FORM NRC-313 I (1-79) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

19

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*

	a. NEW LICENSE
	b. AMENDMENT TO: LICENSE NUMBER
xx	c. RENEWAL OF: LICENSE NUMBER 37-0003-08 (refer to control no. 94003)

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
SAFETY LIGHT CORPORATION (formerly United States Radium Corporation)
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(717)784-4344

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Jack Miller, President
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(717)784-4344

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
4150-A Old Berwick Rd.
Bloomsburg, PA 17815

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
4150-A Old Berwick Rd.
Bloomsburg, PA 17815

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

	FULL NAME	TITLE
a.	**********REFER TO APPENDICES 1 THROUGH 19*********************************	
b.		
c.		

7. RADIATION PROTECTION OFFICER
Dr. J.G. MacHutchin

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.
REFER TO APPENDICES 7,13,19 & 21

8. LICENSED MATERIAL

LINE NO.	ELEMENT AND MASS NUMBER A	CHEMICAL AND/OR PHYSICAL FORM B	NAME OF MANUFACTURER AND MODEL NUMBER *(If Sealed Source)* C	MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME D
(1)	Hydrogen 3	any	---	100,000 curies
(2)	Any Byproduct Material	sealed sources		1 millicurie
(3)	Carbon 14	sealed sources		2 curies
(4)	Krypton 85	sealed sources		5 curies

	DESCRIBE USE OF LICENSED MATERIAL E
(1)	******************REFER TO APPENDIX 20***********************************
(2)	******************REFER TO APPENDIX 20***********************************
(3)	******************REFER TO APPENDIX 20***********************************
(4)	******************REFER TO APPENDIX 20***********************************

IN[illegible]MATION REQUIRED FOR ITEMS 15, [illegible] AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit.

(COVERED IN APPENDICES 21 & 22)

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc. (COVERED IN APPENDICES 2 THROUGH 7)

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation.

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

(COVERED IN APPENDICES 8 THROUGH 19)

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, 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.

WARNING.–18 U.S.C., Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)* This is resubmission of renewal application dated 4/5/78-fee paid at that time.	b. CERTIFYING OFFICIAL *(Signature)* J Miller c. NAME *(Type or print)* Jack Miller
(1) LICENSE FEE CATEGORY: 3A	d. TITLE President
(2) LICENSE FEE ENCLOSED: $ see note above	e. DATE December 15, 1980

SAFETY LIGHT CORPORATION

APPENDIX 1 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 6 - INDIVIDUALS WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIALS

	NAME:	TITLE:
a.	Dorothea E. Swank	Foreman, Application/Assembly Operations
b.	Norman G. Fritz	Foreman, Systems Operations
c.	Charles G. Berlin	Group Leader, Health & Safety/ Quality Control
d.	Gary R. Good	Foreman, Health & Safety/ Quality Control
e.	D. John Watts	Vice President
f.	John G. MacHutchin	Manager, Research & Development/ Radiation Safety Officer

SAFETY LIGHT CORPORATIO.

APPENDIX 2 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

DOROTHEA E. SWANK

	TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a.	Principles & Practices of Radiation Protection	United States Radium Corp., Bloomsburg, PA	32 yrs.	yes	no
b.	Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	United States Radium Corp., Bloomsburg, PA	32 yrs.	yes	no
c.	Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	United States Radium Corp., Bloomsburg, PA	32 yrs.	yes	no
d.	Biological Effects of Radiation	United States Radium Corp., Bloomsburg, PA	32 yrs.	yes	no

SAFETY LIGHT CORPORATION

APPENDIX 3 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

NORMAN G. FRITZ

	TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a.	Principles & Practices of Radiation Protection	United States Radium Corp., Bloomsburg, PA	2 yrs.	yes	no
b.	Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	United States Radium Corp., Bloomsburg, PA	2 yrs.	yes	no
c.	Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	United States Radium Corp., Bloomsburg, PA	2 yrs.	yes	no
d.	Biological Effects of Radiation	United States Radium Corp., Bloomsburg, PA	2 yrs.	yes	no

SAFETY LIGHT CORPORATION

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APPENDIX 4 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

CHARLES G. BERLIN

	TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a.	Principles & Practices of Radiation Protection	United States Radium Corp., Bloomsburg, PA	19 yrs.	yes	no
b.	Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	United States Radium Corp., Bloomsburg, PA	14 yrs.	yes	no
c.	Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	United States Radium Corp., Bloomsburg, PA	19 yrs.	yes	no
d.	Biological Effects of Radiation	United States Radium Corp., Bloomsburg, PA	10 yrs.	yes	no

SAFETY LIGHT CORPORATIO.

APPENDIX 5 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

GARY R. GOOD

	TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a.	Principles & Practices of Radiation Protection	United States Radium Corp., Bloomsburg, PA	1 yr.	yes	yes
b.	Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	United States Radium Corp., Bloomsburg, PA	1 yr.	yes	yes
c.	Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	United States Radium Corp., Bloomsburg, PA	1 yr.	yes	yes
d.	Biological Effects of Radiation	United States Radium Corp., Bloomsburg, PA	1 yr.	yes	yes

SAFETY LIGHT CORPORATION

APPENDIX 6 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

D. JOHN WATTS

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles & Practices of Radiation Protection	Fulmer Research Institute, Stoke Poges, England	1 yr.	yes	no
	Brandhurst Co., Ltd. High Wycombe, England	7 yrs.	yes	yes
	American Atomics Corp. Tucson, AZ	4 yrs.	yes	no
b. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	Fulmer Research Institute, Stoke Poges, England	1 yr.	yes	no
	Brandhurst Co., Ltd. High Wycombe, England	7 yrs.	yes	no
	American Atomics Corp. Tucson, AZ	4 yrs.	yes	no
c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	Fulmer Research Institute, Stoke Poges, England	1 yr.	yes	no
	Brandhurst Co., Ltd. High Wycombe, England	7 yrs.	yes	no
	American Atomics Corp. Tucson, AZ	4 yrs.	yes	no
d. Biological Effects of Radiation	Fulmer Research Institute, Stoke Poges, England	1 yr.	yes	no
	Brandhurst Co., Ltd. High Wycombe, England	7 yrs.	yes	yes
	American Atomics Corp. Tucson, AZ	4 yrs.	yes	no

SAFETY LIGHT CORPORATION

APPENDIX 7 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 16 - FORMAL TRAINING IN RADIATION SAFETY

JOHN G. MACHUTCHIN

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles & Practices of Radiation Protection	Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada	6 yrs.	yes	no
	Atomic Energy of Canada, Ltd., Ottawa, Ontario, Canada	6 yrs.	yes	no
	United States Radium Corp., Bloomsburg, PA	12 yrs.	yes	no
b. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments	Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada	6 yrs.	yes	no
	Atomic Energy of Canada, Ltd., Ottawa, Ontario, Canada	6 yrs.	yes	no
	United States Radium Corp., Bloomsburg, PA	12 yrs.	yes	no
c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity	Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada	6 yrs.	yes	no
	Atomic Energy of Canada, Ltd., Ottawa, Ontario, Canada	6 yrs.	yes	no
	United States Radium Corp., Bloomsburg, PA	12 yrs.	yes	no
d. Biological Effects of Radiation	Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada	6 yrs.	yes	no
	Atomic Energy of Canada, Ltd., Ottawa, Ontario, Canada	6 yrs.	yes	no
	United States Radium Corp., Bloomsburg, PA	12 yrs.	yes	no

SAFETY LIGH CORPORATION

APPENDIX 8 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF DOROTHEA E. SWANK

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Radium-226	0.01 Curies	United States Radium Corp. Bloomsburg, PA	20 yrs.	Self-luminous products
Hydrogen-3	1,500 Curies	United States Radium Corp. Bloomsburg, PA	12 yrs.	Self-luminous products

SAFETY LIGHT CORPORATION

APPENDIX 9 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF NORMAN G. FRITZ

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Radium-226	1.8 Millicuries	United States Radium Corp. Bloomsburg, PA	2 yrs.	Radiation standard source
Hydrogen-3	1,500 Curies	United States Radium Corp. Bloomsburg, PA	2 yrs.	Self-luminous products
Plutonium-239	.01 Millicuries	United States Radium Corp. Bloomsburg, PA	2 yrs.	Radiation standard source
Krypton-85	17.8 Millicuries	United States Radium Corp. Bloomsburg, PA	2 yrs.	Light standard source
Strontium-90	1.0 Millicuries	United States Radium Corp. Bloomsburg, PA	2 yrs.	Light standard source

SAFETY LIGH CORPORATION

APPENDIX 10 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF CHARLES G. BERLIN

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Radium-226	100 Millicuries	United States Radium Corp. Bloomsburg, PA	5 yrs.	Radioactive lab production
Polonium-210	100 Millicuries	United States Radium Corp. Bloomsburg, PA	5 yrs.	Radioactive lab production
Cobalt-60	50 Millicuries	United States Radium Corp. Bloomsburg, PA	3 mos.	Radioactive lab production
Cesium-137	200 Millicuries	United States Radium Corp. Bloomsburg, PA	3 yrs.	Radioactive lab production; Health physics wor
Americium-241	100 Millicuries	United States Radium Corp. Bloomsburg, PA	1 yr.	Radioactive lab production; Health physics wor
Strontium-90	100 Millicuries	United States Radium Corp. Bloomsburg, PA	6 mos.	Radioactive lab production
Nickel-63	25 Millicuries	United States Radium Corp. Bloomsburg, PA	6 weeks	Radioactive lab production
Promethium-147	10 Millicuries	United States Radium Corp. Bloomsburg, PA	1 week	Health physics wor
Krypton-85	200 Millicuries	United States Radium Corp. Bloomsburg, PA	3 mos.	Radioactive lab prodction
Hydrogen-3	1,000 Curies	United States Radium Corp. Bloomsburg, PA	14 yrs.	Radioactive lab production; Health physics wor
Neutron (Ra:Be)	80 Millicuries	United States Radium Corp. Bloomsburg, PA	13 mos.	Radioactive lab production

SAFETY LIGH CORPORATION

APPENDIX 11 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF GARY R. GOOD

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Hydrogen-3	1,000 Curies	United States Radium Corp. Bloomsburg, PA	1 yr.	Self-luminous products; industrial wastes
Carbon-14	10 Millicuries	Wilkes College Wilkes-Barre, PA	3 mos.	Research work

SAFETY LIGH CORPORATION

APPENDIX 12 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF D. JOHN WATTS

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Uranium-238 (Metallic)	5-50 grams	Fulmer Research Institute Stoke Poges, England	1 yr.	Research & development
Radium-226	pCi quantities	Brandhurst Co., Ltd. High Wycombe, England	1 mo.	Decontamination
Thorium X (Radium-224) Radiothorium (Thorium-228)	µCi quantities	Brandhurst Co., Ltd. High Wycombe, England	4 yrs.	Production
Promethium-147	µCi quantities	Brandhurst Co., Ltd. High Wycombe, England	1 yr.	Production
Hydrogen-3 (Tritium)-Self-luminous compounds	mCi quantities	Brandhurst Co., Ltd. High Wycombe, England	3 yrs.	Production
Hydrogen-3 (Tritium) Raw materials and sealed sources	kCi Quantities	Brandhurst Co., Ltd. High Wycombe, England	7 yrs.	Research & development
Hydrogen-3 (Tritium) Raw materials and sealed sources	kCi quantities	American Atomics Corp. Tucson, AZ	4.5 yrs	Research & development
Carbon-14	µCi quantities	American Atomics Corp. Tucson, AZ	6 mos.	Production
Krypton-85	µCi quantities	American Atomics Corp. Tucson, AZ	1 yr.	Production

SAFETY LIGHT CORPORATION

APPENDIX 13 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 - RADIATION EXPERIENCE OF JOHN G. MACHUTCHIN

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Plutonium-239	1,000 gms.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	5 yrs.	Separation & purification
Uranium-233	5 gms.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	2 yrs.	Separation & purification
Mixed Fission Products	500 Ci.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	3 yrs.	Separation & purification
Hydrogen-3	1,000 Ci.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	8 yrs.	Production & enrichment
Carbon-14	100 mCi.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	5 yrs.	Production & separation
Phosphorous-32	5 Ci.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	5 yrs.	Production & separation
Sulfur-35	1 Ci.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	5 yrs.	Production & separation
Iodine-131	5 Ci.	Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada	5 yrs.	Production & separation
Cobalt-60	5,000 Ci.	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	3 yrs.	Teletherapy, source production
Polonium-210	100 mCi.	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	2 yrs.	Production & separation
Actinium-227	500 mCi.	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	3 yrs.	Production & separation

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SAFETY LIGH CORPORATION

APPENDIX 13, Page Two RADIATION EXPERIENCE OF JOHN G. MACHUTCHIN

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION	TYPE OF USE
Ra:Be Neutron Sources	100 Millicuries	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	4 yrs.	Manufacture
Po:Be Neutron Sources	50 Millicuries	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	2 yrs.	Manufacture
Ac:Be Neutron Sources	100 Millicuries	Atomic Energy of Canada, Ltd. Ottawa, Ontario, Canada	3 yrs.	Manufacture
Hydrogen-3	5,000 Curies	United States Radium Corp. Bloomsburg, PA	12 yrs.	Manufacture self-luminous sources, tritiated foils & tritiated phosphor
Nickel-63	1 Curie	United States Radium Corp. Bloomsburg, PA	4 yrs.	Manufacture of gas chromatography sources
Krypton-85	50 Curies	United States Radium Corp. Bloomsburg, PA	5 yrs.	Manufacture of self-luminous and radiation sources.

