, then close and seal as rapidly as possible.
- 3.5.1 Check that impregnator is completely empty before inserting new load.
- 3.5.2 Grease on all quartz faces exposed should be smoothed and replenished as required.
- 3.5.3 "O" rings and their grooves should be cleaned and greased lightly while the impregnator is open.
- 3.5.4 Load should be positioned as nearly as possible in the center of the heated area of the impregnator.
- 3.5.5 When closing the impregnator, the sealing faces should be positioned for best sealing, then the seal tightened hand tight and visually checked.

- 3.6 Only when satisfied with visual seal, can the final seal be made.
- 3.6.1 When sealing pressure is applied by nuts, these should be tightened only a minimum number of turns per cycle, using a sequence involving diametrically opposite units.
- 3.6.2 Final sealing pressure should be comparable to that obtained on 5/16" nuts using a 4" long wrench.

- 3.7 Pump the impregnator and manifold slowly to avoid overloading the tritium scrubber.
- 3.7.1 When most air removed from impregnator, check that seal is still at maximum tension.
- 3.7.2 If pumping appears slow, the most obvious suspect is the impregnator seal. Check this by isolating the impregnator and a pressure gauge and observing buildup of pressure.

3.8 When system is leak tight, isolate manifold and impregnator again, backfill with argon and pump as before.

3.8.1 A second backfill and pump should remove all traces of oxygen.

4.0 Impregnation

4.1 With impregnator and manifold leak tight and flushed with argon, check that the appropriate impregnator line valves are open from the tritium working pot manometer area.

4.1.1 Make sure that all valves are closed to any impregnators not in use.

- 4.2 Pump tritium handling areas, including manometers, expansion volumes, transfer cylinders, etc.
- 4.2.1 Pump all uranium pots at room temperature to remove any helium daughter evolved.
- 4.2.2 Isolate all uranium pots, expansion volumes, etc. not needed for current operation empty and ready for emergency use.
- 4.2.3 Isolate tritium manometer area behind double valves.

4.3 With system pumping in a satisfactory range, start heating the impregnator slowly to drive off vapors adsorbed onto walls.

4.3.1 Check that thermocouple in impregnator area is connected to pyrometer.

- 4.4 Prepare to generate tritium.
- 4.4.1 Open valve from uranium/tritium storage pot to isolated manometer area.
- 4.4.2 Check that valves above other uranium pots are closed and pumping system is isolated from manometer area behind double valves.
- 4.4.3 Check that air is flowing over the loaded uranium pot and through the scrubber line.
- 4.4.4 Plug in the heater on the uranium/tritium "storage" pot.

- 4.5 Generation of tritium from "storage" pot.
- 4.5.1 When pressure starts to build up in the isolated manometer area, prepare to pull plug on heater when pressure reaches about half of desired final pressure.
- 4.5.2 Thermal lag will cause continued generation of tritium.
- 4.5.3 When pressure stops rising, close valve to uranium pot, then adjust pressure to that desired by absorption or generation of tritium.
- 4.5.4 If a working uranium pot is being utilized as a separate unit, absorb the gas generated in 4.5.3 onto the empty working pot, isolate from the manometer area and generate this known quantity of gas by heating the "working" pot.
- 4.5.5 By measuring the pressure of the tritium and knowing the system volumes involved, it is very simple to calculate the quantity of tritium out as gas.

- 4.6 Tritium transfer.
- 4.6.1 During this tritium generation interval, the impregnator has been slowly baking and pumping at a temperature considerably below the "opening" temperature of titanium.
- 4.6.2 Record vacuum, temperature, current, etc. and when impregnator is in the currently accepted closure range, isolate it behind double valves.
- 4.6.3 Make sure gauge is set to indicate pressure buildup in the volume between the two valves isolating the impregnator from the pumping system.
- 4.6.4 Admit the gaseous tritium generated earlier into the isolated impregnator.
- 4.6.5 Pressure in the manometer area should drop proportionate to the difference in volumes involved.
- 4.6.6 There should be no indication of pressure buildup due to tritium leakage into the volume between the two valves isolating the impregnator.
- 4.6.7 If there is leakage, discontinue heating the impregnator and take the gaseous tritium back onto a cold uranium pot. This leak must be eliminated before any further processing is attempted.

