Original

APPENDIX A

FORM NRC-313 I (6-78) 10 CFR 30 — U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

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

X	a. NEW LICENSE
	b. AMENDMENT TO LICENSE NUMBER 30-28659
	c. RENEWAL OF LICENSE NUMBER 13508

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.

2. APPLICANT'S NAME (Institution, firm, person, etc.)
Catholic University of Puerto Rico
College of Sciences
TELEPHONE NUMBER AREA CODE – NUMBER EXTENSION
(809) 844-4150 x-126

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Dr. Gabriel A. Infante
TELEPHONE NUMBER AREA CODE – NUMBER EXTENSION
(809) 844-4150 x-335

4. APPLICANT'S MAILING ADDRESS (Include Zip Code)
College of Sciences
Catholic University of Puerto Rico
Station No. 6
Ponce, Puerto Rico 00732

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED (Include Zip Code)
Las Américas Avenue
Catholic University of Puerto Rico
Ponce, Puerto Rico 00732

(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.	Dr. Gabriel A. Infante	Professor of Chemistry Director Research Program
b.	Dr. José N. Correa, M.D.	Professor of Biology Radiotherapist
c.	Mr. Efrain Bonilla	Professor of Mathematics and Safety Officer

7. RADIATION PROTECTION OFFICER
Mr. Efrain Bonilla and
Mr. Daniel Torres (Consultant)

Attach a resume of person's training and experience as outlined in items 16 and 17 and describe his responsibilities under item 15.

8. LICENSED MATERIAL

LINE NO	A. ELEMENT AND MASS NUMBER	B. CHEMICAL AND/OR PHYSICAL FORM	C. NAME OF MANUFACTURER AND MODEL NUMBER (If Sealed Source)	D. MAXIMUM NUMBER OF MILLICURIES AND OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME
(1)	Cesium-137	Sealed Source	Mark I -Model 25	7,000 curies
(2)			Irradiator	
(3)			J.L. Shepherd and	
(4)			Associates	

	E. DESCRIBE USE OF LICENSED MATERIAL
(1)	The Cesium-137 -Gamma MARK I Model 25 from J.L. Shepherd and Assoc
(2)	Glendale, California. The irradiator will be used to irradiate
(3)	solutions of biologically important compounds such as purine bases, pyrimidine bases, Kreb's cycle components. The irradiator will be
(4)	used by Drs. Infante and Correa only, under the supervision of the safety officer, Mr. Efrain Bonilla.

FORM NRC 313 (6-78)

10-9-12

18230

APPENDIX A

9. STORAGE OF SEALED SOURCES

LINE NO.	A. CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED.	B. NAME OF MANUFACTURER	C. MODEL NUMBER
(1)	The MARK I Model 25 Irradiator is covered by Device Approval Sheet No. 80-2 issued by the State of California and also appears in the Approved Sources and		
(2)	Devices Catalog of the U.S. N. R. C. The irradiator will be installed in Room No. 120 First Floor- Ferré Building	See appendix I for further information.	
(3)	(College of Sciences) Catholic University of Puerto Rico. See Appendix II for exact position, diagram of the room and floor diagram.		
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	A. TYPE OF INSTRUMENT	B. MANUFACTURER'S NAME	C. MODEL NUMBER	D. NUMBER AVAILABLE	E. RADIATION DETECTED (alpha, beta, gamma, neutron)	F. SENSITIVITY RANGE (milliroentgens/hour or counts/minute)
(1)	G-M Counter	Victoreen	COV-700 Model 6b	4	α, β, γ	0-5mR/hr x1;10;x100and0-300
(2)	Pocket Dosimeter	Bendix	COV V138	30	α, β, γ	0-200 mR
(3)	Cutie Pie	Victoreen	740F	1	α, β, γ	0-25 mR-/hr x1;10x100;x 1,000
(4)	(Please see continuation page)					

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☒ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY

☒ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

Mr. Daniel Torres, Health Physics Nuclear Regulatory Commission Lic. 52-1830(will perform the calibration.

12. PERSONNEL MONITORING DEVICES

A. TYPE (Check and/or complete as appropriate.)	B. SUPPLIER (Service Company)	C. EXCHANGE FREQUENCY
☒ (1) FILM BADGE	R. S. Landeur, Jr. & Co. Division of Technical Operations Glenwood Science Park Glenwood, IL 60425	☒ MONTHLY
☐ (2) THERMOLUMINESCENCE DOSIMETER (TLD)		☐ QUARTERLY
☐ (3) OTHER (Specify) _____		☐ OTHER (Specify)

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s))

☒ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS (Include filtration, if any), ETC.

☐ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING (Fixed and/or temporary), ETC.

☐ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC.

☐ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC.

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED

Waste - It is a sealed source which will be returned to the manufacturer.

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

5/6/85 Aps 9 II Broun

10965 #230/3E Application 5/6/85 Broun

FORM NRC 313 (6-78)

10-9-13

5/4/15

10. RADIATION DECTECTION INSTRUMENTS (Continuation)

Type of Instrument A	Manufacturer.s Name B	Model Number C	Number Available D	Radiation Detected (alpha, beta, gamma, nuetron) E	Sensitivity Range (milliroentgens/hr or counts/minute) F
(4) Geiger Muller Detectors	Nuclear Chicago	Model 34	2	α, β, γ	0 to 10^6 cpm
with thin window 1.4 mg/cm^2 and Scaler Nuclear Chicago Model 8740					
(5) Scintillation Detector	Nuclear Chicago	Model 412	1	α, β, γ	0 + to 10^6 cpm
with Sodium Iodide (Thallium activated) sensitive crystal and Scaler Nuclear Chicago Model 8740					

APPENDIX A

INFORMATION REQUIRED FOR ITEMS 15, 16 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.

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.

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.

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)* License for possesion and use of by product material in sealed sources.	b. CERTIFYING OFFICIAL *(Signature)* Julio Rivera
	c. NAME *(Type or print)* Julio Rivera Collazo
(1) LICENSE FEE CATEGORY E By product material	d. TITLE Dean of Sciencies
(2) LICENSE FEE ENCLOSED $ 230.00	e. DATE 4/26/85

FORM NRC-313 I (6-78)

15. RADIATION PROTECTION PROGRAM

The Mark I Model 25 - Cesium-137 Irradiator will be installed in Room No. 120, First Floor, Ferre Building (College of Sciences). Drs. Gabriel a Infante and José N. Correa, and Mr. Efrain Bonilla, Safety Officer will be the only ones that will have keys to open Room 120. Drs. Gabriel A. Infante and José N. Correa will irradiate the samples and Mr. Efrain Bonilla will be in charge of the checking the irradiator on a day to day basis. A Nuclear Chicago Model 412 Geiger Muller Detector and Model 8740 Scaler will be on all the time in the room to provide appropriate background measurements. The operators (Drs. Infante and Correa), the Safety Officer (Mr. Efrain Bonilla) and any visitor to the facility will carry a film badge provided by R. S. Landeur, Jr. and Co., Gleenwood, Illinois. The film badges will be exchanged every month. The survey instrumentation described in item 10 of this application will be checked and calibrated whenever necessary and least one time per year by Mr.Daniel Torres, Health Physicist Nuclear Regulatory Commission License No. 52-18306. Mr. Torres will also conduct periodic surveys to insure proper shielding of the source including the initial survey when the irradiator arrives to Catholic University of Puerto Rico. Mr. Torres will also perform the leak tests every six months. J. L. Shepherd and R. N. Doneleson authorized radiation officers from Shepherd and Associates State of California License No. 1777-70. Routine surveys in unrestricted areas will also be performed by the radiation safety officer using the G-M Counter and the Cutie Pie. For more information about the safety features of the irradiator and the room in which will be installed, see Appendixes I and II.

A log book for irradiator users will be filled each time that the irradiator will be used. See example in Appendix III. A current occupational external radiation exposure sheet will be filled by the radiation safety officer for each person that uses the irradiator facility. See example in Appendix III.

Manufacturer's operating and emergency procedures will be located and posted at the irradiator facility and will be made available to each user of the irradiator facility. Nuclear Regulatory Commission regulations and protocols on the use of a sealed gamma source will also be located and posted at the irradiator facility and will be made available to each user of the irradiator. Phone numbers and radiation safety signs are posted in side and outside of the room where the irradiator will be installed.

In case of any emergency, for example if the unrestricted areas have radiation le vels over 0.6mR/hr or restricted area (Room 120) has le vels over 5mR/hr an alarm will ring and the safety officer will be called inmediately.

The operators of the irradiator, Drs. Gabriel A. Infante and José N. Correa, have vast experience in radiation and irradiation facilities. Dr. Infante has a M.S., Ph.D. and Post Doctoral work in Radiation Chemistry and has used Gamma Sources similar to the irradiator described at Puerto Rico Nuclear Center at Mayaguez. Department of Chemistry, Texas A&M University, Radiation Laboratory, Carnegie Mellon University and Radiation Laboratory, University of Notre Dame.