SAFETY LIGHT CORPORATION

APPENDIX 14 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

DOROTHEA E. SWANK, FOREMAN, APPLICATION/ASSEMBLY OPERATIONS

Mrs. Swank has been with Safety Light Corporation (formerly known as United States Radium Corporation) since 1948. She was promoted to the position of Foreman, Application/Assembly Operations, effective August 6, 1979. As the Application and Assembly Operations foreman, she has the responsibility for the day-to-day operations involving the application of painting technology utilized in the manufacturing operations of the plant site and to oversee the final assembly of self-luminous production items.

Mrs. Swank is a graduate of Benton High School in Benton, Pennsylvania. Prior to coming to Safety Light Corporation she held various positions at American Car and Foundry Co. and at Valley Novelty Works, both in Berwick, Pennsylvania.

From 1948-1980, Mrs. Swank has been employed by Safety Light Corporation to work in various phases of the Painting Application and Sign Assembly departments. Her experience includes working with automatic screening machines, hand-painting and hand-screening of parts, mixing tritiated adhesives, and wiping etched parts with radium and tritium paints.

APPENDIX 15 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

NORMAN G. FRITZ, FOREMAN, SYSTEMS OPERATIONS

EDUCATION:

1950-1954	Upper Moreland High School Willow Grove, Pennsylvania Major-Academic
1954-1958	Lycoming College Williamsport, Pennsylvania Received A.B. Biology, Minor in English

BUSINESS EXPERIENCE:

Present	SAFETY LIGHT CORPORATION Bloomsburg, Pennsylvania Manufacturers of self-luminous products Foreman, Systems Operations Responsible for the day-to-day operations of Foil/Target production and Radio-Fluorescent Tube manufacturing within the plant site. Started as a Health Physics technician, performing routine duties as assigned by the Radiation Safety Officer as part of the plant radiation protection program. Work included radioactive contamination surveys, radio-bioassay analysis and radiation sample counting to obtain data from samples obtained during surveys, as well as associated calculations and record-keeping.
9/77-9/78	SELF-EMPLOYED Bloomsburg, Pennsylvania Roofing, siding, general carpentry, remodeling
1/71-9/77	WALTER J. MILO, CUSTOM HOMES Berwick Pennsylvania Builder of new homes Carpenter

/...continued

Norman G. Fritz, Foreman, Systems Operations

9/65-9/70

KAWNEER CO., INC.
Bloomsburg, Pennsylvania
Architectural aluminum products manufacturer, including extrusion, buffing, anodizing, and fabrication.

Production Manager

In charge of overseeing all manufacturing operations, shipping and receiving. Duties included developing budgets.

Management Trainee

Duties included cost analysis, trouble-shooting production processes and assisting personnel manager.

Finishing Foreman

Set up anodizing, buffing and laboratory in new plant. Developed waste water plan and installed same.

9/58-9/65

MERCK & CO., INC.
Riverside, Pennsylvania
Manufacturer of chemicals, food additives and pharmaceuticals

Laboratory Supervisor

Supervised qualitiative and quantitative analyses on production fermentation samples and final production. Developed new and improved test procedures.

Laboratory Technician

Maintained microbiological cultures in Research and Development laboratory. Worked on pilot processes.

APPENDIX 16 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

CHARLES G. BERLIN, GROUP LEADER, HEALTH & SAFETY/QUALITY CONTROL

EDUCATION:

1941-1945	Berwick High School Berwick, Pennsylvania
1948-1950	Scranton School of Watch Repair (Industrial Schooling)

BUSINESS EXPERIENCE:

Present	SAFETY LIGHT CORPORATION Bloomsburg, Pennsylvania Manufacturers of self-luminous products Group Leader, Health & Safety/Quality Control Responsible for the day-to-day operation of the Health & Safety and Quality Control functions within the plant site by performing or overseeing, routine duties as assigned by the Department Foreman and/or Radiation Safety Officer as part of the plant radiation protection program. Work includes radioactive contamination surveys, radio-bio-assay analysis and radiation sample counting ot obtain data from samples obtained during surveys, as well as associated calculations and record-keeping.
1975-1976	BECHTEL POWER CORPORATION Bell Bend, Pennsylvania Nuclear power plant Engineering Assistant Assisted engineers at Susquehanna Steam Electric Generating Station.
1957-1975	UNITED STATES RADIUM CORPORATION (now known as Safety Light Corporation) Bloomsburg, Pennsylvania Manufacturers of self-luminous products

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Charles G. Berlin, Group Leader, Health & Safety/Quality Control

Health Physics Technician I

Responsibilities were as follows:

Acquisition and preparation of gaseous, liquid, and particulate sample media from operational and environmental areas and the use of instrumentation for radiometric assay and consequent quantitiative and qualitative computation of concentrations of radioisotopes.

Surveillance and monitoring of radiation areas, radioactive operations, and attendant personnel.

Calibration and minor maintenance of radiation detecting and measuring instrumentation.

Operation, maintenance, and assessment of twin liquid evaporators and ion-exchange radioactive waste systems and effluent outfails.

Contamination control and decontamination factor determinations of decontamination agent and media.

Preparations of solid waste, and coordination of radioactive materials shipments.

Determination of ventilation flow rate and volume capacities and efficiencies of HEPA filtration affecting the function of hoods, glove-boxes, ducts and stacks of exhaust and make-up air systems.

Maintenance of a working knowledge of federal and state regulations applicable to radiation protection and transportation.

Maintenance of records and data acquisition for formulating reports.

Radioactive Laboratory Technician

Responsibilities included the following:

Radium-Beryllium neutron source preparation.

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Charles G. Berlin, Group Leader, Health & Safety/Quality Control

Radium compact making.

Polonium compact making.
Radium D Beryllium neutron source preparation.
Strontium 90 compact making.
Radium tube breaking.
Assembly of equipment and test preparation.
Make up radium and polonium foils and measuring same.
Compound "undark" luminous compound.
Blow glass bulbs and flame seal ampoules.
Operate krypton-85 gas fill system.
Operate tritium gas fill system.
Soft solder and silver solder.
Operate lathe, drill press and milling machines.
Pour lead radioactive source containers.
Operate cesium-137 hot cell.
Plating of radioactive foils and wire.
Interpret sales orders and product order completely through to shipping.

1951-1957

FALCON'S JEWLERY STORE
Berwick, Pennsylvania
Jewelry store

Watch Repairman and Assistant Manager

Repaired watches and assisted with store operations.

SAFETY LIGHT CORPORATION

APPENDIX 17 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

GARY R. GOOD, FOREMAN, HEALTH & SAFETY/QUALITY CONTROL

EDUCATION:

1968-1974	Benton Area High School Benton, Pennsylvania Major-College Preparatory
1974-1976	University of Pennsylvania Philadelphia, Pennsylvania Major-Chemistry
1976-1978	Wilkes College Wilkes-Barre, Pennsylvania Received B.S. Chemistry
1980 (40 hrs)	University of Texas San Antonio, Texas Continuing Education seminar on Radiological Health.

BUSINESS EXPERIENCE:

Present

SAFETY LIGHT CORPORATION
Bloomsburg, Pennsylvania
Manufacturers of self-luminous products

Foreman, Health & Safety/Quality Control

Responsibilities include:

a. Supervision of the plant Health & Safety program which involves the protection of employees and the environment from both radioactive materials and chemical agents.

b. Management of a radioactive material waste program.

c. Supervision of company compliance with applicable shipping requlations.

d. Supervision of plant quality control program.

SAFETY LIGHT CORPORATION

APPENDIX 18 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

D. JOHN WATTS, VICE PRESIDENT

EDUCATION:

1959-1965	Mill End County Secondary School High Wycombe, England
1965-1966	High Wycombe College of Technology & Art High Wycombe, England Studied National Diploma in Engineering
1966-1970	Slough Technical College, England Studied Applied Mathematics, Pure Mathematics, Physics and Chemistry

BUSINESS EXPERIENCE:

Present — SAFETY LIGHT CORPORATION
Bloomsburg, Pennsylvania
Manufacturers of self-luminous products

Vice President

Acting as technical advisor to plant management. Responsibilities include new products and systems design and improvements in existing products and systems.

10/75-3/80 — AMERICAN ATOMICS CORPORATION
Tucson, Arizona
Manufacturers of high volume self-luminous light sources for commercial and government applications

Research Associate and Manager Special Products/ Government Contracts

In first position, set up and ran military facility to produce first article production, set up and developed commercial tritium source production line (this involved glassworking, coating, filling, laser and quality control), developed stationary

/...continued

D. John Watts, Vice President

laser cutting system as per U.S. Patent Nos. 4,045,201 and 4,146,380, developed watch-tube coating system and developed high volume tritium filling rig.

In second position, set up and managed special products and government contracts. This involved quotation, development and production of all products other than watch tubes and exit signs.

Experience gained in the use and development of the following: cryogenics, health physics, government quality control specifications as per MIL-I 45208 and MIL-Q 9859A, solid state electronics, project management and basic computer programming.

2/69-8/75 BRANDHURST COMPANY LTD.
High Wycombe, England
Manufacturers of medium volume self-luminous light sources for commercial and government applications

Tritium Filling Room Manager and Research and Development Engineer

In first position, following training, supervised all production in Tritium Filling Room, with a maximum staff of 13, kept records of all tritium logs, developed prototype tubes, was responsible for all quality control from glassworking through to filling and helped develop first rotary index filling rig.

In second position, assisted in initial laser cutting set-up, developed 12 position rotary tritium filling system, jointly with one other was responsible for manufacture of all equipment for military and commercial contracts for American Atomics Corporation and visited the United States to assist with American Atomics Corporation's initial set-up of equipment.

Experience gained was in the use and development of the following: high vacuum equipment, glass cutting using CO_2 laser, relay electronics, radioactive gas handling, liquid scintillation techniques and glassworking.

/...continued

D. John Watts, Vice President

7/66-1/69

FULMER RESEARCH INSTITUTE
Stoke Poges, England
Private research institute

Research Assistant in Corrosion Metallurgy Department

Projects included: work on development of material used for Concorde undercarriage and collaboration on patents for the following processes: high rate electro-forming, high rate electro-forming from ore to copper wire, electro-plating aluminum oxide film on steel, stress corrosion equipment, electro-plating equipment and general machine shop work.

APPENDIX 19 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW
USNRC LICENSE NO. 37-00030-08

ITEM 17 (Continued) - RESUME

DR. JOHN G. MACHUTCHIN, MANAGER, RESEARCH & DEVELOPMENT AND RADIATION SAFETY OFFICER

EDUCATION:

1938-1942	McGill University, Montreal, Canada Receive B.S., Honors in Chemistry
1942-1947	McGill University, Montreal Canada Received Ph.D. in Physical Chemistry

BUSINESS EXPERIENCE:

Present

SAFETY LIGHT CORPORATION
Bloomsburg, Pennsylvania
Manufacturers of self-luminous products

Manager, Research & Development and Radiation Safety Officer

In the first position, responsible for the research and development functions within the plant.

In the second position, responsible for establishing the radiation safety and associated regulatory compliance program at this plant. Also responsible for the usual functions of a Radiation Safety Officer including state and federal license management and for general safety and industrial hygiene.

1969-1979

DURON CANADA LTD.
Montreal, Canada
Leading developer and manufacturer of an extensive variety of specialty coatings and resin-based products used in architectural and industrial applications

Vice-President, Research

Responsible for the operations of the Company's Technical Center, including all Research and

/...continued

Dr. John G. MacHutchin, Manager, Research & Development and Radiation Safety Officer

Development work, quality control, customer technical service and technical liaison with Marketing.

1956-1969

UNITED STATES RADIUM CORPORATION
(now known as Safety Light Corporation)
Bloomsburg, Pennsylvania
Manufacturers of self-luminous products

Manager, Research & Development
Also served as Chairman, United States Radium Corporation Isotopes Committee

Principal projects involved development of methods and equipment used for:

a) Production of self-luminous markers and exit signs utilizing H^3 and Kr^{85} gases as phosphor excitation agents.
b) Manufacture of tritiated self-luminous compounds for use on watch dials and in low luminance level markers for military and commercial applications.
c) Manufacture of a variety of tritiated metal foils for use as accelerator targets and as ionization sources for commercial applications.
d) Manufacture of special Ni^{63}-plated foils for use as ionization sources in electron capture detectors (high temperature gas chromatograph applications).

1943-1955

ATOMIC ENERGY OF CANADA, LTD.
Chalk River, Ontario, Canada and
Ottawa, Ontario, Canada

Participated in:

a) Studies on radioactive isotope enrichment using Szilard-Chalmers technique.
b) Laboratory and pilot plant scale separations of PU^{239} and U^{233} from reactor rods. Recovery of uranium and thorium from extraction plant wastes.
c) Supervision of a group associated with reactor irradiation and separation of isotopes such as H^3, C^{24}, P^{32}, S^{35}, Cl^{36}, etc.

/...continued

Dr. John G. MacHutchin, Manager, Research & Development and Radiation Safety Officer

d) Multicuries level separations of fission products such as Sr^{90}, Ru^{106}, Cs^{137}, Ce^{144}, and Pm^{147}.
e) Chemical Production Manager of a department engaged in routine production of most of the commercially used radio-isotopes. Work also included preparation of Ra^{226} and Co^{60} filled medical needles and tubes, plus Ra:Be, Po:Be and Ac:Be neutron source production. Routine production of kilocurie Co^{60} sources for therapy use was also a function of this group.
f) Design of Radioachemical Laboratories for multicurie level production of isotopes.
g) Radiation hazards control and decontamination procedures associated with radioactive work outlined above.