- 4.7 Impregnation proper.
- 4.7.1 Once satisfied that the impregnator is sealed satisfactorily, further tritium can be generated from the uranium pot till the total quantity of tritium required for the run is out as gas in the impregnator and manometer areas.
- 4.7.2 Increase power to the impregnator heater such that the impregnator load can be expected to reach the "opening" temperature in about 45 minutes.
- 4.7.3 Record readings on all gauges and meters and manometers at five minute or shorter intervals.
- 4.7.4 Since the impregnator and associated manometer can act as as gas thermometer, the pressure will rise with the temperature. The rate of rise tends to be quite rapid initially, then decreases as the "opening" temperature is approached.
- 4.7.5 When the "opening" temperature is reached, the pressure will start to drop, and will continue to do so till all the titanium present reaches equilibrium with tritium at the temperature involved.
- 4.7.6 The power to the impregnator heater should be reduced as soon as "opening" temperature is attained so as to hold the impregnator temperature within $\pm 30^{\circ}\text{C}$ of "opening" temperature.
- 4.7.7 Pressure will typically drop steadily for about ten minutes, then level off and start a slow rise.

- 4.7.8 Temperature is held $\pm 30_0$ °C of "opening" temperature for a standard minimum time, the time being increased if there is any sign of continued pickup.
- 4.7.9 When satisfied that the load has attained equilibrium with the tritium, the power to the impregnator heater is cut off and the impregnator permitted to cool to room temperature.
- 4.7.10 Record pressure, temperature etc. at end of heating.

5.0

Tritium recovery after impregnation.

5.1

When temperature in impregnator is near room temperature, manometer reading should be recorded, then any unreacted tritium should be absorbed onto a cold empty uranium pot.

- 5.2 Under ordinary circumstances, most of the tritium will absorb quite rapidly, but we usually find a buildup of "inerts" in the uranium pot and the manometer area close to it. These inerts will slow pullback drastically.
- 5.2.1 To speed pullback, the simplest safe technique is to isolate the minimum volume of uranium pot and manometer, wait till there is no further sign of pickup, then expand these inerts into an evacuated chamber like the expansion volume or transfer cylinder.
- 5.2.2 On isolating the uranium pot and manometer area, the pressure will be found to have decreased markedly, and the uranium pot will resume absorbing tritium.

5.3

By repeating the above, it is usually possible to reduce the pressure of gas in the whole system to the point where the quantity of gas (mostly inerts) in the manometer and uranium pot areas is below that which could be pumped safely even if pure tritium.

5.3.1

At this point, this volume can be pumped and further cycling will remove all tritium.

5.4

When all tritium has been recovered from the gas in the impregnator, the impregnator can be isolated from the manometer area and pumped.

5.5 The impregnator can then be isolated and backfilled with argon, preparatory to opening, following procedures as in 3.4 and 3.5

5.5.1 Withdraw load onto a clean disposable material, cover, then close and pump impregnator as in 3.5, 3.6 and 3.7.

5.6 By heating the appropriate uranium pots, all tritium can be transferred to one storage pot.

5.6.1 Make sure air stream to tritium scrubber is directed over proper uranium pots.

5.7 With all tritium on one storage pot, and the manometer reading pressures on an isolated section of known volume, it is simple to generate known amounts of tritium and absorb them onto an empty uranium pot.

5.7.1 When inventory is complete, tritium used can be determined by difference from previous inventory.

5.8 When inventory is complete, the "inerts" expanded earlier into the expansion volume, transfer pot, etc. can be exposed to the "stripped" uranium pot for as long as seems desirable, with portions pumped off whenever deemed safe.

5.8.1 At the completion of absorption of the residual tritium values from the inerts, the uranium pot and manometer area can be pumped.

5.8.2 On isolating the manometer area and heating the uranium pot involved, any adsorbed tritium will be evolved. This gas can be added to the recorded inventory.

- 5.9 At any convenient time, the empty impregnator that has been pumped as per 5.5, can be given a bakeout to remove any adsorbed material.
- 5.9.1 Power to the impregnator heater should be comparable to that used during impregnation but heating should be continued till a temperature at least 50°C above the maximum impregnation temperature is attained.
- 5.9.2 Pumping should be continued at this temperature till satisfied that all adsorbed material has been removed.
- 5.9.3 If there are indications that there is a large amount of condensables to be removed, it is often advisable to isolate the hot impregnator, backfill it with argon, then slowly pump the hot argon/vapor mix which will pass through the system quite readily.
- 5.9.4 When the impregnator has been pumped hot till a satisfactory vacuum can be obtained, power to the impregnator heater can be cut off and the impregnator permitted to cool to room temperature while pumping.