15. RADIATION PROTECTION PROGRAM (Continuation)

Dr. José N. Correa is an M.D. and he is a radiotherapist with vast experience. He has also used similar irradiators at Puerto Rico Nuclear Center, Río Piedras, P.R., Oncologic Clinic, Ponce, P. R. and at the National Cancer Institute, Bethesda, Maryland. The Safety Officer, Mr. Efrain Bonilla, is a health physicist with the appropriate degree and training in the field. He has also used similar irradiators at Puerto Rico Nuclear Center, Mayaguez and Río Piedras, Puerto Rico. For complete curriculum vitaes of the operators and the radiation safety officer see next sessions (16 and 17).

For General Rules for the Operation of the Radioisotope Laboratory, see the enclosed information.

CATHOLIC UNIVERSITY OF PUERTO RICO
COLLEGE OF SCIENCES
RADIOCHEMISTRY LABORATORY

RULES FOR THE OPERATION OF THE RADIOISOTOPES LABORATORY

1. Copies of the license and regulations pertaining the use of radioactive material in parts 19 and 20 of Chapter I "Code of Federal Regulation - Energy" are available in the Radiochemistry Laboratory (Room 119) in the College of Sciences. The use of the radioisotopes Laboratory facilities requires the supervision and authorization from the Radiation Safety Officer and/or the Radiation Safety Committee as specified by the N.R.C. Materials License 5. The restricted areas will be limited to authorized individuals. Authorized individuals are defined as:

   (a) Researchers that have complied with the requisites established by the Radiation Protection Committee which is presided by the Safety Officer.

   Any researcher that wants to use radioisoto in his/her research project must file a form indicating previous work experience with radioactive material, type of radioisotope, resume of research project, anticipated radiation levels and anticipated occupancy time in the area involved.

2. Licensed material shall be used only at the location (restricted area) as specified by the N.R.C. Materials License.

3. Before ordering radioactive material inform the Radiation Safety Officer, Mr. Efrain Bonilla of the type and amount of isotope to be ordered. No one may order radioactive material without the written consent of the Radiation Safety Officer of their particular area of work. Each person who receives radiactive material shall provide information to the Radiation Safety Officer so he may keep records showing the receipt, transfer and disposal of such material.

4. Licensed material shall be stored in the restricted areas in the College of Science. Diluted radioactive material permitted to be stored in an unrestricted area and not in the Radiochemistry Laboratory shall be kept under the constant surveillance and immediate control of the Radiation Safety Officer.

5. An emergency plan in case of radioisotopes contamination is to be posted in each area where radioisotopes are being used. Products used for decontamination must be available in each laboratory and properly labeled as such.

6. A suitable dosimeter or film badge should be worn when any work is conducted with radioactive material.

7. Any contamination of the body, clothing or equipment should be reported to the person in charge of the laboratory and/or the Radiation Safety Officer.

8. The person responsible of a contamination will carry out the proper procedure to decontaminate the area and/or equipment with the supervision and/or help of the Radiation Safety Officer.

9. No one will be permitted to leave if a contamination happens until the proper decontamination procedure has been followed.

10. All containers with radioactive material should be labeled with radiation warning signs or tapes.

11. Solid radioactive waste should be stored in containers labeled as to content, date and radiation level.

12. Liquid radioactive waste not disposed in the sewer system should be stored in containers labeled as to content, date and radiation level.

16. TRAINING

Gabriel A. Infante

1968 - 1969

Radiochemistry and Radiobiology training at the Puerto Rico Nuclear Center, Mayaguez, Puerto Rico. Also radioisotopes techniques.

Duration of training:

From June 1, 1968 to May 30, 1969.

1971 - 1973

Radiation Chemistry training at Texas A&M Univeristy, College Station, Texas.

1973 - 1974

Past Doctoral work on Radiation Chemistry at Radiation Research Laboratory, Carnegie Mellon Univeristy, Pittsburg, Pa.,

Some of the courses toward:

Radiobiology I, Radiobiology II, Nuclear Chemistry, Radiochemistry, Radiation Chemistry, and Radioisotopes techniques.

Experience with gamma irradiators-Co-60 and Cs-137 at Puerto Rico Nuclear Center, Texas A&M University and Radiation Research Laboratory, Carnegie Mellon University.

17. EXPERIENCE:

Positions	Year	Location	Research Area
Graduate Assistant	1967-68	Univ. of P.R.	Radiation Chemistry
Auxiliary Instructor	1968-69	Univ. of P.R.	Radiation Chemistry
Instructor	1969-71	Catholic Univ.	Radiation Chemistry
A.E.C. Research Assistanship	1971-72	Texas A&M Univ.	Radiation Chemistry
R.A. Welch Foundation Fellowship	1972-73	Texas A&M Univ.	Radiation Chemistry
Assistant Professor	1973 to date	Catholic Univ. of P.R.	Radiation Chemistry and Pollution
Tenure	1974	Catholic Univ of P.R.	Radiation Chemistry, Radiobiology and Pollution
Visiting Fellow Summer	1974	Carnegie-Mellon	Radiation Chemistry
Associate Professor	1975 to date	Catholic Univ. of P.R.	Radiation Chemistry, Radiobiology and Pollution
Associate Scientist (Ad honorem)	1975 to date	Center for Energy and Environmental Research	Radiation Chemistry, Radiobiology and Pollution
Biomedical Research Program Director	1978 to date	Catholic University of Puerto Rico	

RESUME

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Gabriel A. Infante	Professor	11/3/45

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	FIELD OF STUDY
Catholic University of PR, Ponce, PR	B.S.	1967	Chemistry
University of Puerto Rico, Mayaguez, PR	M.S.	1969	Chemistry
Texas A&M University	Ph.D.	1973	Chemistry
Carnegie Mellon University	Post-Doc.	1974	Radiation Chemistr

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. List, in chronological order, the titles and complete references to recent representative publications

Positions

1972 - 1973 - R. A. Welch Foundation Fellowship, Texas A&M University
1973 - 1974 - Post-doctoral Fellow - Carnegie Mellon University Summers.
1974 - 1976 - Assistant Professor, Department of Chemistry, Catholic University of PR
1975 to present - Associate Scientist, Puerto Rico Center for Energy and Environment.
1976 - 1981 - Associate Professor, Catholic University of Puerto Rico.
1977 - - Tenure Granted
1977 to present - Director Biomedical Research Program, Catholic University of PR
1981 - to present - Professor, Catholic University of Puerto Rico.

Techniques

Radiobiological and Radioisotopes Techniques, Nuclear Science Division, Puerto Rico Nuclear Center, 1968-1969.
Pulse Radiolysis Techniques various summers at Carnegie Mellon University and at Notre Dame University.
A great number of short courses on chromatographic and spectroscopic techniques.

Honors

Dean's Honor List, four times during B.S. studies.
Medals in Organic, Analytical, Physical and Industrial Chemistry in Commencement Ceremonies, 1967.
Outstanding Graduate Student Award, Texas A&M University, 1973.
Outstanding Educator of America, 1975.
Who's Who in the South and Southwest, 1976.
Noteworthy Americans, 1978.
Puerto Rico Chemist Association Annual Award, 1978.
President, Puerto Rico Session of the American Chemical Society, 1977.
Chairman, Caribbean Chemical Conference, 1977.
Travel Award, Radiation Research Society, Tokyo, Japan, 1979.
President, Puerto Rico Chemists Association, 1980-1981.
Cited in American Men and Women in Sciences, 1982.
Chaired different sessions at scientific meetings and several University committees during the past six years.
Invited Speaker of Plenary Lecture at different scientific meetings.
President of the Organizing Committee of the XV Latin American Chemical Congress to be held in San Juan, PR, October, 1982.

Honors (Cont'd.)

Member of the Puerto Rico Governor's Scientific Committee, 1981 to date.
Member of the Advisory Committee for the 8th MBRS Symposium, 1980.
Member N.I.H. Radiation Study Section from 1980 through 1984.