SAFETY LIGHT CORPORATION

APPENDIX 20 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 8.E - USE OF LICENSED MATERIAL

(1) a. Manufacture of self-luminous safety devices for aircraft for distribution under USNRC License No. 37-00030-09G.

b. Manufacture of self-luminous sources for distribution under USNRC License No. 37-00030-10G.

c. Manufacture of tritium foils (USRC types 508-2 and 508-3), tritium targets, and tritiated rods and pins for distribution to specifically and/or generally licensed persons.

d. Filling of electron tubes with diluted tritium gas for distribution to generally licensed persons.

e. Application of tritium self-luminous paint to timepieces, hands and dials for distribution under USNRC License No. 37-00030-07E; application of tritium self-luminous paint to various dials, pointers, spheres, etc. for distribution to specifically licensed persons.

f. Research and development as defined under Title 10, Code of Federal Regulations 30:4(q).

g. Manufacture of self-luminous devices under contract to the United States Government.

(2) Used as reference standards for radiation and/or luminance measurements.

(3) Used as reference standards for radiation and/or luminance measurements.

(4) Used as reference standards for radiation and/or luminance measurements.

APPENDIX 21 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 9 - STORAGE OF SEALED SOURCES

ITEM 10 - RADIATION DETECTION INSTRUMENTS

ITEM 11b - CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

ITEM 12A - PERSONNEL MONITORING DEVICES

ITEM 13b - FACILITIES AND EQUIPMENT

ITEM 15 - RADIATION PROTECTION PROGRAM

Refer to Safety Light Corporation Health and Safety Program Revision 2, attached hereto.

SAFETY LIGHT CORPORATION

HEALTH AND SAFETY PROGRAM

REVISION 2

ISSUED: December 1, 1980

TABLE OF CONTENTS

1.0.0 DEFINED AREAS

1.1.0 RESTRICTED AREAS

A restricted area shall be any area access to which is controlled by Safety Light Corporation for the purposes of protection of individuals from exposure to radiation and radioactive materials. All buildings of the Safety Light Corporation Nuclear Production facility shall be designated as restricted areas and marked as such.

1.2.0 RADIOACTIVE MATERIALS ZONE

1.2.1 Yellow Zone-

A Yellow Zone is an area in which there exists a potential hazard of radiation or contamination due to materials in process, storage, or transit; and in which contamination levels do not normally exceed the following limits:

(a) Direct radiation to a major portion of the body not greater than 2 mREM/hr.

(b) Airborne contamination not greater than the levels stated in Title 10, Code of Federal Regulations (10 CFR), Part 20, Appendix B, Table II.

(c) No removable tritium contamination above 5,000 dpm/100 cm^2.

(d) Fixed alpha contamination not greater than 1,000 dpm/100 cm^2.

(e) No removable alpha or beta-gamma contamination, other than tritium, above background.

1.2.2 Magenta Zone-

A Magenta Zone is an area in which any of the contamination levels exceed those of a Yellow Zone, but in which the occupants will not normally 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 mREM/hr.

(b) Airborne contamination not greater than the levels stated in 10 CFR, Part 20, Appendix B, Table I.

(c) Fixed alpha contamination not greater than 10,000 dpm/100 cm^2.

(d) Removable alpha contamination not greater than 2,000 dpm/100 cm^2.

(e) Removable tritium contamination not greater than 200,000 dpm/100 cm^2.

(f) Removable beta-gamma contamination, other than tritium, not greater than 5,000 dpm/100 cm^2.

1.2.3 Red Zone-

A Red Zone is an area in which any of the contamination levels normally exceed those of a Magenta Zone. Entry to a Red Zone must be authorized by the Radiation Safety Officer or his designate.

1.2.4 Exceeded Limits-

When the specified limits of any radioactive materials zone are exceeded, action will be taken, at the direction of the Health & Safety department, to correct the problem by the end of the next working day. Should the problem be classified by the Radiation Safety Officer as an extreme hazard, immediate action will be taken.

2.0.0 ENTRY REQUIREMENTS FOR SAFETY LIGHT CORPORATION BUILDINGS

2.1.0 ORIENTATION

2.1.1 Safety Light Corporation Employees-

All employees must receive a yearly orientation briefing by the Health & Safety department concerning the provisions of Title 10, Code of Federal Regulations, Chapter I, Part 19, "Notices, Instructions, and Reports to Workers; Inspections" and Part 20, "Standards of Protection Against Radiation", and general plant safety regulations.

2.1.2 Vistors-

(a) Vistors will be admitted to Safety Light Corporation buildings only with special authorization from the Health & Safety department, and-

(1) must be accompanied by personnel who have received an orientation briefing within the last 12 months; or

(2) the visitor(s) must receive an orientation briefing from the Health & Safety department prior to entry unless special authorization is granted by the Radiation Safety Officer.

(b) All visitors must sign the Entry Record kept in the Health & Safety office.

3.0.0 EMERGENCIES

3.1.0 EMERGENCIES DURING PLANT HOURS

3.1.1 Evacuation Alarm System-

A building evacuation alarm connected to a manual switch in the Health & Safety office will be sounded if an immediate evacuation of the entire building is necessary. In the event an evacuation alarm is sounded all personnel will leave the building through the nearest exit.

3.1.2 Verbal Evacuation Orders-

(a) If an order is given by the Health & Safety department to evacuate any portion of the Nuclear Production facility, all personnel in that area will secure their operations for an extended shutdown. Personnel in restricted areas must deposit all protective clothing before leaving the area. Circumstances may arise where the orders given by the Health & Safety department may override the above-stated procedure, in any event, all orders given must be followed immediately. After evacuation has been completed, appropriate Safety Light Corporation management members are to be notified by the Health & Safety department that an evacuation order had been issued.

(b) Instances may arise where an area must be cleared instantaneously. In such instances the systems operator has authority to order an immediate evacuation of the problem area. Such evacuation must be followed by promptly notifying the Health & Safety department of the evacuation order and nature of the problem causing the evacuation. The Health & Safety department will, in turn, notify the appropriate members of Safety Light Corporation management.

3.2.0 EMERGENCIES AFTER PLANT HOURS

3.2.1 In the event of any occurrence listed below, the Plant Surveillance person on duty will immediately

call the following parties, in the order indicated (telephone numbers are listed in Section 3.3.0):

(a) Fire

(1) Fire Department.

(2) Safety Light Corporation Health & Safety Department.

(3) Safety Light Corporation Management.

(b) Sprinkler System Failure

(1) Safety Light Corporation Health & Safety Department.

(2) Contract Plant Maintenance.

(3) Safety Light Corporation Management.

(c) Stack Monitor Alarm

(1) Safety Light Corporation Health & Safety Department.

(2) Safety Light Corporation Management.

(d) Room Monitor Alarms

(1) Safety Light Corporation Health & Safety Department.

(2) Safety Light Corporation Management.

(e) Building (or Property) Damage

(1) Safety Light Corporation Health & Safety Department.

(2) Safety Light Corporation Management.

(f) Unauthorized Entry

(1) Safety Light Corporation Health & Safety Department.

(2) Police Department.

(3) Safety Light Corporation Management.

3.3.0 EMERGENCY TELEPHONE NUMBERS

3.3.1 (a) Fire Department: 784-7911.

(b) Police Department

(1) Local Police: 784-7911.

(2) Pennsylvania State Police: 784-9000.

(c) Safety Light Corporation Health & Safety Department

(1) C. Berlin: 759-8873.

<u>or</u> (2) G. Good: 683-5625

<u>or</u> (3) J. MacHutchin: 752-4929.

(d) Contract Plant Maintenance

(1) J. Powlus: 356-7644.

(e) Safety Light Corporation Management

(1) J. Miller: 759-2990

<u>or</u> (2) J. Watts: 925-2887

<u>or</u> (3) L. Harmon: 454-8249

4.0.0 SHIPPING AND RECEIVING OF RADIOACTIVE MATERIALS

4.1.0 RECEIVING

All incoming shipments marked as containing any radioactive material will be monitored before unpacking by the Health & Safety department and the results will be documented in a permanent Receiving Ledger kept by the Health & Safety department. Should any leakage or contamination be found, appropriate precautions will be taken, as directed by the Radiation Safety Officer. Notification required by Title 10, Code of Federal Regulations, Part 20, Section 20.205(b)(2) will be made by the Radiation Safety Officer, immediately after the survey results are known.

4.2.0 SHIPPING

4.2.1 All outgoing shipments of radioactive materials will be monitored for leakage and contamination by the Health & Safety department before being shipped. The results will be documented in a permanent Shipping Ledger kept by the Health & Safety department.

All outgoing shipments will have no significant removable radioactive surface contamination as defined by Title 49, Code of Federal Regulations, Part 173, Section 173.397.

4.2.2 Certification of Compliance-

All outgoing shipments of radioactive materials will be properly classified, described, packaged, marked, and labeled, and be in proper condition for transportation according to the applicable regulations of the U.S. Department of Transportation.

4.3.0 NUCLEAR MATERIAL TRANSACTION REPORT

When Safety Light Corporation transfers at any one time 1,000 curies or more of tritium, a Nuclear Material Transaction Report (Form DOE/NRC-741) must be completed and distributed. The form is to be completed in accordance with the printed instructions for completing the form and 10 CFR Part 20, Section 30.55

5.0.0 MONITORING PROGRAMS

5.1.0 AIRBORNE CONTAMINATION

5.1.1 Room Air Samples-

Each room in the Nuclear Production facility designated as a Magenta Zone and in which tritium gas is handled, will be continuously monitored for tritium using an alarm equipped monitor.

5.2.0 SURFACE CONTAMINATION

5.2.1 Daily Smear Surveys-

(a) Any room in the Nuclear Production facility designated as a Magenta Zone will be surveyed for removable surface contamination by the Health & Safety department each day production activity has taken place in that room. This survey shall be made by taking a number of smears at random locations in each room. The number of smears will be determined by the type of operation, the amount of radioactivity, and the past contamination history of the operation.

(b) High traffic areas shall also be surveyed for removable surface contamination each day production has taken place in a Magenta Zone. High traffic areas shall include restrooms, lunchroom and hallway.

5.2.2 Weekly Smear Surveys-

Each room in the Nuclear Production facility shall be smear-surveyed at least once during each work week by the Health & Safety department.

5.2.3 Quarterly Smear Surveys-

Each room occupied by Safety Light Corporation personnel in unrestricted areas will be smear-surveyed once each calendar quarter by the Health & Safety department.

5.3.0. AIRBORNE EFFLUENT

5.3.1 The Nuclear Production Facility Stack-

The Nuclear Production Facility stack exhaust will be monitored continuously for tritiated particulates, tritium oxide, and elemental gaseous tritium by methods currently approved by the Nuclear Regulatory Commission and the Environmental Protection Agency. The sample train shall consist of:

(a) Particular filters-either cellulosic membranes or glass microfiber-a maximum pore size of 2.0 micrometers.

(b) Three 500 mL. Greenburg-Smith impingers.

(c) An ionization chamber.

When practical, sampling rates shall be maintained at a level so as to insure isokinetic sampling.

5.4.0 LIQUID EFFLUENT

5.4.1 Potentially Contaminated Water-

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

6.0.0 ENVIRONMENTAL MONITORING PROGRAM

[THIS SECTION RESERVED FOR FUTURE USE]

7.0.0 BIOASSAY PROGRAM

7.1.0 WEEKLY BIOASSAYS FOR TRITIUM

All employees of Safety Light Corporation working in the Nuclear Production facility will be bioassayed for tritium on a weekly basis. For any type of non-routine operations, the Radiation Safety Officer will determine if supplementary tritium bioassays should be performed.

7.2.0 NON-ROUTINE BIOASSAYS FOR TRITIUM

Any non-employee of Safety Light Corporation doing work in the Nuclear Production facility will be bioassayed for tritium as dictated by the nature and frequency of their exposure to tritium as determined by the Radiation Safety Officer.

7.3.0 SAMPLE TREATMENT

7.3.1 Decolorization-

The urine sample shall be decolorized according to the following procedure:

(a) Obtain a 50-100 mL. sample of urine.

(b) Add 3-5 g. of activated charcoal and then slurry.

(c) Filter through a qualitative grade filter paper. The filtrate should be clear and colorless. If necessary, repeat charcoal addition and filtration.

7.3.2 Counting-

The following procedure shall be used to count the sample:

(a) Pipette a 1 mL. aliquot of the decolorized urine into a polyethylene liquid scintillation counting vial.

(b) Add 15 mL. of scintillation counting fluid.

(c) Place the vial in the Packard Instruments, Model 3380, Liquid Scintillation Spectrometer,

allow 30 mintues for the sample to cool and dark-adapt, then count.

7.3.3 Results-

All results from bioassays will be reported in acceptable units of microcuries of tritium per liter of urine (μCi/L).

7.4.0 DOSE CALCULATIONS

Estimations of whole body internal dose shall be calculated using formulas derived from International Commission on Radiological Protection Publication 10: "Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposure";

$$\text{Dose (REM)} = [A_2 - A_1 \exp(-0.05775\ t)]8.86 \times 10^{-3}$$

A_2 = activity of current bioassay.

A_1 = activity of preceding bioassay.

t = number of days between A_1 and A_2.

8.0.0 VENTILATION AIR CONTROL

8.1.0 WORK STATIONS - TRITIUM

All work stations where unconfined tritium, tritiated phosphors, or metallic tritides are handled will have protective air flow by means of fume hood or glove box type devices. Measurement of the air flow through these devices will be made quarterly by the Health & Safety department.