- 6.0 Target and foil transfer and measurement.
- 6.1 With impregnator load on a clean surface, separate it as to destination, if necessary.
 - 6.1.1 Sheet requiring further processing or scanning can be bagged and transferred to the appropriate box.
 - 6.1.2 Targets requiring only measurement should be bagged and transferred either to storage or the measurement drybox.

- 6.2 Procedure in measurement drybox.
 - 6.2.1 Warm up and calibrate measurement equipment.
 - 6.2.2 Arrange targets so they can be identified by their position.
 - 6.2.3 Make whatever measurements are appropriate to the targets and record the values obtained.
 - 6.2.4. When measurements complete, transfer the targets in order to numbered holders and record these identifying numbers with the appropriate radiation measurement.
 - 6.2.5 Store all measured targets in desiccated ventilated storage.

6.3 Prior to shipment, transfer targets back to measurement drybox.

6.3.1 Measure as per 6.2.1, 6.2.2, 6.2.3 and 6.2.4 making the final identifying number the U.S.R.C. permanent number.

- 6.4 Transfer numbered holders to a jar or similar container of appropriate size and include packing to eliminate rattle and bagged desiccant for moisture removal.
- 6.4.1 Wipe outside of container with wet wipers to remove any removable activity, label properly, and take a swipe of the surface which is to be measured and approved by Health Physics prior to shipment.

- 6.5 Sheet stock may be processed as follows.
- 6.5.1 By applying the active side of a foil sheet to a phosphor coated plastic sheet, an outline of the activity distribution can be obtained.
 - 6.5.1.1 A tracing of this distribution can be made and filed. At this time a number is applied to the sheet which follows it till ultimate disposal.
- 6.5.2 Sheet stock is stored in numbered desiccated containers in such a way that its expected output can be easily estimated.
- 6.5.3 Sheet stock is usually reduced to smaller standard dimensions prior to measurement and shipment.
- 6.5.4 Square and rectangular pieces can be cut to dimension in a drybox provided with a precision shear.
- 6.5.5 Circular pieces are usually punched using standard punches in a drybox.
- 6.5.6 Pieces cut to desired dimensions are bagged and transferred to the measurement box then handled under section 6.2 to 6.4.
- 6.5.7 Excess sheet is returned to its original numbered desiccated container for storage.

- 6.6 All scrap rejects and any other tritiated material not suitable for sale will be transferred to a labeled container.
- 6.6.1 This container will periodically be sealed up, wiped down, transferred to another sealable container, sealed, wiped, and labeled as to content.
- 6.6.2 The outer container will be swiped and the swipe counted and approved by Health Physics prior to shipment.

7.0 Tritium receipt.

7.1 Tritium can be transferred either as gas in a transfer cylinder or as a solid in the form of uranium tritide inside a transfer pot.

7.1.1 Remove the protective outer seal over the connector on the transfer pot or cylinder and connect it onto the system.

7.1.2 Make sure that valves on the transfer container are shut firmly, then pump the lines to the connector, until all air removed.

7.2 If the tritium is transferred as a gas, isolate the manometer area behind double valves, then open the valve on the transfer cylinder and determine the pressure across the whole system.

7.2.1 Since the volumes involved are known, it is a simple matter to calculate the volume of gas involved.

- 7.3 After obtaining the initial rough estimate of the gas volume involved, the gas is exposed to a cold uranium pot to pick up tritium.
- 7.3.1 The uranium pot will preferably be empty initially to simplify calculations on pick up.
- 7.3.2 Pick up will be continued till no further tritium will absorb, then the manometer area and uranium pot can be isolated from the transfer cylinder.
- 7.3.3 If no observable pick up occurs in the smaller volume within a ten minute interval, and if the volumes involved are small enough, the "inerts" can be pumped.
- 7.3.4 With the "inerts" out of the way, pick up will usually resume on exposing the gas remaining in the transfer cylinder to the uranium pot.
- 7.3.5 Continue absorption till all tritium is on the uranium pot. The "inerts" remaining in the transfer cylinder can be pumped.