Publications

1. G. A. Infante, H. J. Fendler and E. J. Fendler. "Recent Developments in Radiation Chemistry of Pyrimidine Bases in Aqueous Solutions", Radiation Research Review 5, 301, 1973.
2. G. A. Infante, P. Jirathana, J. H. Fendler and E. J. Fendler, "Radiolysis of Pyrimidine Bases in Aqueous Solutions II", J. Chem. Soc. Faraday 1, 70,.1162,1974.
3. J. H. Fendler, G. A. Infante, P. Jirathana and E. J. Fendler, "Radiolysis of Pyrimidines in Aqueous Solutions III", J. Chem. Soc. Faraday 1, 70, 1171, 1974.
4. G. A. Inante, P. Jirathana, and E. J. Fendler, J. Chem. Soc. Faraday I, 69, 1064, 1973.
5. J. Campos, Shirley Santiago, Odette Portuondo, and Ganriel A. Infante, Science-Ciencia 1, 3, 1974.
6. G. A. Infante, S. Santiago, J. Campos and O. Portuondo, Radiation Chemistry of Uric Acid in Aqueous Solutions", Rad. Res. 59, 27, 1974.
7. Gabriel A. Infante, Jaime Martínez, Sandra Gracia and José N. Correa, "Radiosensitization Studies on Balb-C Mice", Science-Ciencia 6, 12 (1979).
8. Felicita García, Bernice Irizarry, Juan Negrón and Gabriel A. Infante, "Solubilization of Vitamin K and Folic Acid by Micelle Forming Surfactants", Colloid and Interface Science, Vol. 2, p. 475, 1976, Academic Press, New York.
9. Gloria Gotay de Jove, Julian López, Rubén Padrón, Juan Negrón, and Gabriel Infante, "How Petroleum Oils Become Solubilize in Water", Colloid and Interface Science, Academic Press, N. Y. Vol. 2 p. 576, 1976.
10. G. A. Infante, G. Gotay de Jove, R. Irizarry and M. A. Rodríguez, "Chemical Effects of Micelle Forming Surfactants in the Solubilization of Petroleum Oils", Rev. Col. Quim de P.R., 25, 6-10, (1980).
11. G. A. Infante, G. Gotay de Jove, and R. Irizarry, "Solubilization of Petroleum and Petroleum Derivatives by Micellar Surfactants", In Solution Behavior of Surfactants, K.L. Mittal and E. J. Fendler, editors, Plenum Press, New York (1982).
12. G. A. Infante, C. Camacho, E. Pagán, A. Santos, R. Pérez, D. Cruz, J. N. Correa, L. D. Moore, Jr., W. Whitter, and John A. Myers, "Radiosensitization Studies on Mouse Sarcoma, Cancer Management", Radiation Sensitization 5, 497-501 (1980).
13. G. A. Infante, A. Mateo, A. Santos, G. Yordán, and A. Martín, "Micellar Effects on the Radiation Chemistry of Azaguanine and Folic Acid", Science-Ciencia 7, 109-116 (1980).
14. Gabriel A. Infante and John A. Myers, "Micellar Effects in the Radiation Chemistry of Biologically Important Compounds", In Solution Behavior of Surfactants, E. Fendler, K. L. Mittal, editors, Plenum Press, New York, 17 pages (1982).
15. G. A. Infante, S. Burgos, A. González, and J. Vera, "Radiation Chemistry Studies of Xanthine in Aqueous Solutions", Radiation Research 87, 508 (1981).
16. G. A. Infante, P. González, D. Crus, J. N. Correa, J. A. Myers, N. F. Ahmad, W. L. Whitter, A. Santos, and P. Neta, "Radiation Sensitization and Chemical Studies on Isoindole-4,7-Diones", Radiation Research 92, (1982).
17. G. A. Infante, J. N. Correa, C. Finch, P. Guzmán, A. Baéz, and J. A. Myers, "Cytotoxicity Studies on Isoindole-4,7-Diones", Int. J. Radiation Oncology Biology Physics 8, 811 (1982).

Publications (Cont'd.)

18. G. A. Infante, J. W. Castro, H. Infante and E. Rivera, "Radiation Chemistry of Azapurines in Aqueous Solutions", Radiation Research 94, 602 (1983).
19. G. A. Infante, A. Figueroa, R. Alvarez, P. Guzmán, J. N. Correa, L. Lanier, J. A. Myers, J. Vera and P. Neta, "Radiosensitization by Derivatives of Isoindole -4,7-Diones", Radiation Research 98, 234 (1984).
20. J. W. Castro, H. Infante, E. Girón, and G. A. Infante, "Radiation Chemical Studies of Purine in Aqueous Solutions, Radiation Research (In press).

Dr. José N. Correa

16. TRAINING

1. Radiation treatment of cancer patients.

2. Cell reproduction capacity, the oxygen effect, fast neutron irradiation.

3. Modification of radiation effect on ascitic tumor cells by pharmacol agents.

4. Effects of radiation on chondrosarcoma transplants.

5. Clinical factors and treatment of mouth and esophagel cancers.

6. Radiosensitization studies on transplant murine tumors.

7. Experience with gamma and X-rays irradiators at Ponce Oncologic Clinic, Puerto Rico Nuclear Center and National Cancer Institute, Bethesda, Maryland.

17.

Dr. José N. Correa

EXPERIENCE:

1. Senior Investigator - Radiation Branch
   Bethesda, MD
   2 years

2. Staff Member
   Radiotherapy Department
   Dr. I. G. Martinez Oncologic Hospital
   Ponce, PR
   1 year

3. Associate
   Radiotherapy Department
   School of Medicine - Catholic University of PR
   Ponce, PR
   1 year

4. Chief Scientist II
   P. R. Nuclear Center
   Río Piedras, PR
   1 year

5. Associate Scientist (ad honorem)
   Medical Science and Radiobiology Division
   P.R. Nuclear Center
   Río Piedras, PR
   4 years

6. Radiotherapist
   Oncologic Clinic
   Ponce, PR
   15 years

7. Private Practice Radiotherapy
   Ponce, PR
   15 yeers

8. Professor
   College of Sciences
   Catholic Un veristy of PR

9. Associate Dean
   School of Medicine - Catholic University of PR
   Ponce, PR

17.

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Correa, José N.	Professor Ponce School of Medicine	Dec. 26, 1933

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	FIELD OF STUDY
Univ. of Michigan, Ann Arbor, Michigan	B.S.	1956	Medicine
Univ. of Michigan, Ann Arbor, Michigan	M.D.	1958	Medicine
Blodget Memorial Hosp., Grand Rapids, Mich.		1958-1959	Internship
		1959-1962	Residence, Radiolo

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to recent representative publications, especially those most pertinent to this application. Do not exceed 2 pages.

1. Positions. Senior Investigator, Radiat. Branch, Bethesda, MD 2 yrs.; Staff Member, Radiotherapy Dept. Dr. I. G. Martínez Oncologic Hospital, Ponce. 1 year; Associate, Radiother. Dept., Medic. Sch. UCPR, Ponce 1 year; Chief Scientist II, P.R. Nuclear Cent Río Piedras, 1 year; Associate Scientist (ad honorem), Med. Sci. and Radiobiol. Div., P.R. Nuclear Center, Río Piedras, 4 years; Radiotherapist, Clínica Oncológica, Ponce, 15 years; Private practice radiother., Ponce; 15 years; Professor, College of Sciences Catholic University of PR, Ponce; Associate Dean, Catholic University of PR, School of Medicine, Ponce; Dean, Ponce Sch. of Med., Ponce 1980 - Present. 2. Cancer Research Experience. a) Radiation treatment of cancer patients. b) Cell reproduction capacity, the oxygen effect, fast neutron irradiation. c) Modification of radiation effect on ascitic tumor cells by pharmacol. agents. d) Effects of radiation on chondrosarcoma tranplants. e) Clinical factors and treatment of mouth and esophageal cancers. f) Radiosensitiz. studies on transplant. murine tumors. 3. Honors Assoc. Scientist (ad honorem) Med. Sci. & Radiobiol. Divis., P.R. Nuclear Center, Río Piedras. 4. Oral Presentations. Puerto Rico; Canada; Japan. 5. Publications. Patterson, R., Correa, J.N., and Mathews, K.P.: "Studies on the Neutralizing and Eliciting Activities of altered Ragweed Antigen." Annals of Allergy 17: 442-452, 1959; Patterson R., and Correa, J.N.: "The Demonstration of a Quantitative Relationship between skin sensitizing antibody and antigen." Int. Archieves Allergy 15: 333-342, 1959; Correa, J.N., and Lampe, I. : "The Radiation Treatment of Pituitary Adenomas." J. Neurosurg. 19: 626-631, August, 1962.; Andrews, J.R., Correa, J.N., and Belli, J.A.: "Fast Neutron Irradiation, Cell Reproduction Capacity and the Oxygen Effect." Proc. Int. Atomic Energy Agency Symposium Biol. Effect Neutron Irradiation. Brookhaven Nat. Lab., Upton, L. I., NY, 1964.; Swarm, R.L., Correa, J. N., Andrews, J. R., and Miller, E.: "The Morphologic Demonstration of Recurrent Tumor Following X-Irradiation." J. Nat. Cancer Inst., 33: 657-672, 1964; Correa, J.N., Swarm, R.L. Andrews, J.R., and Walker, C.L.: "Effect of External Irradiation on the Incorporation and Retention of S^{35} in Chondrosarcoma Transplants." Presented at the XIII Tech. Annual Meeting of the Radiation Research Society, Philadelphia, PA; May 24, 1965; Marcial, Víctor, Tome, J.M., Ubiñas, Bosh, A., and Correa, J.N.: "The Role of Radiation Therapy in Esophageal Cancer." Radiology 87: 321-329, 1966.; Correa, J.N., Bosh, A., and Marcial Víctor, : "Floor of the Mouth. Review of Clinical Factors and Results of Treatment." Amer. J. Roent. Rad. Therapy & Nuclear Med. February 1967.; Correa, J.N.: "Experience with the Treatment of Wilm's Tumor at the Clínica Oncológica Andrés Grillasca." Science-Ciencia, 1, #3 Spring 12-14, 1974,; Correa, J.N., Infante, G.A., Plata, P. and Hernández, M.: Radiosensitization on Transplantable Murine Chondrosarcoma", Radiation Research 70, 704, 1977; Correa, J.N., Infante, G.A., Martínez, J., Urta, E. and Cruz, D.: "Radiosensitization-Radioprotection Studies." Radiation Research 74: 5[illegible] 1978; Infante, G.A., Martínez, J. Gracia, S., Correa, J.N.: "Radiosensitization Studies on Rat Prostate." Science-Ciencia 6: 12, 1978.