8.2.0 NUCLEAR PRODUCTION FACILITY STACK

- Air flow of the building ventilation system will be measured quarterly at the stack by the Health & Safety department.

9.0.0 RADIOACTIVE WASTE DISPOSAL

9.1.0 DEFINITIONS

As used by Safety Light Corporation, radioactive wastes shall be defined as, but not limited to, the following:

(a) Any manufactured product containing non-exempt quantities of radioactive materials returned for disposal.

(b) Any waste material originating from processes taking place in any room designated as a Magenta Zone.

(c) All disposable protective clothing used in any room designated as a Magenta Zone.

(d) All disposable hand towels used in any room designated as a Magenta Zone.

(e) All step-pads or similar devices used to control the spread of tritium loose surface contamination.

(f) All disposable tritium emissions control devices or materials.

(g) All building materials being removed from a room designated as a Magenta Zone.

(h) Any production equipment being disposed of which was operated in a room designated as a Magenta Zone.

(i) All items defined as being contaminated with radioactive materials according to the Radiation Safety Officer.

9.2.0 PACKAGING AND TRANSPORTATION

All radioactive waste material will be packaged and transported so as to comply with the regulations of the United States Department of Transportation, the Nuclear Regulatory Commmission, the particular Low-Level Radioactive Waste Disposal Site used for each disposal, and Section 4.2.0 of this manual.

10.0.0 RADIATION PROTECTION INSTRUMENTATION

10.1.0 NUCLEAR PRODUCTION FACILITY STACK GAS MONITOR

10.1.1 Description-

This monitoring system consists of:

(a) A 14.8 liter Cary Tolbert Stainless Steel Spherical Ionization Chamber; and

(b) A Cary Instruments, Model 401, Vibrating Reed Electrometer; and

(c) A Honeywell Electronik 15 Strip Chart Recorder.

10.1.2 Use-

This instrumentation is used to measure stack effluent of gaseous tritium.

10.1.3 Detection-

This instrumentation measures concentrations of tritium in the air through changes in electrical fields brought on by the transformations of the tritium present. It has a sensitivity of 2.0 x $10^{-6}\mu Ci\ {}^{3}H/mL$. air.

10.1.4 Calibration-

A calibration is performed on this system on an annual basis. The calibration is performed using a Johnston Laboratories, Model CL-1, Triton Calibrator. The calibrator consists of a lecture bottle containing methane gas spiked with a known activity of tritium, approximately five (5) microcuries of tritium per liter of gas. A pressure regulator allows a metering volume to be filled from the gas cylinder at a preset pressure. The gas in this metering volume can then be released into the ion chamber air flow circuit.

The following procedure should be used to calibrate the Stack Gas Monitor:

(a) Prepare a closed loop calibration system consisting of the CL-1 Calibrator, the ion chamber, and a peristaltic pump.

(b) Determine accurately the total volume of this calibration system.

(c) With all connections made and joints secured, check to insure that the metering outlet valve is closed.

(d) Open the metering inlet valve.

(e) Turn the outlet pressure adjust knob slowly clockwise watching the reading on the outlet pressure gauge. When the outlet pressure gauge reads the desired injection pressure (typically 20 or 30 psi) close the metering inlet valve.

(f) Open the metering outlet valve for between 2 and 4 seconds and reclose firmly.

In performing step (f), a known aliquot of gas is injected into the ion chamber. To inject subsequents aliquots repeat steps (d) through (f) above. Any number of aliquots may be injected with the stack monitor reading increasing proportionately.

10.1.5 Calculations-

V_G = the volume of gas injected (mL)

$$V_G \text{ (mL)} = n\, V_M \frac{P}{14.7} \quad \frac{298}{273 + T}$$

where: n = the number of aliquots injected.

V_M = the metering volume (11.0 mL).

P = the gauge pressure of the gas in the metering volume (psig) [i.e., reading of the outlet pressure gauge].

T = the temperature of the room (°C)

$$V_G\text{(mL)} = nP \frac{230}{273 + T}$$

A_G = activity injected (µCi)

$$A_G \text{ (µCi)} = nP \frac{230}{273 + T} \quad dA \times 10^{-3}$$

where: A = the specific activity of the gas in the lecture bottle (μCi/liter at 25°C and 14.7 psia).

d = the tritium decay factor since the lecture bottle was calibrated.

$$A_G\ (\mu Ci) = n\ P\ d\ A\ \frac{0.230}{273 + T}$$

C = actual concentration of gas in the calibration system (mL).

$$C\ (\mu Ci/mL) = \frac{nPdA}{V_T}\ \frac{0.230}{273 + T}$$

where: V_T = total volume of calibration system (mL).

Calibration curves are then made relating monitor readings to actual concentrations. Equations are determined for this correlation.

10.1.6 Calibration Standards-

The standard source tritium gas is supplied by Jonston Laboratories, who also perform the assay of the gas.

10.2.0 LIQUID SCINTILLATION SPECTROMETER

10.2.1 Description-

Packard Instruments, Model 3380, Liquid Scintillation Spectrometer.

10.2.2 Uses-

Bioassays, assays of stack discharges, assays of liquid discharges, assays of various environmental samples.

10.2.3 Detection-

This instrument is used to detect "soft" beta radiation. It has a tritium sensitivity of one (1) picocurie per sample.

10.2.4 Calibration-

This instrument is calibrated by the manufacturer at assembly. However, a validation of instrument

performance is done on a routine basis. The following procedures will be used to check the instrument performance:

(a) Normalization of Photomultiplier Tube Gains: (This procedure is done on a monthly basis)

(1) Depress the UNLOAD switch. Wait until the elevator unloads and all action stops.

(2) Place a background standard (toluene-based, unquenched scintillation solution) in the holder that is centered over the loading hole.

(3) Depress the LOAD switch. Wait for the LOAD switch lamp to go out, signifying that the sample is loaded.

(4) Depress the IN push button (Automatic Standardization switches). The IN switch lamp will light, signifying that the gamma source is in the locating block.

(5) Turn the Normalization switch to PMT-1.

(6) Depress the RESET-START switch.

(7) Record the displayed ratio for PMT-1. It should fall between 1.0030 and 0.9970.

(8) Turn the Normalization switch to the PMT-2 position.

(9) Depress the RESET-START switch.

(10) Record the displayed ratio for PMT-2. It should also fall between 1.0030 and 0.9970.

(11) If the PMT-1 and PMT-2 ratios are within the normal range, each photomultiplier gain is normal and adequately balanced with respect to the other.

(12) If the PMT-1 ratio is outside the allowable range, adjust the potentiometer that is directly above the PMT-1 switch position as follows:

i. PMT-1 AES ratio is higher than 1.0030:

A ratio higher than the maximum permitted indicates that the gain of the photomultiplier involved is too high. This gain can be reduced by decreasing the voltage applied to the photomultiplier tube. Turn the PMT-1 potentiometer counterclockwise. For each 0.001 interval that the recorded ratio is above 1.0030, turn the adjustment screw about 36° counterclockwise. Then repeat steps 5 through 7 above. Repeat the adjustment and test procedures until PMT-1 ratio is between 1.0030 and 0.9970.

ii. PMT-1 AES ratio is less than 0.9970:

A ratio lower than the minimum indicates that the gain of the photomultiplier involved is too low. This gain can be increased by increasing the voltage applied to the photomultiplier tube. Turn the PMT-1 potentiometer about 36° clockwise for each 0.001 interval that the recorded ratio is less than 0.9970. Repeat steps 5 through 7 above until the new recorded ratio is within 1.0030 and 0.9970.

(13) If PMT-2 ratio is outside the allowable range, adjust the PMT-2 potentiometer as described for PMT-1 in step 12 above. Normalization switch must be on PMT-2 position. Repeat steps 8 through 12 (for PMT-2 instead of PMT-1) until the PMT-2 ratio is between 1.0030 and 0.9970.

(14) Flip the Normalization switch to OFF.

(15) Set the PRESET TIME switch to 0.1 minutes.

(16) Depress the RATIO and AUTO push buttons (Automatic Standardization switches).

(17) Depress the RESET-START switch.

(18) If the AES ratio is now between 0.9970 and 1.0030, normalization of the instrument is satisfactory.

(19) If the range of the Normalization potentiometers is inadequate to achieve a normal AES ratio consult the manufacturer for technical advice.

(b) Initial Performance Check with Tritium Standards: (This procedue is done on a daily basis)

(1) Select a sealed, unquenched tritium standard.

(2) Determine the present activity of the standard.

(3) Depress the UNLOAD switch. The elevator will stop in the unload position and all action will cease.

(4) Set all three channels for tritium counting.

(5) Turn each PRESET COUNT switch to the 900 x 10^3 position.

(6) Turn each LOW LEVEL REJECT switch to OFF.

(7) Set each background cpm dial to 000.0.

(8) Set the PRESET TIME dial to one minute.

(9) Insert the selected tritium standard into the holder over the loading hole.

(10) Depress the LOAD switch.

(11) Depress the RATIO and AUTO push buttons (Automatic Standardization switches).

(12) Depress the REST-START button. The counting sequence will begin. The printout of AES ratio should be within the range of 0.9970 and 1.003.

(13) When good correlation is obtained between all channels, the instrument performance may generally be considered satisfactory. When good correlation cannot be obtained consult with the manufacturer regarding corrective action to be taken.

(c) Construction of Counting Efficency Correlation Curves: (These curves are constructed on a quarterly basis)

Valid correlation curves are constructed through the use of progressively quenched samples having essentially the same chemistry and contained in the same type vial as those samples to be assayed during the given experiment. A graph is made comparing the amount of quenching, as seen in the AES ratios, to the counting efficiency.

10.2.5 Calibration Standards-

All tritium standards for liquid scintillation counting are purchased from Packard Instrument Company. Packard's standards are prepared from stock solutions which are calibrated against National Bureau of Standards Reference Material #4947. The maximum uncertainty is ±1.4%.

10.3.0 SWAB MONITORING SYSTEM

10.3.1 Description-

This system consists of a three well gas flow counting chamber manufactured by Atomic Development and Machine Corporation and an Eberline Instrument Corporation, Model MS-2, Mini Scaler.

10.3.2 Uses-

Loose surface contamination surveys and radioactive materials source leakage tests.

10.3.3 Detection-

This instrument is used to detect alpha, beta, and gamma contamination. It has a tritium sensitivity of 600 dpm.

10.3.4 Calibration-

The following checks of instrument performance are done as outlined:

(a) Monthly determination of the High Voltage Plateau:

(1) Set the THRESHOLD control to 2.50 and the WINDOW IN-OUT switch to OUT.

(2) Plot a curve of counts versus high voltage with the detector exposed to an appropriate radiation field.

(3) Remove the detector from the radiation source and plot a background curve.

(4) Adjust the high voltage for a point on the plateau below the upswing of the background.

(5) The instrument is now ready for operation.

(b) Daily Instrument Check:

A daily operation check is made of the instrument by measuring a reference check source.

10.3.5 Calibration Standards-

The standard sources used to calibrate this instrument are a Baird-Atomic, BCD-14, carbon-14 source (calibrated by Baird Atomic, 6 July 1967) and a New England Nuclear, NES-9048, nickel-63 (calibrated by New England Nuclear against National Bureau of Standards Ni-63 standard no. SRM-4226, 3 October 1979. The overall error was found to be ±8.5% at the 99% confidence level.)

10.4.0 SCINTILLATION ALPHA COUNTER

10.4.1 Description-

This instrument is an Eberline Instrument Corporation, Model PAC-4S, Scintillation Alpha Counter.

10.4.2 Uses-

This instrument is used in various radiation contamination surveys.

10.4.3 Detection-

This instrument detects the presence of alpha particles being emitted from nuclear transformations. It has a sensitivity of 100 cpm.

10.4.4 Calibration-

To completely set up and calibrate the instrument two separate steps are required as follows:

(a) High Voltage Adjustment-

The proper setting for the high voltage is to operate on the flat portion of the plateau, below the tube noise threshold. One method of arriving at this setting is to slowly turn up the voltage, with no source under the detector, until counting is observed. This will be tube noise. Adjust the voltage until approximately 50 cpm is observed on the meter. This type of check is done before each use.

(b) Calibration to a Standard Source-

Checks of instrument performance by means of standard sources are done prior to each use. This simply involved comparing observed meter readings to known standards and making the proper adjustments, if necessary, to insure their correspondence.

10.4.5 Calibration Standards-

The standards used to calibrate the alpha scintillation counter are a set of four plutonium alpha standards, manufactured and certified by Eberline Instrument Corporation, 25 August 1969.

10.5.0 GEIGER COUNTER

10.5.1 Description-

This instrument is an Eberline Instrument Corporation, Model E-510, Geiger Counter.

10.5.2 Uses-

This instrument is used for radioactive materials contamination surveys.

10.5.3 Detection-

This instrument is used to detect beta-gamma activity. It has a sensitivity of 0.05 mREM/hr.

10.5.4 Calibration-

The instrument was completely calibrated at manufacture. Performance checks are made, however, on a quaterly basis. This is done by using a gamma source.

10.5.5 Calibration Source-

The source used to calibrate the Geiger counter is a 1.84 milligram Radium-226 platinum-iridium needle, R-14627. This source was certified by National Research Laboratories, Ottawa, Canada, 25 May 1948.

10.6.0 TRITIUM GAS MONITORS

10.6.1 Description-

The following tritium gas monitors are used by Safety Light Corporation:

(a) Two Johnston Laboratories, Triton 755B, Tritium Monitors.