- 7.4 With tritium on the uranium pot, either due to absorption as discussed in 7.3 or due to transfer of the loaded uranium pot, it is necessary to obtain an inventory.
- 7.4.1 If the uranium pot has been transferred, a ventilated heater unit, similar to those on the fixed pots and connected to the tritium scrubber train must be installed.
- 7.4.2 By heating the uranium pot and generating tritium into the isolated manometer area in measurable increments, then absorbing the tritium onto another uranium pot, it is possible to transfer all the tritium and at the same time obtain an inventory.
- 7.4.3 The volume of tritium obtained by this physical inventory must be recorded and reconciled with the quantity of tritium charged.

8.0 General operating rules.

8.1 Disposable gloves should be worn at all times. These should be washed periodically and disposed of if perforated or if removal is necessary.

8.2

Damp wipers shall be used periodically on all working areas and disposed of as active waste.

8.3

Whenever active material is handled or stored, the container shall be labeled with the best estimate of current tritium content.

10.2 Try to localize the trouble. Close valves and watch pressure buildup. Any section that shows no measurable pressure buildup on a thermocouple gauge within 5 minutes should not cause any trouble.

10.3

If no section shows a marked increase in pressure, operation of the pumps becomes suspect. By isolation of the various pumps, it is usually possible to determine whether they are operating.

10.4

Concentrate initial efforts on getting the ion gauge on scale in the volume closest to the pumps. Once this is done, it is usually possible to locate the trouble area fairly rapidly by judicious manipulation of the valves.

- 10.5 When the troublesome section has been located, it is necessary to characterize the trouble. Isolate the section and watch pressure rise.
- 10.5.1 A steady rise with no sign of leveling probably indicates gas entry, while a rise that levels off is usually due to condensables.
- 10.5.2 Manipulate any valves in an attempt to see bellows leaks etc. and recheck that valves and flanges are firmly sealed.
- 10.5.3 If pressure buildup indicates the possibility of crud or condensables, heat the section with a hot air gun, torch, or electric heater. A sharp increase in pressure is probably confirmation of crud.

10.6

If presence of crud is confirmed, open the section to the pumps and heat as hot as joints, seals and components can stand while pumping. If at all possible, do an argon or even an air purge to blow crud from the area.

10.7

If, after the removal of crud, there is still a pressure buildup, this is probably due to gas. Isolate section with a gauge included and record rate of pressure rise. Once this is determined, spray the various joints and connections with water or acetone and watch for changes in rate of pressure rise. Any change is probably an indication of the leak location.

10.8

When a leak has been located as above, and it is not in a location where tightening is the obvious solution, take black vacuum putty and apply over the entire suspect area. When the leak is sealed, remove the putty piece by piece starting at the most unlikely location and continuing until the leak opens again. After pinpointing the leak by this technique, the area should be carefully cleaned, then sealed by whatever technique seems appropriate, preferably silver soldering.

- 10.9 If the leak cannot be located with vacuum putty, check the seating of the valves.
- 10.9.1 Most bellows seal valves can have the stem and bellows assembly removed and the sealing faces examined. There is often particulate matter imbedded in the elastomer. Clean the seal area, replace or re-grease the seal, if it seems advisable.
- 10.9.1.1 Take care that all swabs etc. that contact the inside of the valve go to active disposal immediately and that gloves are changed often.
- 10.9.2 Re-assemble and close valves, then check for vacuum improvement.
- 10.9.3 If no improvement, substitution of bellows can eliminate possibility of a bellows leak.
- 10.9.4 If the valve involved is a gate or other non-bellows type, it also can often be dis-assembled and the seal area cleaned and re-greased.
- 10.9.4.1 Swabs etc. should be disposed of as 10.9.1.1.
- 10.9.5 If the valve involved is proven to be the source of the leak, and if it is impossible to eliminate the leak by any repairs, the valve must be replaced in its entirety.

10.9.5.1 Extreme care must be taken during this operation.

If it is necessary to heat the valve area to remove or dis-assemble it, make sure ventilation is adequate to remove all traces of tritium.

10.9.5.2 All swabs, gloves etc. should be disposed of as in 10.9.1.1.

10.11

In much of this leak testing, common sense is the most important resource. In general, a leak is most likely to involve these valves, flanges or components most recently operated or moved. Once these areas are checked out, a general tightening of flange bolts, stem seals etc. often works wonders.