G. A. Infante, C. Camacho, E. Pagán, A. Santos, R. Pérez, D. Cruz, J. N. Correa, L. D. Moore Jr., W. Whitter, and John A. Myers, "Radiosensitization Studies on Mouse Sarcoma, Cancer Management," Radiation Sensitization 5, 497-501 (1980). G. A. Infante, J. N. Correa, P. Guzmán, A. Lefebre, R. Alvarez, J. A. Myers, and M. F. Ahmad, "Radiation Sensitization Studies on Isoindole-4, 7-Diones", Radiation Research 87, 480 (1981). G. A. Infante, P. González, D. Cruz, J. N. Correa, J. A. Myers, M. F. Ahmad, W. L. Whitter, A. Santos, and P. Neta, "Radiation Sensitization and Chemical Studies on Isoindole-4, 7-Diones", Radiation Research 92, 000, (1982). G. A. Infante, J. N. Correa, C. Finch, P. Guzmán, A. Báez, and J. A. Myers, "Cytotoxicity Studies on Isoindole-4, 7-Diones", Int. J. Radiation Oncology Biology Phisics (in press).

16. TRAINING

Efraín Bonilla Santiago

1971-1972

M. S. Radiological Health

Trained at the Puerto Rico Nuclear Center, School of Medicine, University of Puerto Rico, San Juan and at Puerto Rico Nuclear Center at Mayaguez, P.R.

Duration of training:

Full academic year starting at August 2, 1971 and ending at July 30, 1972.

Some of the courses toward:

This master degree in Science in Radiologica Health included Dosimetry, Radiobiology, Radiochemistry, Radiation Safety Rules, Nuclear Physics, Instrumentation, Nuclear Reactor Safety, ect.

Experience with gamma irradiators at Puerto Rico Nuclear Center, Rio Piedras and Mayaguez.

Ample knowledge of radiation protection and radiation detection measurements.

17. EXPERIENCE

Since 1972 Mr. Efrain Bonilla Santiago, was contracted to the Catholic University of Puerto Rico as the Radiation Safety Officer and has been working since.

The radioisotopes experience are those listed in our License #52-13508-01, As a student I was dealing with other isotopes as Co (60), Radium, Iodene, C (14), ect. Maximum activity of each are unknown since it was a student training.

17. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR:

BIOGRAPHICAL SKETCH

Give the following information for key professional personnel listed on page 2, beginning with the Principal Investigator/Program Director. Photocopy this page for each person.

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Efrain Bonilla	Assistant Profesor	8/2/49

EDUCATION (Begin with baccalaureate or other initial professional education and include postdoctoral training)

INSTITUTION AND LOCATION	DEGREE (circle highest degree)	YEAR CONFERRED	FIELD OF STUDY
University of Puerto Rico, Mayaguez Campus	B.S.	1969	Mathematics
University of Puerto Rico, Río Piedras Campus	M.S.	1972	Health Physics

RESEARCH AND/OR PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order previous employment, experience, and honors. Include present membership on any Federal Government Public Advisory Committee. List, in chronological order, the titles and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. DO NOT EXCEED TWO PAGES.

Assistant Professor - Department of Mathematics - Catholic University of Puerto Rico
1981 to date.

Instructor - Department of Mathematics - Catholic University of Puerto Rico
1974 - 1981.

Health Physcis Officer - College of Sciences - Catholic University of Puerto Rico
1975 to date.

Consultation Health Physcis and Statistics - Ponce School of Medicine
1978 to date.

Training

Trained at the Puerto Rico Nuclear Center, University of Puerto Rico, Río Piedras and Mayaguez Campuses and one summer at Oak Ridge National Laboratory.

Specific training courses on Dosimetry, Radiobiology, Radiochemistry, Radiation Safety Rules, Nuclear Physics, Health Physics Calibration Procedures, Instrumentation, Nuclear Reactor Safety, Radiation Facilities Safety, Radioisotope Techniques, Biostatistics and other.

APPENDIX I

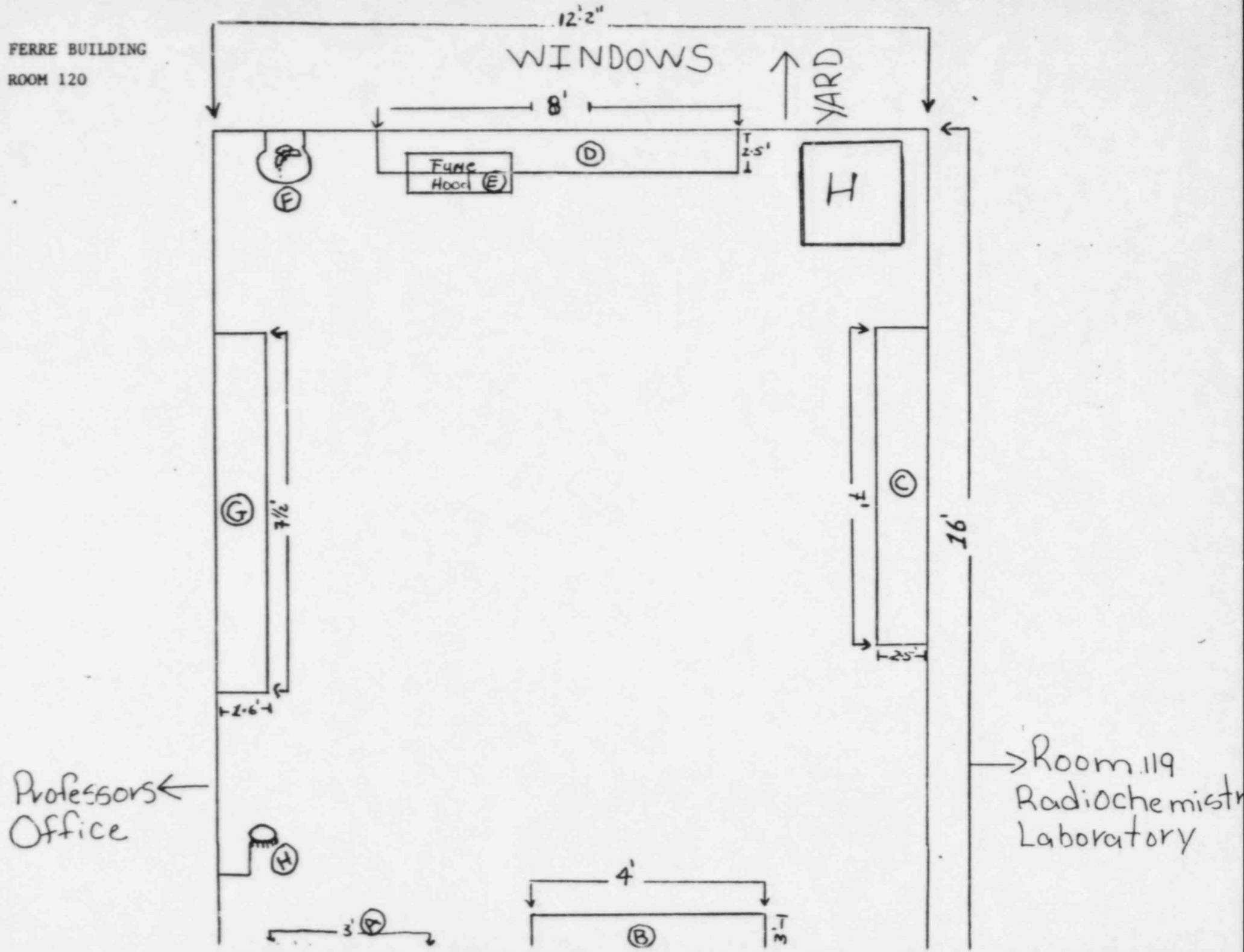
INFORMATION ABOUT MARK I MODEL 25 CESIUM-137 IRRADIATOR FROM SHEPHERD AND ASSOCIATES

APPENDIX II

EXACT POSITION OF THE IRRADIATOR AT CATHOLIC UNIVERSITY OF PUERTO RICO

FERRE BUILDING

ROOM 120



Description of Diagram for Room 120 - First Floor - Ferre Building, where MARK I Model 25 Cesium-137 Gamma Irradiator will be Installed

(A) Entrance Door (3')

(B) Lab. Cabinet and Table

(C) Lab. Cabinet and Table

(D) Lab. Cabinet and Table

(E) Fume Hood

(F) Hand washer

(G) Lab. Cabinet and Table

(H) Watershower

(I) Gamma Irradiator*

Next to Room 120 we have to the left Room 119 - Radiochemistry Laboratory and to the right Professors Office. In front o passage and behind a yard. In the second floor next to Room 120 is Dr. Mercado's Biochemistry Research Laboratory.

Radiation detection instruments such as the Geiger-Muller and Scientillation Counters are under the tables next to the Irradiator and conected to an alarm ring.

A University Map indicating the position of Room 120 is also enclosed for your information.