(b) One Johnston Laboratories, Triton 855, Tritium Monitor.

(c) One Johnston Laboratories, Triton 955, Tritium Monitor.

(d) One Johnston Laboratories, Triton 955B, Tritium Monitor.

(e) One Johnston Laboratories, Triton 1055B, Tritium Monitor.

10.6.2 Uses-

These instruments are used to monitor room air concentrations of tritium, to quality control check manufactured products, and to monitor incoming shipments of tritium gas.

10.6.3 Detection-

These instruments measure tritium concentrations in air through beta detection. The sensitivity is 10 $\mu Ci/m^3$.

10.6.4 Calibration-

Refer to Section 10.1.4.

10.6.5 Calibration Standards-

Refer to Section 10.1.6.

11.0.0 RADIATION SOURCES

11.1.0 STORAGE OF SOURCES

11.1.1 All sources will be marked, stored, and leak-checked according to the applicable sections of Title 10, Code of Federal Regulations.

11.1.2 All storage areas for sources of direct radiation will be monitored each calendar quarter.

11.2.0 INVENTORY OF SOURCES

11.2.1 Light Sources-

Isotope	Activity	Identification Number
Kr-85	25 mCi	LS-110
Kr-85	15 mCi	LS-122
Kr-85		LS-105
Kr-85	22 mCi	LS-108
Kr-85	44 mCi	LS-102
Kr-85	7 mCi	LS- 50
Kr-85	74 mCi	LS-120
Kr-85	42 mCi	LS-116
Kr-85	20 mCi	LS-104
Kr-85	15 mCi	LS-123
Sr-90		173
H -3	3 Ci	
H -3	5.7 Ci	39403
H -3	3.26Ci	48638
H -3	2 Ci	
C -14	9 mCi	
C -14	9 mCi	

11.2.2 Disc Sources

Isotope	Activity	Identification Number
C-14	0.126 μCi	14BD, B14-73
Cs-137	0.98 μCi	S-108
Tc-99	0.0047 μCi	B-133
Th-230	0.0019 μCi	10236
Pu-239	2600 dpm	P-6055
Pu-239	26,800 dpm	P-6759
Pu-239	277,900 dpm	P-6113
Pu-239	3,185,000 dpm	P6876

Isotope	Activity	Identification Number
Am-241	3.16 x 10^5 dpm	AMR23, R400
Am-241	0.1 µCi	AMR33, R9022
Pb-210	<1 µCi	SD-210
Ni-63	6.7 µCi	NES-9048
Th-230	0.0020 µCi	10235
Cs-137	0.97 µCi	S-25
Tc-99	0.005 µCi	52/69
Co-60	0.021 µCi	6338
Ra-226	<1 µCi	85
Pb-210	0.015 µCi	3504
Pb-210	0.005 µCi	3209
U-238	0.005 µCi	1387
Th-230	0.003 µCi	CS-10
Th-230	0.003 µCi	CS-10
Th-230	0.015 µCi	CS-12
Cs-137	8 µCi	CS-7A
H -3	8 µCi	CS-14
C -14	16.25x10^{-5}mCi	AIC
Co-60	2.74x10^{-5} mCi	AIC
Tl-204	0.980x10^{-5}mCi	AIC
Bi-210	1.91x10^{-5}mCi	AIC
Pa-234	0.46x10^{-5}mCi	AIC

11.2.3 Liquid Scintillation Sources

Isotope	Activity	Identification Number	
H -3	257,500 dpm(ea)	CHOH-58	set of 10 vials
H -3	133,800 dpm	L 1115	
H -3	132,400 dpm	L 0144	
C-14	102,000 dpm	L 0144	
Cl-36	51,200 dpm	L 0144	
H -3	1.0x10^6dpm(ea)		set of 10 vials
C -14	1.0x10^5dpm(ea)		set of 10 vials

11.2.4 Gamma Spectroscopy Sources

Isotope	Activity	Identification Number
Cd-109	2.06 µCi	CT-100-1
Co-57	0.116 µCi	CT-100-2
Ba-133	0.243 µCi	CT-100-3
Cs-137	0.231 µCi	CT-100-4
Mn-54	0.380 µCi	CT-100-5
Na-22	0.146 µCi	CT-100-6
Co-60	0.212 µCi	CT-100-7

11.2.5 Miscellaneous Sources

Isotope	Activity	Identification No.	
Ra-226	7.0 μCi	MX 1083 C/PDR-27	rod
Ra-226	2.0 mCi	R-14627	needle
Tl-204, Ba-139	40 μCi		rod
Pm-147	4.84×10^4 dps/g	4940-B	glass ampoule

12.0.0 RECORDS

Records of all previously mentioned surveys radioactive materials monitoring, bioassays, and disposal of radioactive material will be kept in accordance with Title 10, Code of Federal Regulations, Part 20, Section 20.401.

12.1.0 RECORD MAINTENANCE

All above-referenced records shall be maintained until the Nuclear Regulatory Commission authorizes their disposition.

13.0.0 ADMINISTRATION PROCEDURES

13.1.0 RADIATION SAFETY OFFICER RESPONSIBILITIES

13.1.1 The Radiation Safety Officer is responsible for the development and execution of an adequate health and safety program consistent with the requirements of applicable State and Federal regulations and objectives of professional health physics and industrial hygiene.

13.1.2 The Radiation Safety Officer will review all significant changes in production processes and methods prior to their adoption.

13.1.3 The Radiation Safety Officer is responsible for assuring that all appropriate communications are made to regulatory agencies.

13.2.0 FOREMAN, HEALTH & SAFETY RESPONSIBILITIES

13.2.1 The Foreman, Health & Safety is responsible for the supervision of the Company Health & Safety Program.

13.2.2 The Foreman, Health & Safety shall review all routine Health & Safety Program surveys and samples during the same working day in which they are taken. If such review is not possible, he will review them no later than the next working day.

13.2.3 In the event the Foreman, Health & Safety cannot perform the review as stated in Section 13.2.2, he will designate a member of management to make the review. The designated individual will be approved by the Radiation Safety Officer for each occasion.

13.2.4 The Foreman, Health & Safety will recommend corrective action, including work stoppage, to appropriate members of management whenever survey data or other information indicates that an unwarranted hazard exists. If the recommendations of the Foreman, Health & Safety are not acceptable to the person responsible for the operation involved, the Foreman will report the situation to the Radiation Safety Officer or to a higher Company authority for action. It is important that immediate action be taken with regard to any unwarranted hazard thought to exist. In any event, any permanent change in operational procedures will not be made without the approval of the Radiation Safety Officer.

13.3.0 PRODUCTION MANAGER RESPONSIBILITIES

13.3.1 The Production Manager will review all significant changes in production processing and methods with the Radiation Safety Officer and the Foreman, Health & Safety prior to adopting such changes.

14.0.0 NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS

14.1.0 NOTICES

14.1.1 The following notices shall be posted on the Employee's bulletin board according to Title 10, Code of Federal Regulations, Part 19, Section 19.11:

(a) Form NRC-3, "Notice of Employees".

(b) Any notice of violation involving radiological working conditions or any proposed imposition of penalty and any response from Safety Light Corporation.

14.1.2 Current copies of the following documents shall be available in the Company administration office for employee examination upon request to the Health and Safety department:

(a) Parts 19 and 20 of Title 10, Code of Federal Regulations.

(b) The license, license conditions, or documents incorporated into a license by reference, and amendments thereto.

(c) The operating procedures applicable to licensed activities.

14.2.0 INSTRUCTIONS TO WORKERS

All individuals working in or frequenting any portion of a restricted area shall:

(a) Be kept informed of the storage, transfer, or use of radioactive materials in such portions of the restricted area;

(b) Be instructed in the health protection problems associated with exposure to such radioactive materials, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed;

(c) Be instructed in, and instructed to observe, to the extent within the worker's control, the appli-

cable provisions of the Nuclear Regulatory Commission regulations and licenses for the protection of personnel from exposures to radioactive materials occurring in such areas;

(d) Be instructed of their responsibility to report promptly to their immediate supervisors any condition which may lead to or cause a violation of Commission regulations and license or unnecessary exposure to radioactive material;

(e) Be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radioactive material;

(f) Be advised as to the radiation exposure reports which workers may request.

The above requirement shall be met by offering an introductory orientation for new employees during the first day of their employment and through compulsory yearly orientation for all employees.

14.3.0 REPORTS TO INDIVIDUALS

14.3.1 At the request of any worker, Safety Light Corporation shall advise such worker annually of the worker's exposure to radioactive materials as shown in the records maintained by Safety Light Corporation.

14.3.2 When Safety Light Corporation is required to report to the Nuclear Regulatory Commission any over-exposure of an individual to radioactive materials, Safety Light Corporation shall also provide the individual with a report on his exposure data. Such report shall be transmitted at a time no later than the transmittal to the Commission.

14.4.0 INSPECTIONS

14.4.1 Safety Light Corporation shall afford to the Nuclear Regulatory Commission at all reasonable times, opportunity to inspect materials activities, facilities, premises, and records pursuant to regulations in Title 10, Code of Federal Regulations, Chapter I.

14.4.2 Nuclear Regulatory Commission inspectors may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of Commission regulations and licenses to the extent the inspectors deem necessary for the conduct of an effective and thorough inspection.

14.4.3 During the course of an inspection any worker may bring privately to the attention of the inspectors, either orally or in writing, any past or present condition which he has reason to believe may have contributed to or caused any violation of the Atomic Energy Act of 1954 (including any amendments thereto), the regulations in Title 10, Code of Federal Regulations, Chapter I or license condition, or any unnecessary exposure of an individual to radioactive materials under the control of Safety Light Corporation.

14.4.4 Any worker, or representative of workers, who believes that a violation of the Atomic Energy Act of 1954 (including any amendments thereto), the regulations in Title 10, Code of Federal Regulations, Chapter I, or license condition exists or has occurred in licensed activities with regard to radiological working conditions in which the worker in engaged, may request an inspection by giving notice of the alleged violation to the Director of the Nuclear Regulatory Commission regional office, or to Commission inspectors. All requests for inspection shall conform to the instructions in Title 10, Code of Federal Regulations, Part 19, Section 19.16.

14.4.5 Safety Light Corporation shall not discharge or in any manner discriminate against any worker because such worker has filed any complaint or instituted or caused to be instituted any proceeding under the regulations of Title 10, Code of Federal Regulations, Chapter I, or has testified or is about to testify in any such proceeding or because of the exercise by such worker on behalf of himself or others of any option afforded by Title 10, Code of Federal Regulations, Part 19.

SAFETY LIGHT CORPORATION

APPENDIX 22 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 15 - RADIATION PROTECTION PROGRAM

EVALUATION OF TRITIUM RELEASES TO THE ENVIRONMENT

A. THEORETICAL CONSIDERATIONS

For the purposes of the present evaluation, use has been made of the basic equation presented by Turner[1], which describes the dispersion of a single event of limited duration as follows:

$$X(x,y,z;H) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\} \quad \ldots\ldots\ldots(1)$$

where:

X = Downwind concentration of tritium in air (Ci/m^3 or $\mu Ci/mL$).

x = Distance downwind in the direction of the mean wind (m).

y = Crosswind distance (m).

z = Height above ground level (m).

H = Effective stack height (m).

Q = Emission rate of source (Ci/sec).

σ_y = Standard deviation in the crosswind direction of the plume concentration distribution horizontally (m).

σ_z = Standard deviation in the plume concentration distribution vertically (m).

u = Mean wind speed (m/sec).

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[1] Turner, D. Bruce (1970): "Workbook of Atmospheric Dispersion Estimates", Report PB-191482 U.S. Department of Health, Education and Welfare, Cincinnati, Ohio.

/...continued

In evaluating potential hazards to the local populace, of concern are the concentrations of tritium in air at ground level, i.e., where z=0. Under this condition, equation (1) can be simplified to the following:

$$X(x,y,0;H)=\frac{Q}{\pi\sigma_y\sigma_z u}\exp[-\frac{1}{2}(\frac{y}{\sigma_y})^2]\exp[-\frac{1}{2}(\frac{H}{\sigma_z})^2]\ldots\ldots(2)$$

Further simplification results if it is assumed that we are interested in the maximum concentration, i.e., the concentration along the centerline of the plume (y=0):

$$X(x,0,0;H)=\frac{Q}{\pi\sigma_y\sigma_z u}\exp[-\frac{1}{2}(\frac{H}{\sigma_z})^2]\ldots\ldots(3)$$

The effective stack height, H, at which the plume becomes essentially level, can be estimated from the equation:

$$H = h + \Delta H\ldots\ldots(4)$$

where:

h = Physical height of the stack (m).

ΔH = Rise of the plume above the stack (m).

Using the equation of Holland[2], ΔH can be estimated from:

$$\Delta H=\frac{\upsilon_s d}{u}(1.5 + 2.68 \times 10^{-3}\rho\frac{T_s-T_a}{T_s}d)\ldots\ldots(5)$$

where:

ΔH = Rise of the plume above the stack (m).

υ_s = Stack gas exit velocity (m/sec).

d = Inside diameter of stack (m).

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[2] Holland, J.Z.(1953): "A Meteorlogical Survey of the Oak Ridge Area", p. 540, Atomic Energy Commission Report ORO-99, Washington, D.C.

/...continued

u = Wind speed (m/sec).

ρ = Atmospheric pressure (mb).

T_s = Stack gas temperature (°K).

T_a = Air temperature (°K).

and 2.68×10^{-3} is a constant ($mb^{-1}m^{-1}$).