APPENDIX A

IMPREGATOR SCHEMATIC 1-22-69

<u>Valve Number</u>	<u>Description</u>
1	1" bellows seal, brass
2,3	4" gate valve, aluminum, VCS 41A
4,5	2" gate valve, aluminum, VCS 21A
6,7,8	1" bellows seal, brass
9, 10	1/4" bellows seal TY440 S.S. (Hoke)
11,12	1/4" bellows seal Nupro brass
13,14,15	1/4" bellows seal TY440 S.S. (Hoke)
16	1/4" soldered diaphragm SS Hoke 4"
17	1/4" bellows seal TY440 S.S.
18	1/4" soldered diaphragm SS Hoke 4"
19,20,21,22,23, 24,25, 26 and 27	1/4" bellows seal TY440 S.S.
28	1" bellows seal brass
29	5/8" bellows seal brass
30	1/4" bellows seal TY440 S.S.
31	Metal diaphragm P.R.V.
32	5/8" bellows seal S.S.
33,34,35,36 and 37	1/4" Hoke ball valves

Line connections on schematic are indicated by dots with a minimum diameter five times line width.

8.4

Whenever a valve is to be opened that will permit more than 10 cc of any gas to be pumped, the valve must be opened slowly enough that the capacity of the pumps and scrubber train are not exceeded.

9.0

Tritium gas handling rules.

9.1

Whenever tritium gas is generated, two valves in series must be closed on each connection to the pumping system.

9.3

When, in the course of handling tritium gas, it becomes advantageous to open one of the series valves, this opening must be delayed as long as possible. Only the unavoidable minimum amount of tritium shall be permitted to lie against a single valve.

9.4

Whenever it is necessary to pump "inerts" from areas where tritium can be present, particularly in the manometer area, do everything possible to ensure complete stripping of tritium onto uranium. Pump only the smallest volume that can conceivably be of use.

9.5

Under no circumstances, pump one of the uranium pots if it is above room temperature.

9.6

Keep a complete record of all pressures and volumes involved in the log book.

9.7

Whenever it is necessary to heat one of the uranium pots used to hold tritium, an air sweep must be led over it and through the scrubber train. This sweep should continue till the pot is cooled to room temperature.

10.0

Leak Detection

Whenever the system, or any part of it does not pump down as well as expected, the cause must be determined and eliminated. There are several potential causes.

10.0.1

The system pumps are inoperative.

10.0.2

Valves, flanges or fittings are not closed or sealed properly.

10.0.3

Crud or adsorbed materials on the system walls, etc.

10.0.4

A leak.

OPERATING PROCEDURE

VARIAN H-3 FILL SYSTEM

The system consists of three modules attended by one operator. The procedure is for one module. In operation, the same procedure is used on each module. The operation is carried out simultaneously on all three modules with each module progressively further along in the process.

- 1.0 Fill and seal H^3 activated tubes.
- 1.1 Open BTA (Back to Air) valve on the manifold. This is connected to a tritium scrubber which draws air through the manifold and scrubs it while the filled tubes are being removed and a new charge connected to the system. (See #1 and #2 of Appendix #1)
- 1.2 Remove one tube from manifold, cut at seal point, place stub in tube stub flush can (see #3 Appendix #1) and filled tube in the tube carrier. Replace with a tube to be filled. Continue removing and replacing tubes until all positions on the manifold have been changed.
- 1.3 Close BTA valve.
- 1.4 Push start button.
- 1.5 Observe vacuum gauging to determine if there are any leaks. An experienced operator can detect most leaks by the pump down rate.
- 1.6 Observe ion pump pressure. Again an experienced operator can detect leaks by the ultimate ion pump pressure (see #4 Appendix #1).

- 1.7 Repair any leaks detected and return to 1.3.
- 1.8 Push fill start button.
- 1.9 Check the tritium hood monitor for indications of leakage
- 1.9.1 If there is a release rate greater than level A (see #5 Appendix #1), press seal start button, then pull back start button. Allow the tritium to all pull back and the manifold to be pumped. Locate and repair leak, then return to 1.3.
- 1.9.2 If the release rate is greater than level B (see #5 Appendix #1), but less than level A, put the travel probe on the monitor and determine the point of leakage. Pull the tritium back pump and repair as in 1.9.1.
- 1.9.3 If the release rate is less than level B (see #5 Appendix #1), put the travel probe on the monitor and determine the point of leakage. Continue with the filling and sealing operation but repair the leak before the start of the next cycle.
- 1.10 Adjust the tritium pressure by cracking the valve on the tritium reservoir until the required filling pressure is attained.
- 1.11 Seal tubes.
- 1.11.1 Press seal start button.
- 1.11.2 Position the IR lamps so that they focus on the IR absorbing band on the first tube on the manifold.