CATHOLIC UNIVERSITY OF PUERTO RICO

Buildings

1. Spellman Building
2. Auditorium
3. McManus Building
4. Dr. Perea Building
5. Fine Arts Building
6. Psychology Building
7. Ferré Building
8. Aguayo Building
9. Valdés Building
10. González Pató Building
11. Valdés Library
12. Administration Building
13. Music Pavillion
14. Medical Technology
15. ICE (Cosol)
16. Home Economics Building
17. Physical Education (Women)
18. Santa María Reina Church
19. Residence for religious faculty
20. 21 Men's Residence
22. Residence for religious faculty
23. 24,25,26, Residence for religious faculty
27. Residence for religious faculty
28. 29 Women's Residence
30. Physical Facilities Building
31. WEUC Radio Station
32. 33,34,35,36 Parking Areas
37. 39, Tennis Courts
38. Basketball Courts
40. Gymnasium
41. Future Projects
42. Santa María School
43. Ponce Medical School
44. Damas Hospital

APPENDIX III

EXAMPLES OF RADIATION PROTECTION FORMS

THAT WILL BE USE FOR THE IRRADIATOR FACILITY

CURRENT OCCUPATIONAL EXTERNAL RADIATION EXPOSURE

Identification

1. Name (Print - last, first, middle)	2. Social Security Number
3. Date of Birth (month, day, year)	4. Name of Licensee or Registrant

Occupational Exposure

5. Dose recorded for (Specify: whole body; skin or whole body; or hands and forearms, feet and ankles).

6. Whole body dose status (rem)

7. Methods of monitoring (e.g., Fil Badge-FB; Pocket Chamber-PC Calculations-Calc.

Beta-gamma _____ Neutron _____

8. Period of Exposure (from-to)	Dose for the Period (rem)				13. Running Total for Calendar Quarter (rem)
	9. Gamma	10. Beta	11. Neutron	12. Total	

Life Accumulated Dose

14. Previous total (rem)	15. Total Quarterly Dose Date rem	16. Total Accumulated Dose (rem)	17. Perm. Acc. Dose (rem) 5(N-18)	18. Unused Part Perm. Acc. Dose (rem)

MONTHLY RADIATION INSPECTION
AND SURVEY-FACILITIES

ROOM _____ DATE _____

Smear Test: _____

Table top:

Table A _____

Table B _____

Trash container:

Inside: _____

Outside: _____

Instruments: (detail)

Others:

_____

Efrain Bonilla Santiago
Radiation Safety Officer
M.S. Health Physics

CATHOLIC UNIVERSITY OF PUERTO RICO
COLLEGE OF SCIENCES
BIOMEDICAL RESEARCH PROGRAM

LOG MARK I CESIUM 137 IRRADIATOR
FERRE 120

DATE_____ USE_____

PERSONS IN EXPERIMENT

_____

_____

_____

DOMIMETER BADGE NUMBER

_____

_____

_____

PURPOSE OF EXPERIMENT OR IRRADIATION

_____

_____

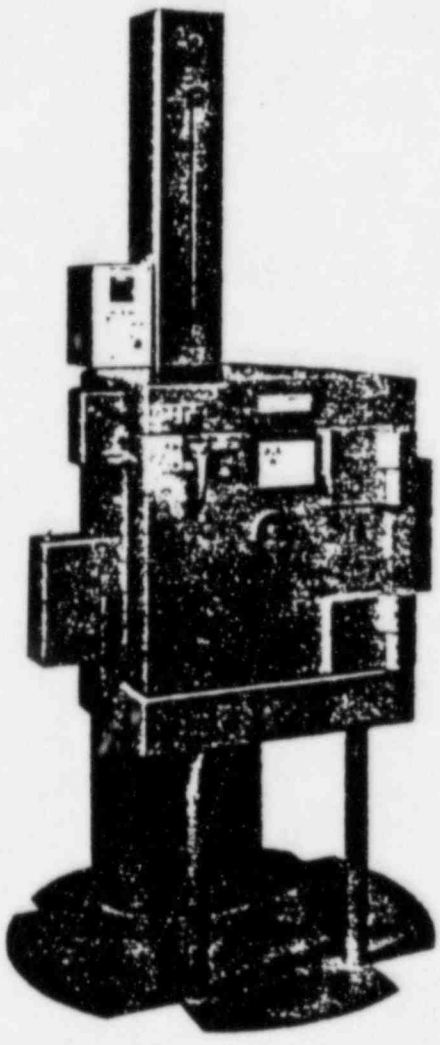
_____

_____

_____
SIGN PERSON IN CHARGE

MARK I

^{137}CESIUM IRRADIATORS



FOR BIOLOGICAL, BIOCHEMICAL, HORTICULTURAL,
CHEMICAL, AND ELECTRONIC APPLICATIONS

J.L. SHEPHERD and Associates
740 SALEM ST.
GLENDALE, CA 91203
(213) 245-0187

The MARK I ^{137}Cesium Irradiator is a self-contained unit designed for use in any available lab space. It incorporates the following features:

- Large fixed cavity (up to 12" dia. x 14" high-see table) in which the environment can be controlled
- ^{137}Cesium, with a half-life of 30 years as the radiation source, which eliminates frequent dosimetry corrections and costly reloadings
- Variable flux (up to a factor of 100), through the use of attenuators, with no reduction of cavity space
- Simple operation — no motors, transmissions or complicated drive assemblies, yet preset time operation is standard
- High flux capability for small samples coupled with lower flux capability for large samples in the same cavity with the same source loading, plus flux selection capability as listed above
- Source travel time is less than two seconds from the OFF position to the IRRADIATE position, and less than one second return from IRRADIATE to OFF. This short travel time permits short exposures without travel time corrections.
- Animal or other spills in the cavity cannot affect operation and are readily cleaned up.

SOURCES

The ^{137}Cesium line source is doubly encapsulated in Series 300 stainless steel, with both inner and outer capsules sealed by heliarc welding and is certified "Special Form."

All capsules undergo a rigorous series of integrity tests, including leak test, before delivery.

OPERATION

1. With the source in the OFF position, the sample is placed on the turntable in the cavity, and the door is secured.
2. The desired time is preset on the timer.
3. The source is raised from the OFF position to the IRRADIATE position by means of an operating handle. A latch holds the source in the IRRADIATE position.
4. The source is returned immediately to the OFF position:
   At the end of the predetermined time as set on the preset timer
   By pushing the OFF button on the control panel or by power interruption

   If the mode selector switch on the control panel is set to MANUAL, the source will remain exposed until the OFF button is pressed

APPLICATIONS

- Biological irradiation of animals in a controlled environment
- Botanical and horticultural irradiation
- Sterilization of pharmaceuticals or medical appliances
- Radiation research on materials at high or cryogenic temperatures
- Radiation chemistry reactions (systems can be set up in fixed position and allowed to reach equilibrium conditions before exposure to radiation)

MODEL	CAVITY DIAMETER x LENGTH	FLUX/1000 Ci TO CENTER OF CAVITY R/HR	FLUX/1000 Ci TO CENTER OF 1" D. SAMPLE R/HR	FLUX/1000 Ci TO CENTER OF 2" D. SAMPLE R/HR	MAXIMUM LOADING ^{137}Cs. Ci.	WT. IN LBS.	DIMENSIONS DIAM. x HEIGHT
22	4" x 6"	3.7×10^4	1.2×10^5	9.0×10^4	6,000	2,000	29" x 60"
25	6" x 8"	2.0×10^4	1×10^5	7×10^4	8,000	3,000	29" x 66"
30	8" x 10"	1.2×10^4	7.5×10^4	4.8×10^4	10,000	4,000	29" x 68"
68	12" x 12"	7.3×10^3	5×10^4	3.6×10^4	12,000	5,200	32" x 72"
68 A	12" x 14"	6.7×10^3	4.5×10^4	3.2×10^4	12,000	6,000	32" x 78"

All fluxes based on 1000 Ci loading. Higher loadings may reduce unit fluxes by 20% or less.

CONSTRUCTION

The external surface of both the source-shield and the cavity-shield sections is mild steel painted.

All inside surfaces are constructed of, or lined with corrosion-resistant material.

Shielding is in the form of void-free lead, in all welded steel and/or stainless steel closures.

The source tube is welded in the cavity so that the source drive mechansim cannot be damaged by corrosive materials generated or placed in the cavity.

Animal or other spills are cleaned by removing the turntable base plate which is held in place by four bolts.

FLUX VARIATION

The typical flux variation throughout most of the cavity to a sample being rotated about the center point or to a sample being rotated closer to the source is ± 20% or less.