Combining equations (3), (4) and (5):

$$X(x,0,0;H) = \frac{Q}{\pi\sigma_y\sigma_z u} \exp\{-\frac{1}{2}[\frac{h+\frac{\upsilon_s d}{u}(1.5+2.68 \times 10^{-3}\rho\frac{T_s - T_a}{T_s}d)}{\sigma_z}]^2\} \ldots (6)$$

By substitution of the following constants in the above,
i.e., h = Actual stack height = 18.3m.
d = Inside stack diameter = 0.61m.

Equation (6) becomes:

$$\overline{X}(x,0,0;H) = \frac{Q}{\pi\sigma_y\sigma_z u} \exp\{-\frac{1}{2}[\frac{18.3+\frac{0.61\upsilon_s}{u}(1.5+1.63 \times 10^{-3}\rho\frac{T_s - T_a}{T_s}}{\sigma_z}]^2\} \ldots (7)$$

The equations presented so far deal with a single incident of limited duration. For estimating seasonal or annual average concentrations, use is made of an equation described by Turner[1]:

$$\overline{X} = \frac{2.03Q}{\sigma_z x} \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

or,

$$\overline{X} = \frac{2.03Q}{\sigma_z ux} \exp\{-\frac{1}{2}[\frac{18.3+\frac{0.61\upsilon_s}{u}(1.5+1.63 \times 10^{-3}\rho\frac{T_s - T_a}{T_s}}{\sigma_z}]^2\} \ldots\ldots (9)$$

/...continued

B. ESTIMATION OF DOWNWIND TRITIUM CONCENTRATIONS

For use in determining values of σ_y and σ_z, atmospheric stability Class D, obtained from Table I, was assumed. Values of σ_y and σ_z, as a function of downwind distance from the stack, were estimated from Figures 1 and 2. A mean wind speed of two meters/second was used in all calculations*. Other constants used are as shown in later sections.

1. Annual Tritium Releases from Normal Operations-

The total projected release of combined ^3H_I and ^3H_S for the year 1980 is 250 Ci. maximum. It is not anticipated that future annual releases from normal operations will exceed this amount; in fact, efforts to reduce the level of these emissions will be continued.

Values of the annual average concentration of H_I and H_S expressed as a function on downwind distance from our stack, were estimated using equation (9) presented previously:

i.e.,

$$\overline{X}=\frac{2.03Q}{\sigma_z ux} \exp \left\{-\frac{1}{2}\left[\frac{18.3+\frac{0.61\upsilon_s}{u}(1.5+1.63 \times 10^{-3}\rho\frac{T_s-T_a}{T_s})}{\sigma_z}\right]^2\right\}$$

Values assumed for the various terms were as follows:

Q = 7.9×10^{-6} Ci/sec (corresponding to stack emission rate of 250 Ci/yr).

u = 2 m/sec.

υ_s = 9.86 m/sec

T_s = 298°K.

T_a = 283°K.

ρ = 1013 mb

* Future evaluations will be based on data obtained from a meteorological data acquisition system, components of which are currently on order.

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By substitution of these values, the above equation was simplified to:

$$\overline{X} = \frac{8.02 \times 10^{-6}}{\sigma_z x} \exp\left(\frac{-2.66 \times 10^{2}}{\sigma_z^{2}}\right)$$

The calculated data are presented in tabular form in Table II, and graphically in Figure 3.

Conclusions: Under the average annual conditions assumed, it appears that (a) the maximum average ground level concentration of tritium occurs at a distance of approximately 400 meters downwind of our stack, and (b) the annual maximum average tritium concentration at ground level would not exceed the MPC level of 2×10^{-7} µCi/mL, specified for air in 10CFR Part 20, Appendix B, Table II.

Future Action Planned: In order to ascertain if the calculated data are reasonably valid, it will be necessary to conduct a long-term program of environmental monitoring for tritium in the areas surrounding our plant. In this regard, a proposed environmental program has been prepared and submitted to the U.S. Nuclear Regulatory Comission for consideration, prior to initiating work on same. Additionally, an evaluation of the environmental radioactivity near our facility is scheduled to be conducted this Spring by Oak Ridge Associated Universities (ORAU) under contract with the USNRC.

2. Accidental Short-Term Release of Tritium

For the purposes of this evaluation, assumed was a "maximum credible accident" situation whereby an estimated 500 Ci. of tritium, in the form of $^{3}H_{sub}$, was released to the hood exhaust air from the tritium Foil Impregnation System (see System description under Appendix 23, Section IIB2).

Downwind concentrations of $^{3}H_{sub}$ at various distances from the stack were estimated using equation (7), shown previously:

/...continued

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i.e.,

$$\overline{X}(x,0,0;H) = \frac{Q}{\pi\sigma_y\sigma_z u}\exp\left\{-\frac{1}{2}\left[\frac{18.3+\frac{0.61\upsilon_s}{u}(1.5+1.63 \times 10^{-3}\rho\frac{T_s-T_a}{T_s}}{\sigma_z}\right]^2\right\}$$

Term values assumed in the calculations were as follows:

Q = 5.8×10^{-3} Ci/sec (corresponding to 500 Ci. emission averaged over 24 hours).

u = 2 m/sec.

υ_s = 9.86 m/sec.

T_s = 298°K.

T_a = 293°K.

ρ = 1013 mb

By substitution of the above values, the equation was reduced to the following simplified form:

$$\overline{X}(x,0,0;H) = \frac{9.23 \times 10^{-4}}{\sigma_y\sigma_z}\exp\left(\frac{-2.66 \times 10^{2}}{\sigma_z^{2}}\right)$$

The calculated data are shown in tabular form in Table III, and graphically in Figure 4.

Conclusions: From a review of the estimated data, it appears that, under the conditions assumed for this hypothetical accident situation, (a) the maximum average ground level concentration of tritium would again occur at approximately 400 meters downwind from our stack, and (b) the maximum average tritium level should not exceed the MPC level of 4×10^{-5} µCi/mL specified for $^{3}H_{sub}$ for air in 10 CFR Part 20, Appendix B, Table II.

As indicated previously, the availability of information to be obtained from the meteorological data system currently on order will allow for refinement of the above calculations.

/...continued

TABLE I

KEY TO STABILITY CATEGORIES*

Surface Wind Speed (at 10m), m sec^{-1}	Day: Incoming Solar Radiation			Night: Thinly Overcast or	
	Strong	Moderate	Slight	$\geq$4/8 Low Cloud	$\leq$3/8 Cloud
< 2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

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

*Data obtained from Turner: "Workbook of Atmospheric Dispersion Estimates".

TABLE II

ESTIMATED ANNUAL AVERAGE TRITIUM CONCENTRATIONS AT GROUND LEVEL

Distance Downwind (m)	For Stability Category D		$\frac{8.02 \times 10^{-6}}{\sigma_z x}$	$\exp\left(\frac{-2.66 \times 10^{2}}{\sigma_z^{2}}\right)$	$\overline{X}$ (µCi/mL)
	σ_z	$\sigma_z x$			
70	2.9	2.03×10^{2}	3.95×10^{-8}	1.83×10^{-14}	7.2×10^{-22}
100	4.6	4.60×10^{2}	1.74×10^{-8}	3.47×10^{-6}	6.0×10^{-14}
150	6.6	9.90×10^{2}	8.10×10^{-9}	2.23×10^{-3}	1.8×10^{-11}
200	8.4	1.68×10^{3}	4.77×10^{-9}	2.31×10^{-2}	1.1×10^{-10}
250	10.0	2.50×10^{3}	3.20×10^{-9}	6.99×10^{-2}	2.2×10^{-10}
300	12.0	3.60×10^{3}	2.23×10^{-9}	1.58×10^{-1}	3.5×10^{-10}
350	13.5	4.72×10^{3}	1.70×10^{-9}	2.35×10^{-1}	4.0×10^{-10}
400	15.5	6.20×10^{3}	1.29×10^{-9}	3.30×10^{-1}	4.3×10^{-10}
450	17.0	7.65×10^{3}	1.05×10^{-9}	3.98×10^{-1}	4.2×10^{-10}
500	18.5	9.25×10^{3}	8.67×10^{-10}	4.60×10^{-1}	4.0×10^{-10}
600	21.5	1.29×10^{4}	6.22×10^{-10}	5.62×10^{-1}	3.5×10^{-10}
700	24.0	1.68×10^{4}	4.77×10^{-10}	6.30×10^{-1}	3.0×10^{-10}
800	27.5	2.20×10^{4}	3.65×10^{-10}	7.03×10^{-1}	2.6×10^{-10}
900	29.0	2.61×10^{4}	3.07×10^{-10}	7.29×10^{-1}	2.2×10^{-10}
1000	32.5	3.25×10^{4}	2.47×10^{-10}	7.77×10^{-1}	1.9×10^{-10}
2000	50.0	1.00×10^{4}	8.02×10^{-11}	8.99×10^{-1}	7.2×10^{-11}
3000	64.0	1.92×10^{5}	4.18×10^{-11}	9.37×10^{-1}	3.9×10^{-11}

TABLE III

ESTIMATED AVERAGE TRITIUM CONCENTRATIONS AT GROUND LEVEL FROM SHORT-TERM STACK RELEASE

Distance Downwind (m)	For Stability Category D σ_z	σ_y	$\frac{9.23 \times 10^{-4}}{\sigma_y \sigma_z}$	$\exp\left(\frac{-2.66 \times 10^{2}}{\sigma_z^{2}}\right)$	X(x,0,0;H) (μCi/mL)
70	2.9	6.0	5.30×10^{-5}	1.83×10^{-14}	9.7×10^{-19}
100	4.6	8.0	2.51×10^{-5}	3.47×10^{-6}	8.7×10^{-11}
150	6.6	11.5	1.22×10^{-5}	2.23×10^{-3}	2.7×10^{-8}
200	8.4	15.5	7.09×10^{-6}	2.31×10^{-2}	1.6×10^{-7}
250	10.0	19.0	4.86×10^{-6}	6.99×10^{-2}	3.4×10^{-7}
300	12.0	22.0	3.50×10^{-6}	1.58×10^{-1}	5.5×10^{-7}
350	13.5	26.0	2.63×10^{-6}	2.35×10^{-1}	6.2×10^{-7}
400	15.5	29.5	2.02×10^{-6}	3.30×10^{-1}	6.7×10^{-7}
450	17.0	33.0	1.65×10^{-6}	3.98×10^{-1}	6.6×10^{-7}
500	18.5	35.5	1.41×10^{-6}	4.60×10^{-1}	6.5×10^{-7}
600	21.5	42.0	1.02×10^{-6}	5.62×10^{-1}	5.7×10^{-7}
700	24.0	49.0	7.85×10^{-7}	6.30×10^{-1}	4.9×10^{-7}
800	27.5	56.0	5.99×10^{-7}	7.03×10^{-1}	4.2×10^{-7}
900	29.0	62.0	5.13×10^{-7}	7.29×10^{-1}	3.7×10^{-7}
1000	32.5	68.0	4.18×10^{-7}	7.77×10^{-1}	3.2×10^{-7}
2000	50.0	130.0	1.42×10^{-7}	8.99×10^{-1}	1.3×10^{-7}
3000	64.0	190.0	7.59×10^{-8}	9.37×10^{-1}	7.1×10^{-8}

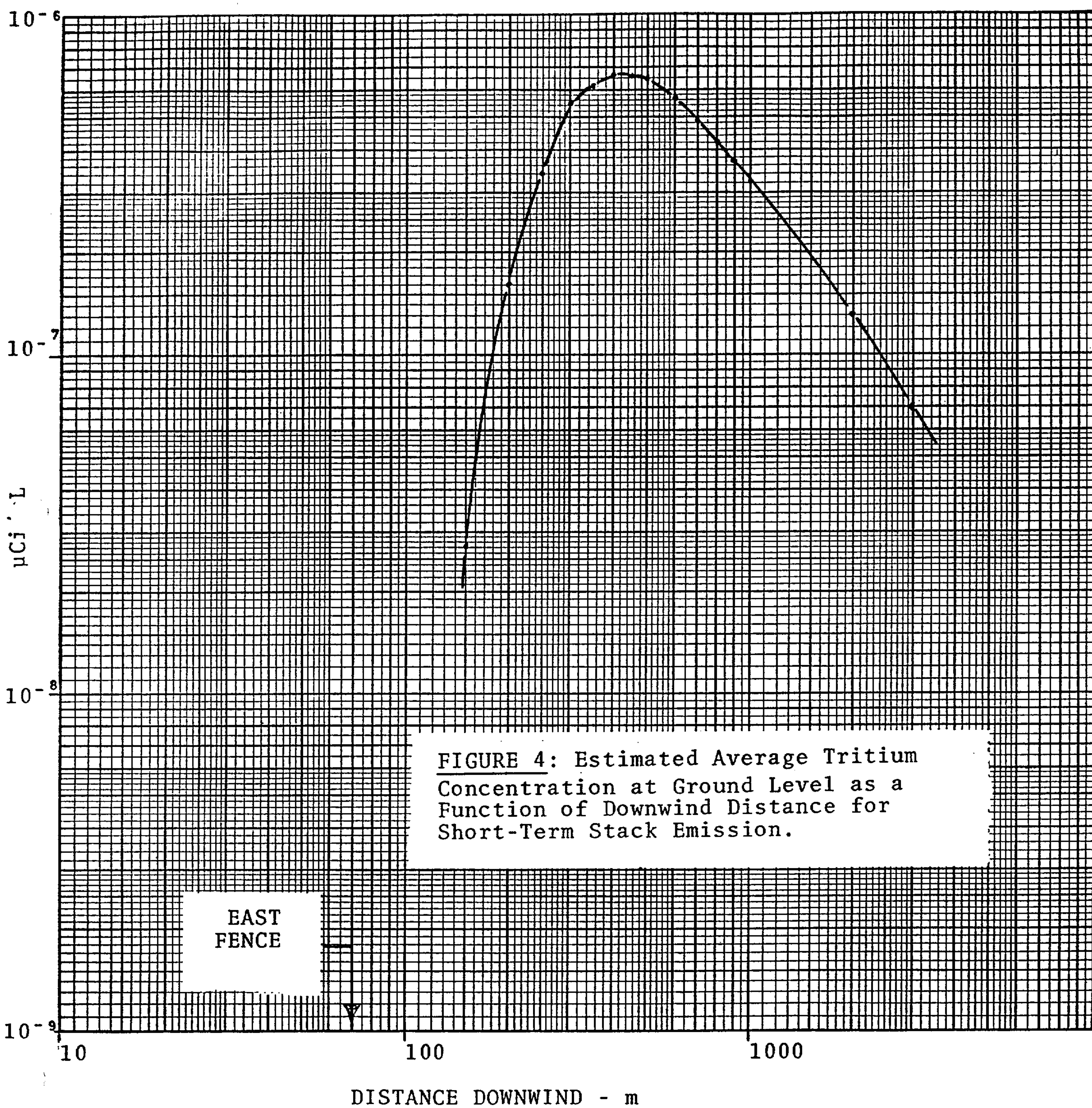

FIGURE 4: Estimated Average Tritium Concentration at Ground Level as a Function of Downwind Distance for Short-Term Stack Emission.