- 1.11.3 Activate lamps as per #6 Appendix #1.
- 1.11.4 Repeat 1.11.2 and 1.11.3 until all the tubes on the manifold are sealed.
- 1.12 Push pull back start button.
- 1.13 Observe ion pump pressure. When it has reached its ultimate pressure (see #4 Appendix #1), open BTA valve and repeat cycle.

- 2.0 Safety in operation of the H³ fill system.
- 2.1 Tritium hood monitor is to be used at all times.
- 2.2 Operation of the system is to be carried out under subdued light in order that the tube luminosity may be used as a guide in the operation.
- 2.3 The operator is to wear rubber or plastic gloves at all times.
- 2.4 All leaking or reject tubes are to be immediately crimped into appropriate length of copper tubing, dip soldered and labeled.
- 2.5 All releases of tritium gas are to be reported to Health Physics not later than the end of the shift.
- 2.6 The number of leaking tubes encountered in the shift is to be reported to Health Physics.
- 2.7 Closed carriers are to be used for the transfer of tubes between work areas.
- 2.8 All rules regarding labeling and safe handling of gaseous radioisotopes are to be strictly adhered to at all times.
- 2.9 Any unforeseen event or situation that could affect the safety of the operator, or cause release of tritium gas should be immediately reported to the supervisor.
- 2.10 The operator must never leave the immediate area when any module is in the fill or seal stage of the operation.
- 2.11 Tritium in the gaseous form is never to be left in any section of the system during non-operating periods.

APPENDIX #1

- 1) All copper oxide reactors to be 350°C to 450°C.
- 2) Air flow through manifold scrubber to be 2 Lpm.
- 3) Air flow through tube stub flush can to 2 Lpm during operating period and 1 Lpm in non-operating periods.
- 4) The ultimate ion pump pressure varies considerably depending on what has taken place over the previous few days, and also on weather conditions. The operator must know what the current ultimate pressure is at that time.
- 5) Action levels on H³ release to fill hood.
 - Level A = 40 uc/m³
 - Level B = 10 uc/m³
- 6) Sealing conditions IR lamps
 - Voltage = 60 volts
 - Time = 30 seconds

ISOLITE ASSEMBLY

OPERATING PROCEDURE

1.0.0.0 Safety procedures.

1.1.0.0 Broken light sources.

1.1.0.1 Immediately upon detection of a broken, or suspected broken, light source, the building evacuation alarm shall be actuated and all personnel shall leave the building.

1.1.0.2 No one shall re-enter the building until approval is given by Health Physics.

1.2.0.0 Broken skin injury.

Health Physics shall be notified of all cases of injury involving broken skin. Health Physics shall determine whether the injury involves radionuclide contamination and, if so, make appropriate recommendations.

2.0.0.0 Assembly procedures.

2.1.0.0 Movement of radioisotope activated light sources.

All light sources not assembled into their designated light diffuser shall be moved only in containers which have been approved by the Health Physicist for that purpose.

2.2.0.0 Storage of light sources.

All light sources, whether in assemblies or not, will be stored only in continuously monitored storage which has been approved by the Health Physicist.

2.3.0.0 Assembly operations with unpotted light sources.

All assembly operations involving light sources that are not imbedded in their designated light diffuser will be performed only on work tables approved by the Health Physicist.

2.4.0.0 Test of completed units.

2.4.1.0 All completed units will be surveyed for surface contamination prior to removal from the assembly area. No unit shall leave the area, except as authorized by Health Physics if the surface contamination survey is found to be equal or above 0.005 microcuries.

2.4.2.0 Each completed unit will be leak tested by a procedure which has been approved by the Health Physicist as meeting the requirements of applicable A.E.C. license requirements.

2.5.0.0 Storage of completed units.

Completed units shall be placed in a continuously monitored storage area which has been approved by the Health Physicist whenever they are not required for shipping or other designated purpose.