EXTERNAL RADIATION LEVEL

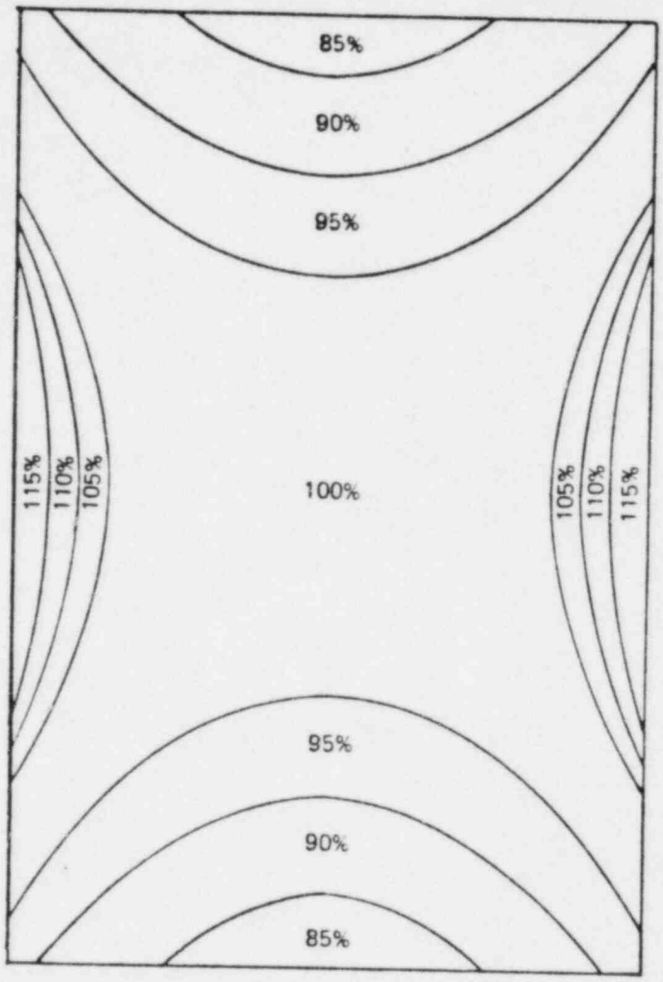
The external radiation level at all operating surfaces of the Mark I is approximately 2 to 3 mR/hr, with maximum level of 15 mR/hr, at the rear of the unit. At three feet the external radiation level is less than 0.75 mR/hr.

SPECIAL SHIELDING OPTION

A special shielding option is available on all Mark I Irradiators which reduces the external radiation level to less than 0.5 mR/hr at one foot from all surfaces.

SAFETY FEATURES AND INTERLOCKS

- Both the cavity door and the source lift mechanism are equipped with solenoid latches which are spring loaded in the LOCKED position. Each is also equipped with a switch, so constructed that the door cannot be opened unless the source rod is in the OFF position, locked with its solenoid and engaging the switch for the door latch solenoid. Likewise, the source cannot be raised unless the door is closed, locked and engaging the switch for the source lock solenoid. Thus, it is impossible to be accidentally exposed to radiation from the unit.
- Tandem switches are used throughout to provide complete backup system in case of switch failure.



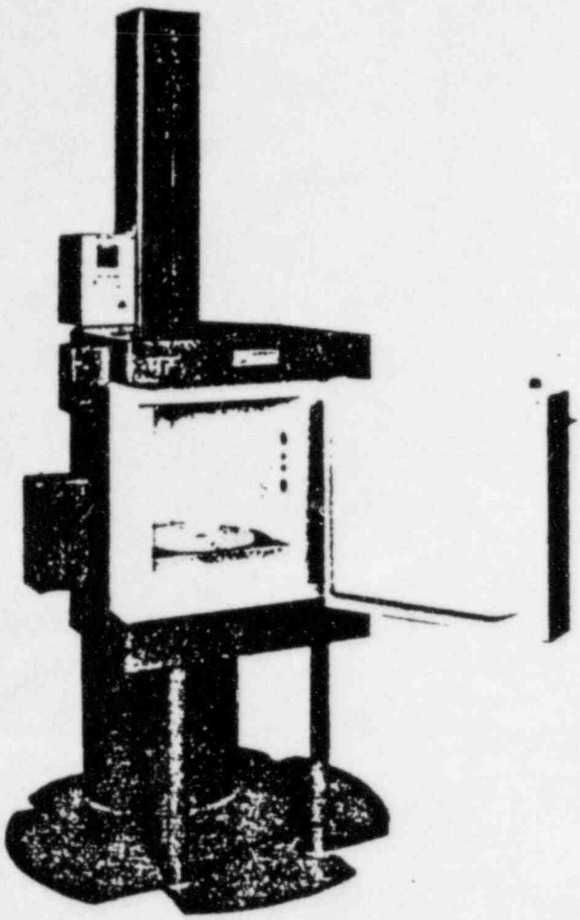
TYPICAL ISODOSE CURVE

- The operating handle, attached directly to the source rod, shows the position of the source at all times.

CONTROL PANEL

The control panel mounted on the unit contains:

- Key-operated *power* switch (with indicator light) which controls all functions of the irradiator
- Digital preset timer with range: 0-999.99 ± .01 minutes
- Selector switch for *preset time* or *manual* operation
- Source position indicator lights
- *Source raise* and *Source return* switches
- The *DOOR OPEN* switch and turn-table control switches are mounted on the front of the irradiator



MODEL 68

CAVITY

A full width door exposes the entire cavity for setting up experiments.

Four each access tubes (2 each, 1" diameter and 2 each, ½" diameter in Models 30 and 68 and four each, ½" diameter in Models 22 and 25) are built into all units, permitting entry of electrical leads, heating or cooling media, controlled air flow, etc. to the specimen chamber.

A 3-position turntable (rotational speed = 6 r.p.m.) is mounted in the floor of the cavity. One position is located at the center of the cavity, the second position permits irradiation of full cavity size samples with the X-100 attenuator in place and the other position may be located as required (minimum distance from source tube is 5/8" for 1" dia. samples). Please specify positions on purchase request. Additional turntable positions, higher and dual speed turntable drives are available as accessories.

CERTIFICATION

Calibration and isodose curves, as well as Leak Test and External Radiation Level Certificates are provided with each irradiator. All calibration data is traceable to N.B.S.

WARRANTY

Free parts and service will be allowed for 3 months following installation, with replacement of faulty components for an additional 9 months.

Instruction and maintenance manuals will be supplied, as well as services of J.L. Shepherd & Associates personnel in familiarizing customer's personnel with operation of the unit.

ACCESSORIES

- ACCESS TUBES of 1/2" or 1" i.d., in any required number, are available
- CONTROLLED ATMOSPHERE SYSTEMS, temperature and/or gas composition
- HIGH AND LOW TEMPERATURE irradiation chambers
- IRRADIATION COILS for gas or liquid irradiation
- ADDITIONAL TURNTABLE POSITIONS
- DUAL AND HIGHER SPEED TURNTABLES
- ATTENUATORS are available to reduce radiation flux delivered to the cavity. x2; x5; x10; x50; x100
- MODEL 302 SHAPED ATTENUATOR
- MODEL 335 VARIABLE SLIT COLLIMATOR SYSTEM.
- ANIMAL CHAMBERS
- TEST TUBE HOLDERS

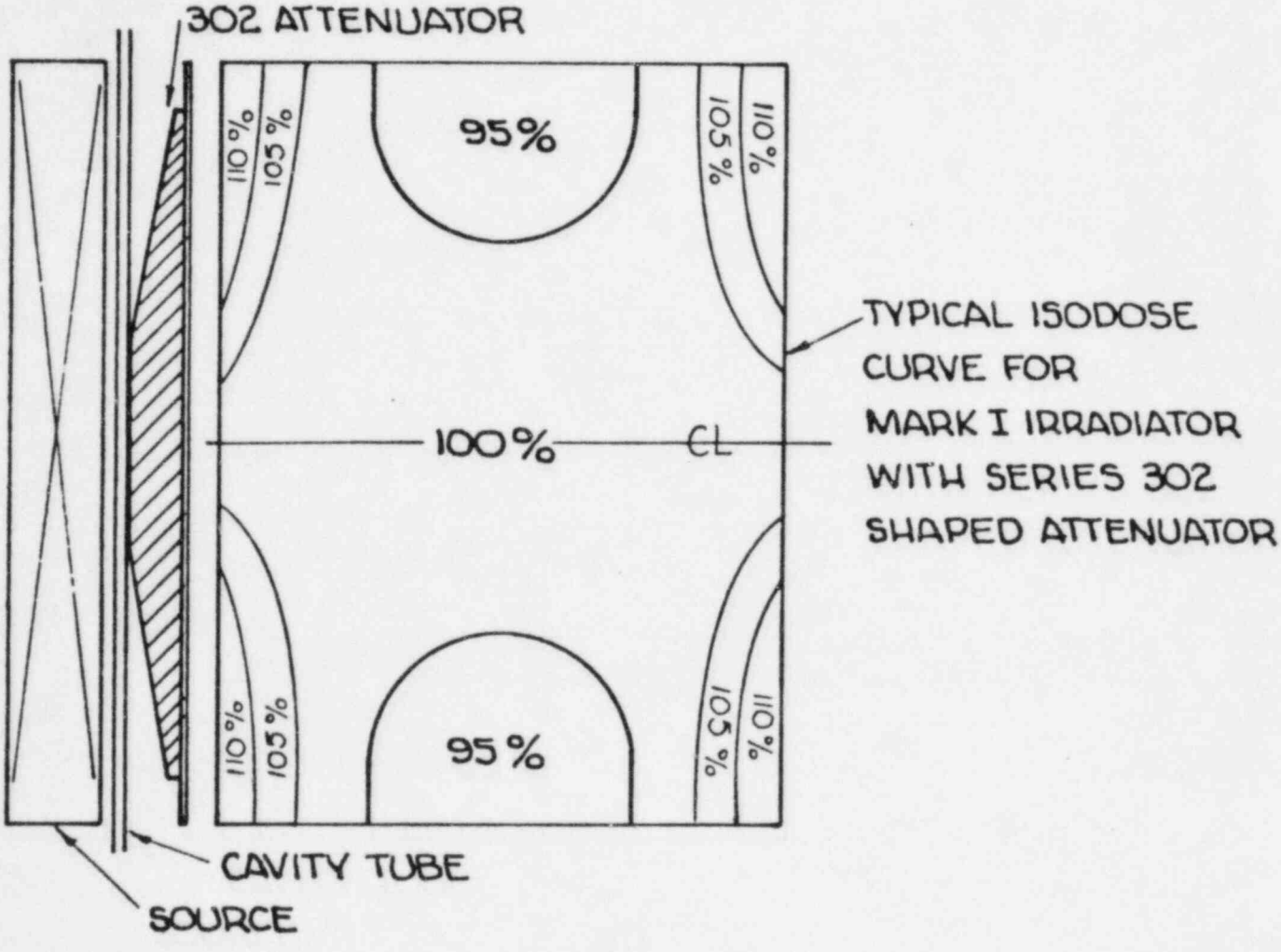
SHIPMENT

All **MARK I IRRADIATORS** are shipped with source installed in returnable DOT overpacks (which are also available for rental or purchase).