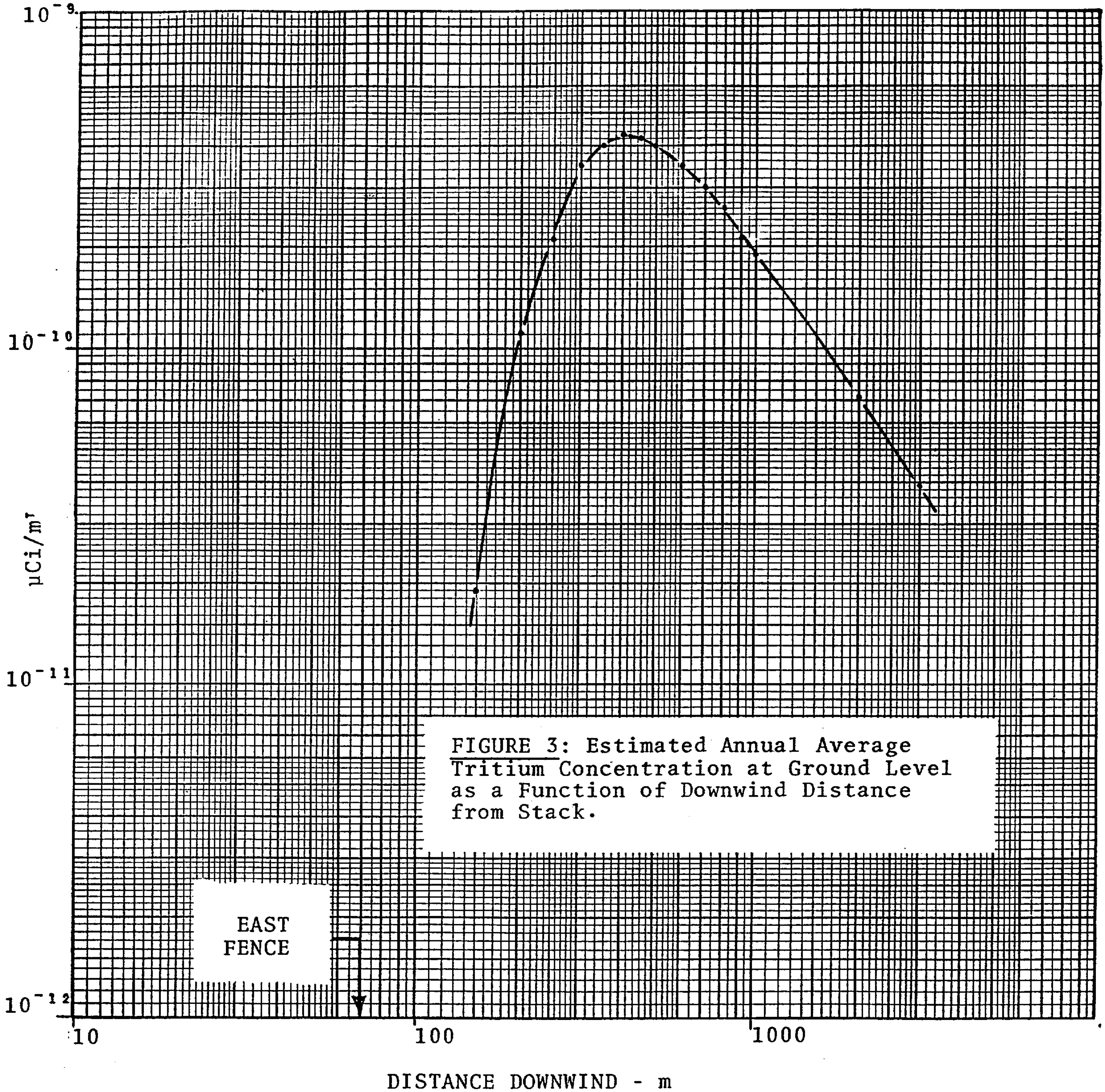

FIGURE 3: Estimated Annual Average Tritium Concentration at Ground Level as a Function of Downwind Distance from Stack.

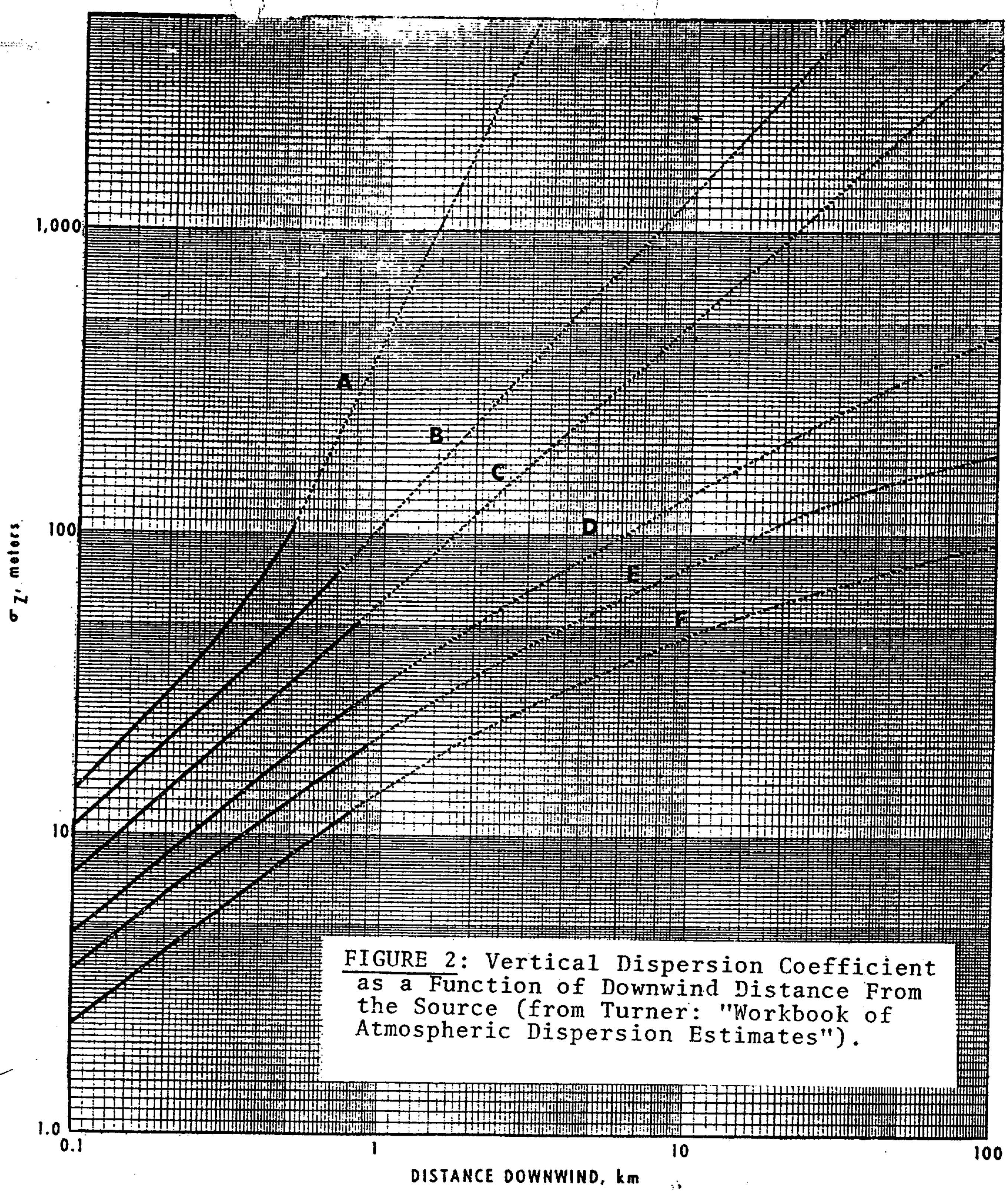

FIGURE 2: Vertical Dispersion Coefficient as a Function of Downwind Distance From the Source (from Turner: "Workbook of Atmospheric Dispersion Estimates").

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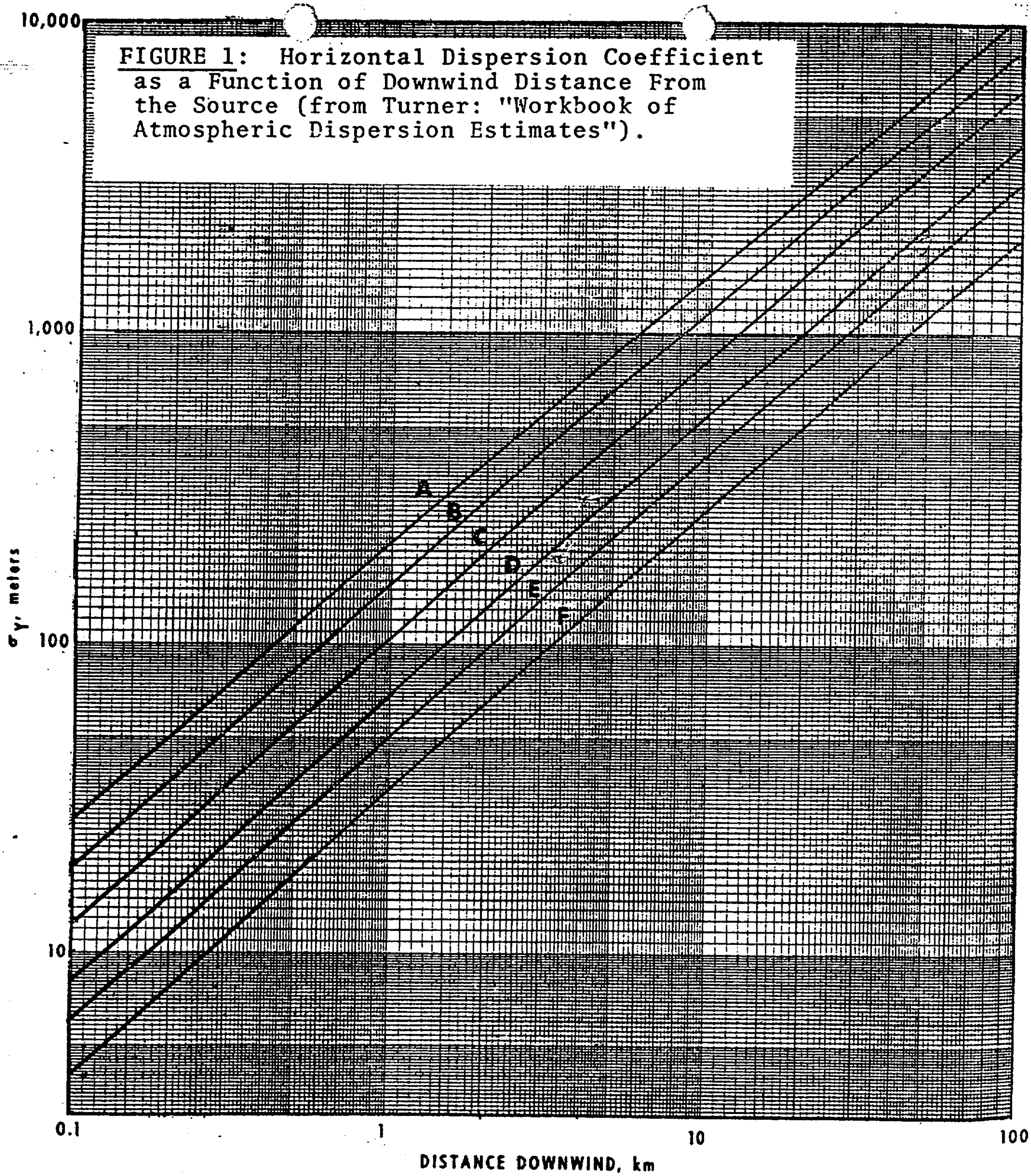

FIGURE 1: Horizontal Dispersion Coefficient as a Function of Downwind Distance From the Source (from Turner: "Workbook of Atmospheric Dispersion Estimates").