ACCESSORIES FOR MARK I IRRADIATORS

SERIES 302 SHAPED ATTENUATOR

Series 302 Shaped Attenuators reduce the integrated dose variation throughout the entire cavity volume of any J.L. Shepherd and Associates Mark I Irradiator to approximately plus 10% minus 5%. (See typical isodose curve below.)



Maximum dose rate to a full cavity size sample with the Series 302 in place is 40% to 50% of the unattenuated center cavity dose rate. If a lower dose rate is required, the Series 302 can be increased in thickness.

Series 302 Shaped Attenuators are individually designed for each Mark I and the source with which it is loaded. Complete isodose curves are supplied with the Series 302.

Series 302 Shaped Attenuators fit around the source tube at the back of the cavity of any Mark I. They are easily installed and removed. Each Mark I is equipped with a turntable position which permits a full cavity size sample to be irradiated with the Series 302 in place.

MODEL 335 COLLIMATOR SYSTEM
FOR MARK I, MODEL 68

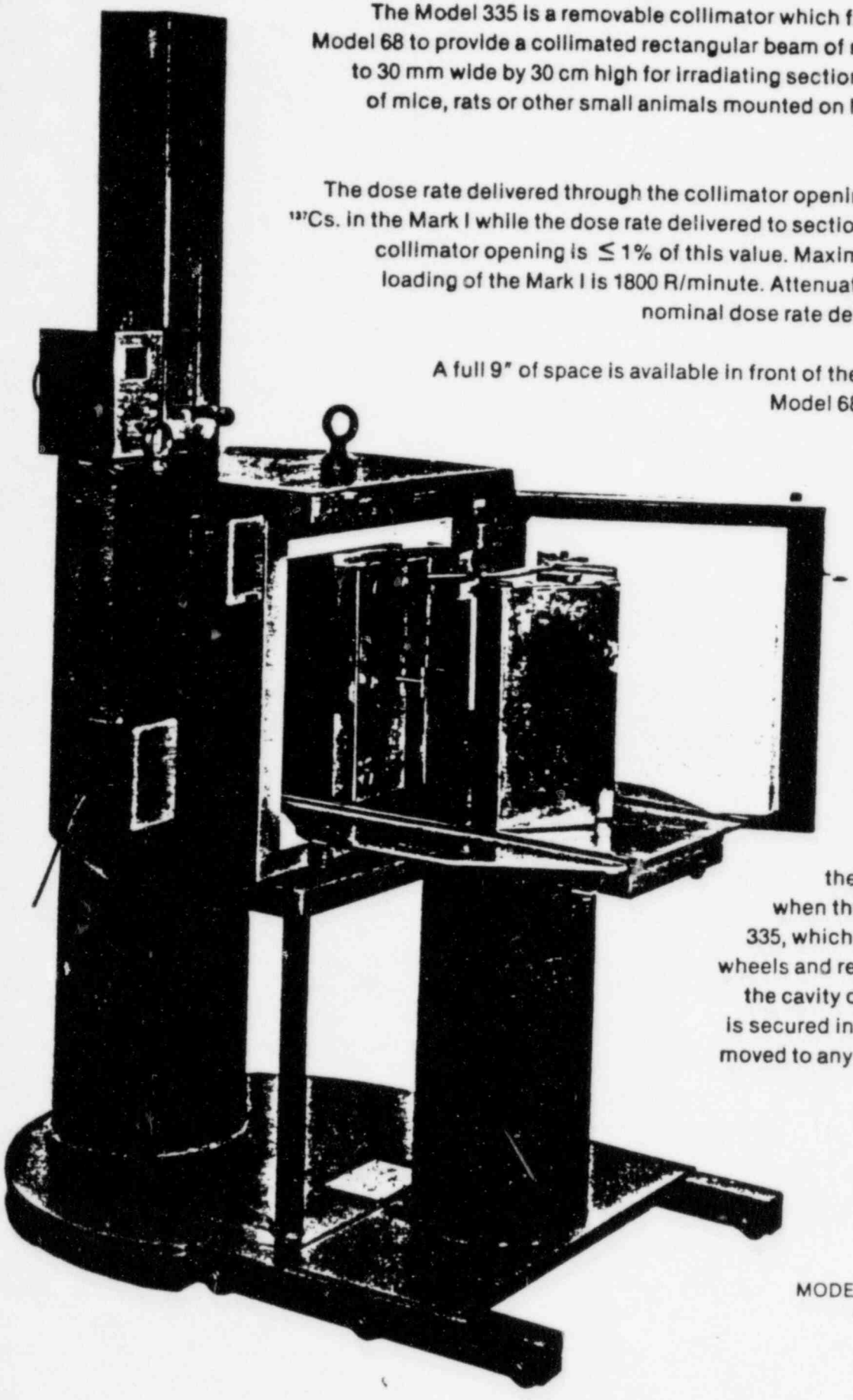
The Model 335 is a removable collimator which fits into the cavity of any Mark I, Model 68 to provide a collimated rectangular beam of radiation adjustable from 5 mm to 30 mm wide by 30 cm high for irradiating sections; i.e. legs, thighs or abdomen of mice, rats or other small animals mounted on holders attached to the front of the collimator.

The dose rate delivered through the collimator opening is 150 R/minute per 1000 Ci. ^{137}Cs. in the Mark I while the dose rate delivered to sections of the animal outside of the collimator opening is $\leq 1\%$ of this value. Maximum dose rate with a 12,000 Ci. loading of the Mark I is 1800 R/minute. Attenuators are available to reduce the nominal dose rate delivered by up to a factor of 100.

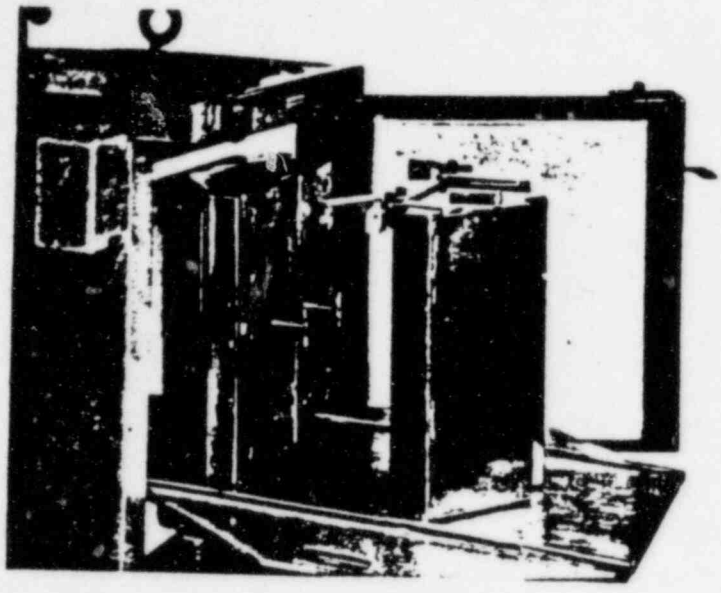
A full 9" of space is available in front of the Model 335 in the cavity of the Model 68 for mounting animal holders.

The Model 335 Collimator may easily be removed from the cavity so that the Model 68 may be used for normal full cavity irradiation of large samples.

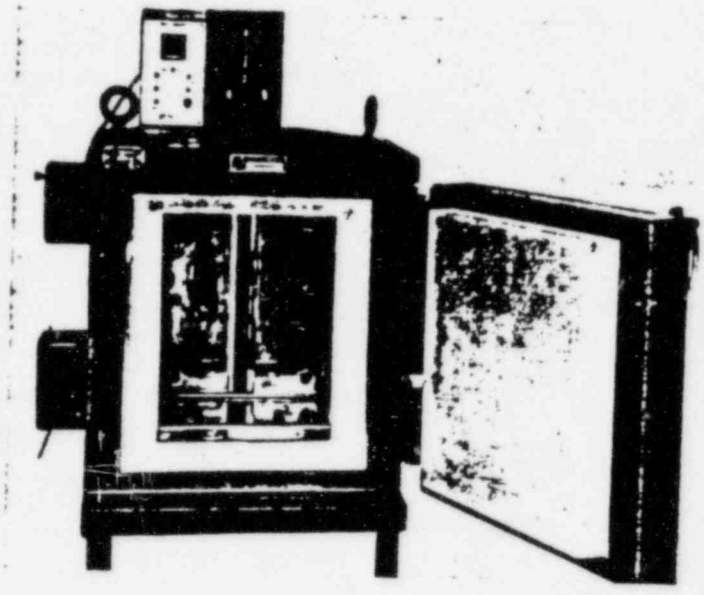
A rolling stand for storage, as well as insertion and removal of the Model 335 from the Mark I, Model 68 is provided. This stand fits into the door section of the Model 68 when the door is open, and the Model 335, which is equipped with ball bearing wheels and removable handles, rolls out of the cavity onto the rolling stand where it is secured in place. The stand can then be moved to any convenient storage location.