SAFETY LIGHT CORPORATION

APPENDIX 23 TO APPLICATION DATED DECEMBER 15, 1980 TO RENEW USNRC LICENSE NO. 37-00030-08

ITEM 13a - FACILITIES AND EQUIPMENT

1. DESCRIPTION OF FACILITY (Refer to Drawing No. 4003-80)

The entire facility is located at 4150-A Old Berwick Road, Bloomsburg, Pennsylvania 17815, and consists of seven designated buildings:

One Processing Building

One Solid Waste Building

One Liquid Waste Building

One Machine Shop

Three Storage Buildings

The facility is contained within a six foot high chain link fence with three entrances. One entrance is located on the southern boundary and is normally locked. Two entrances are located on the western boundary and are locked, except during normal plant working hours.

Also located on the property is a concrete block building (labeled "vault") which was used in past operations as a radium storage vault. This building does not contain any inventory of radium; it is locked, sealed, posted and is not used in any current operations.

Located strategically on the eastern boundary are three environmental sample points (labeled "So. Env. Sample", "Ctr. Env. Sample" and "No. Env. Sample"). These are continuously monitored for oxides of tritium as set forth under Appendix 21.

II. PROCESSING BUILDING (Refer to Drawing No. 4004-80)

A. The building is a modular, clear span, steel building set on a concrete slab. The inner walls are non-load bearing with steel studs covered with standard one-hald inch drywall.

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1. Air Conditioning (Refer to Drawing No. 4002-80)

   Air conditioning is designed in two separate units, one for each of the two radiation zones of the building. In the yellow zones*, an electric powered heat pump system conditions and recirculates the air in a manner that is standard for well ventilated work areas. 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 Appendix 21.

2. Ventilation (Refer to Drawing No. 4001-80)

   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 (refer to Consultants' Drawing No. 655-80-1).

   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 as necessary "at the source", no filter bank is provided 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.

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All exhaust air from the Processing Building is through an 18.3 meter high stack of 0.61 meter diameter with a flow rate of 9.68 meter per second. Located in the stack at a point which will give a representative sample of stack effluent is a probe connected to the continuous stack monitoring system as set forth in Appendix 21.

3. 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 is utilized to restrict the movement of radioisotope surface contamination within magenta zones.

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

4. Control of Contaminated Liquid Effluent

Contaminated aqueous liquid lines drain to the existing liquid waste building for appropriate monitoring and processing.

All potentially contaminated aqueous liquids are assayed for tritium prior to release to the environment to assure that all liquid effluent releases conform to applicable regulations (refer to Appendix 21).

5. Control of Direct Radiation Hazards

Brehmsstrahlung radiation from tritiated foils are the only significant source of direct radiation at this facility. Appropriate handling procedures and, where required, radiation shielding are provided.

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

**AERE-M1169/Technical Report: "Possible Radiological Hazards from Tritium Sources Absorbed on Titanium".

B. Tritium Processing Area

The Tritium Processing Area is used to transfer gaseous tritium to a sealed source or a metallic hydride form.

This area contains 1) the Gaseous Tritium Light Source System, 2) the Tritium Foil Impregnation System, and 3) the Spark Gap Tube Filling System. All three systems are described in detail in the subsequent sections.

The Tritium Processing Area is monitored continuously by tritium monitors. The monitors are 1) the room air monitor (labeled "E_1" on Drawing No. 4004-80), 2) a spare monitor (labeled "E_2"), 3) the Scrubbing System monitor (labeled "E_3") and 4) the Tritium Filling Hood monitor (labeled "E_4"). All monitors (with the exception of E_2) have a strip chart recorder on their output to correlate any detectable tritium release.

The Tube Storage/Dark Room area is monitored by a portable tritium monitor (labeled "E_5"). This monitor can be used in other monitoring situations should the need arise.

All air monitors are calibrated at least once per calendar year per Appendix 21.

1. Gaseous Tritium Light Source (GTLS) Filling System

GTLS' are glass ampoules, internally coated with a phosphor which, by means of the

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GTLS Filling System, are filled with a measured amount of 94% or better purity tritium gas.

The GTLS Filling System can be divided into three subsystems:

a. Subsystem A: Vacuum System-
   This system consists of 1) a low vacuum line evacuated to approximately 5×10^{-3} torr by a rotary pump whose exhaust is connected to the Scrubbing System and 2) a high vacuum line evacuated to approximately 1×10^{-6} torr by a sputter ion pump. Both of these subsystems can be connected by appropriate valving to the Bulk Storage and GTLS systems.

b. Subsystem B: Bulk Storage-
   This system, consisting of reservoirs of depleted uranium and appropriate valving, is used in the transfer of tritium gas from Oak Ridge National Laboratory (ORNL) cylinders, and storage of the gas. As required, the tritium gas is transferred from the Bulk Storage system, in measured quantities, to the GTLS Filling system.

c. Subsystem C: GTLS Filling System-
   This system consists of uranium beds, pressure gauges, thermostatically controlled electric heaters, an automatic pressure regulator, infrared heating lamps, and appropriate valves and connections which allow the connection of an internally phosphor-coated tube to the system. The tube is evacuated, first, by the low vacuum system, then, by the high vacuum system and filled with a measured quantity of tritium gas. The gas has been transferred from storage in an uranium bed by heating the bed with an electric heater. The gas is then passed through a pressure controlling valve, and into the evacuated tube. The tube is sealed with infrared heating lamps. The tritium

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remaining in the lines on the upstream of the tube seal is removed by opening these lines to an uranium bed, which reabsorbs the residual tritium. After the tritium has been removed from the lines, they are evacuated by the low vacuum system, and the sealed tube is removed from the GTLS system.

All hermetic systems of this GTLS Filling System are checked with a mass spectrometer leak detector to 1 x 10^{-8} standard cc/min. Tubes removed from the GTLS System are first placed in containers for a time period, and then checked with a tritium monitor to determine if those tubes have leaked. If a leak is found, that tube is sealed in an airtight container and properly disposed of. If the tubes have not leaked, they are washed in decontaminating solution in a sink in the GTLS Filling System hood, to remove any surface contamination, dried, and checked for contamination by swab testing. If the tubes pass, they are placed, through a pass window, into the Tube Storage/Dark Room area where they are checked for brightness and then placed in storage cabinets that are connected to the building air evacuation system.

2. Tritium Foil Impregnation System

The foil impregnation system consists of four subsystems:

a. Subsystem A: Low Vacuum System- This system consists of 1) a rotary fore pump whose exhaust is connected to the scrubber system, 2) a diffusion pump, and 3) valving that allows bypassing of the diffusion pump for rough vacuum pumping. This system has been leak checked to 1 x 10^{-8} standard cc/min. The pump component of this system is located in its own air hood.

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b. Subsystem B: High Vacuum System-
This system consists of 1) a sputter ion pump with valve, connected to a port on the low vacuum subsystem.

c. Subsystem C: Impregnation Chamber-
This system consists of 1) a fused quartz reaction vessel, with a bolt on high vacuum seal, and 2) an electric heating mantle.

d. Subsystem D: Tritium Storage and Generation System-
This system consists of three uranium beds with isolation valving, and a pressure gauge.

The total system is used to impregnate titanium and scandium foils by heating the foils under vacuum at an elevated temperature. The foils are placed in the quartz pot and evacuated for a minimum 12 hour period and then heated until vacuum conditions indicate that the foil is outgassed sufficiently. The pressure sufficient to achieve impregnation is then generated in that subsystem by heating the uranium bed sufficiently hot, after which, the tritium is admitted to the quartz reaction chamber.

After impregnation has occurred the quartz chamber is cooled to room temperaturn and the residual non-reacting tritium is redrawn to the uranium bed. After a minimum 12 hour period the chamber is redrawn once more to the uranium bed and the quartz chamber is pressurized to slightly less than one atmosphere with room air and is allowed to remain thus for 24 hours, after which, the chamber is evacuated, removing all residual inert material and possible tritium oxide through the scrubbing system.

The foils are then removed to a glove box where they are measured for ion current

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and brehmsstrahlung, and then prepared for storage or shipment.

After leaving the foil measurement hood, the foils pass to a storage hood where they are placed in a desiccated chamber for storage, or placed in primary packaging for shipment and placed in the packing hood.

In the packing hood, the foils are placed in secondary packaging and prepared for exit from the room and eventual shipment.

Certain foils are removed from the storage hood in sealed containers to the foil cutting hood where they are cut into smaller sizes and then transferred to the packing hood for processing and shipment.

3. Spark Gap Tube Filling System

This system, located in the GTLS Filling System hood, consists of 1) a multiple valve manifold which is connected to the GTLS Filling System low vacuum and high vacuum subsystems, 2) a depleted uranium storage vessel connected to an expansion flask, and 3) a pressure gauge.

The spark gap tubes are an electronic tube type, are fabricated of ceramic and metal, and have a copper filling tube at one end. Prior to filling, the crimp/soldered filling tubes of the units are cut off, and the opened tube ends are attached to the filling system manifold. The units are then evacuated to less than one micron pressure and, if found leak tight, are then filled with several millicuries of hydrogen-diluted tritium, followed by pressurizing to approximately one atmosphere with nitrogen.

After filling, the tubes are crimp-cut from the system, and then crimp-cut again to a fixed length in a pneumatic press

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located in the hood. The crimp-cut end seals are then dip soldered and the sealed units stand for approximately 24 hours in individual sealed containers for subsequent leak testing, using a tritium monitor unit. Any unit showing detectable leakage is disposed of, in a sealed container, as radioactive waste.

The leak tight units are then washed in decontaminant solution, dried and wiped tested. All units passing the swab test are transferred to the packing area, where they are packed for shipment. Each outer package is wipe tested and if found acceptable, transferred to the shipping department.

C. Scrubbing System

The Scrubbing System consists of adsorbing-type columns to remove any tritium oxides residual from the manufacturing processes. The exhausts from the rotary pumps of the GTLS Filling System, the Foil Impregnation System, and the Mass Spectrometer Leak Detector, are passed through these columns having 99% or better removal efficiency for tritium oxides.

In order to consistent with A.L.A.R.A. principles, techniques and equipment are being developed and evaluated in the facility that will reduce tritium emissions to the environment at the source, rather than at effluent exit at the stack.

D. Application Area

Tritiated paint is mixed and applied to various metal and plastic substrates in this area. Tritiated phosphor is removed from the storage area and brought into the Application Area and placed in the mixing box (a stainless steel glove box equiped with an absolute filter). The tritiated phosphor is combined with various adhesives to form the paint mixture. This paint is mixed in glass storage containers which are transferred

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from the mixing box to the machine or screening hood where it will be used. All areas where tritiated paint is used are contained in hoods.

All materials painted or screened in the Application Area are packaged and the outermost package is swab checked for surface contamination. If passed, the package is taken to the shipping department. If the package does not pass the swab check, it is re-packaged and swab checked again; this procedure is repeated until the package passes the swab check.

The filter used on the stainless steel mixing box is a self-contained absolute filter with maximum efficiency of 99.97% for the 0.3 micron size or large particles. Change of the filter cartridge is performed regularly to prevent excessive dust accumulation.

E. Sign Assembly Area

Devices using GTLS tubes are assembled in this area. GTLS tubes are removed from storage cabinets in the Tube Storage/Dark Room area and then to the work area table. The GLTS tubes are installed in the device and the device is packaged. A tritium monitor (labeled "E_5" on Drawing No. 4004-80) samples room air continuously during assembly and packaging.

After packaging the container is checked for surface contamination by swab testing. If passed, the package is sent to the shipping department. If a tube should leak during assembly or if a package is contaminated, it is passed back into the tritium handling room, where the leaking tube is sealed in a container and properly disposed of. Any usable tubes are decontaminated again and put back into storage.

III. SOLID WASTE BUILDING (Refer to Drawing No. 4003-80)

The Solid Waste Building is a block building used for processing, packing, and storage of low-level radioactive production waste material. It is desig-

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nated as a loose surface contamination area so that protective clothing is worn on all entries. This building is surveyed for contamination on a quarterly basis.

IV. LIQUID WASTE BUILDING (Refer to Drawing No. 4003-80)

The Liquid Waste Building is a modular, clear span, steel building consisting of two below-ground catch tanks which receive waste water (excluding sanitary water) from the Nuclear Production Facility and four above-ground steel tanks where the water is stored, treated, and subsequently released through a line extending from the Liquid Waste Building to an outfall box located in the bed of the Northern Branch of the Susquehanna River. This building is surveyed for contamination on a quarterly basis.

V. MACHINE SHOP (Refer to Drawing No. 4003-80)

This building is a block building, located on the Northern boundary. All work done in this area is non-radioactive and consists of machining items later used in the assembly of finished products.

VI. STORAGE BUILDINGS (Refer to Drawing No. 4003-80)

A. Storage Building 1

Storage Building 1 is a two-story wood frame building. This building is used for the storage of production equipment, both contaminated and uncontaminated. It is designated as a loose surface contamination area so that 1) all entries must be authorized by the Health and Safety Department, 2) protective clothing is worn during all entries, and 3) any equipment removed is checked for contamination and appropriate precautions taken, if necessary. This building is surveyed for contamination on a quarterly basis.

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B. Storage Building 2

Storage Building 2 is a block building which is used for the storage of both contaminated and uncontaminated production equipment. All entries must be authorized by the Health and Safety Department and no items are removed before they are surveyed for contamination. This building is monitored on a quarterly basis for surface contamination.

C. Storage Building 3

Storage Building 3 is a block building which is used for the storage of uncontaminated equipment and supplies. It is surveyed for surface contamination on a quarterly basis.