MODEL 335 WITH STAND
AND MARK I



MODEL 335 BEING INSTALLED
IN MARK I



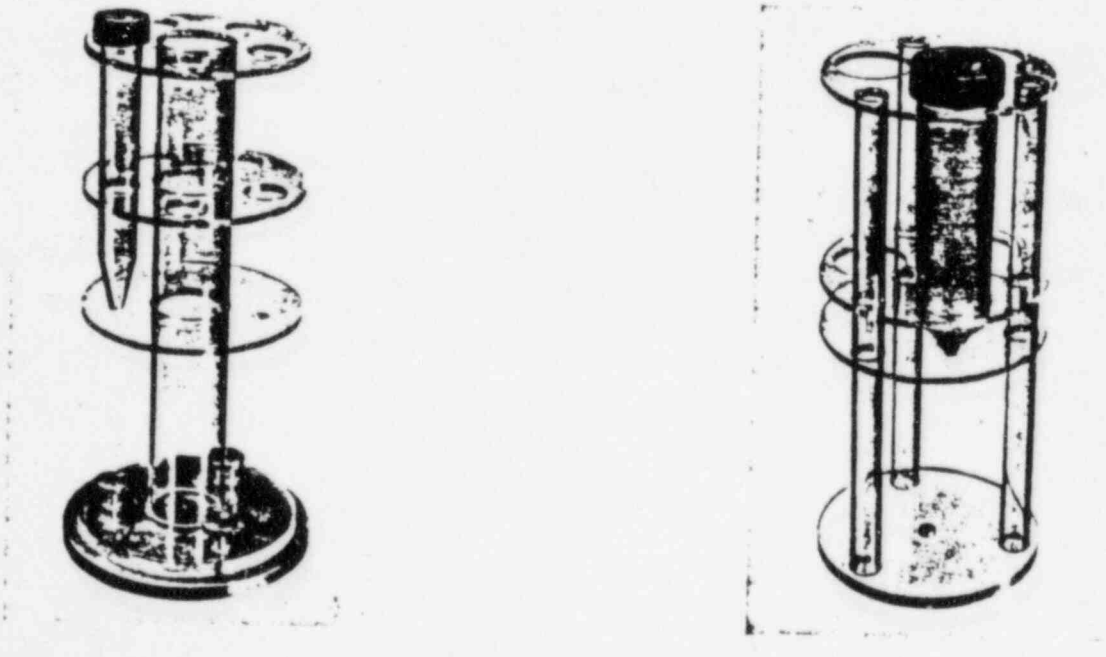
MODEL 335 INSTALLED IN MARK I

TEST TUBE HOLDER

J.L. Shepherd and Associates manufactures a complete line of test tube holders for all Mark I Irradiators. These racks are manufactured from Lucite or thin gauge aluminum and are designed so that the material being irradiated is at the vertical centerline of the cavity.

These holders are attached with knurled thumbscrews to the turntables of the Mark I.

Holders are built to hold single or multiple test tubes, dependent upon the size of the turntable to which they are attached; i.e. a single tube for a turntable position near the source for the maximum delivered dose rate.

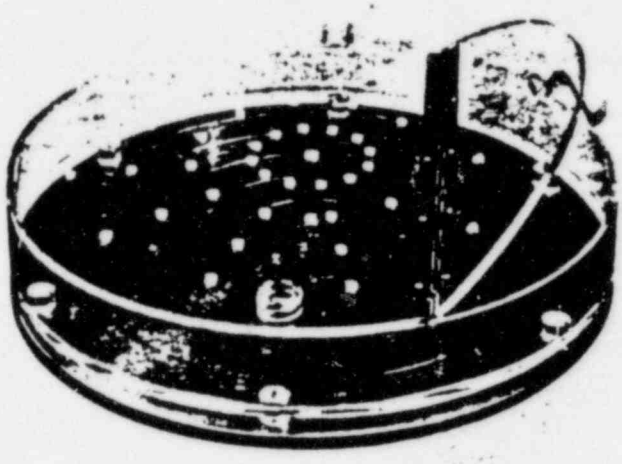


TEST TUBE HOLDERS

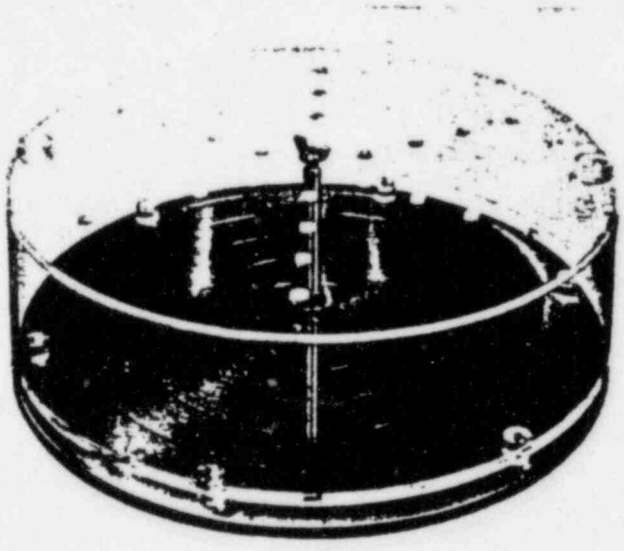
ANIMAL CHAMBERS

J.L. Shepherd and Associates manufactures a complete line of Lucite animal holders for all Mark I Irradiators.

All chambers feature multiple holes in the cover for ventilation and are equipped with standoffs for stacking several chambers in the Mark I cavity to irradiate the maximum number of animals at one time.



Hinged covers on mouse chambers permit easy loading and unloading of animals. The entire top of the rat chamber is removable and is held in place by a brass nut.



SPECIFICATIONS:

	Mouse Holder				Rat Holder			
Irradiator Model No.:	22	25	30	68	22	25	30	68
Inside height:	1¼"				2¾"			
Overall height:	2"				3½"			
Outside diameter:	4"	6"	8"	12"	4"	6"	8"	12"
Inside diameter:	3¾"	5¾"	7¾"	11¾"	3¾"	5¾"	7¾"	11¾"

J.L. SHEPHERD and Associates
740 SALEM ST.
GLENDALE, CA 91203
(213) 245-0187

JL SHEPHERD and Associates

740 Salem Street, Glendale, California 91203 • 213/245-0187

Irradiation & Calibration Equipment • Lead Shielding • Nuclear Applications

DATA SHEET - MARK I IRRADIATORS

The Mark I is an especially versatile irradiator in that full cavity size samples may be irradiated up to X-100 lower than the nominal center cavity dose rate through the use of attenuators and that small samples (test tubes, petri dishes, etc.) may be irradiated up to X-10 higher than the center cavity dose rate by using turntable positions that are located closer to the source tube. Also available for the Mark I Model 68 is the Model 335 adjustable slit collimator. This unit, while not interfering with the normal use of the full size cavity irradiation of samples, provides the capability of irradiating selected organs (kidneys, thighs, heads, etc.) of such small animals as rats or mice by mounting them on a plate in front of the collimation slit.

Of special note is the extremely low external radiation levels associated with the Mark I Irradiators. With maximum loading for any unit, the external radiation level at the surface is in the order of 2-3mR/hr at all surfaces except a maximum of 9-10mR/hr at the rear surface. These low external radiation levels allow the Mark I's to be placed in virtually any location, such as a laboratory, office or storage space. We also offer an additional shielding option which will guarantee that the dose rate will be less than 1mR/hr at one foot from the surface in all directions.

Both the cavity door and the source lift mechanism are equipped with solenoid latches which are spring loaded in the LOCKED position. Each is also equipped with a switch, so constructed so that the door cannot be opened unless the source rod is in the OFF position, locked with its solenoid and engaging the switch for the door latch solenoid. Likewise, the source cannot be raised unless the door is closed, locked and engaging the switch for the source lock solenoid. Thus, it is impossible to be accidentally exposed to radiation from the unit.

Tandem switches are used throughout to provide complete back-up system in case of switch failure.

The door to the irradiation chamber is opened and closed manually. The source is raised from the OFF position to the IRRADIATE position manually, where it is held by a latch, and falls by gravity fromt he IRRADIATE position to the OFF position

by any of the following means: (1) at the end of preset time on the timer; (2) power failure, or (3) by pushing the push-button type OFF switch which overrides the preset timer. If the source does not move from the IRRADIATE position to the OFF position within 10 seconds, an audible alarm sounds. The source is locked in the OFF position by means of a spring-loaded latch to the source rod which can be released only by passing electrical current through a solenoid; in series with the solenoid are three safety switches, two of which are closed by moving the door to its closed position and one of which is closed by a spring-loaded bolt to the door only when the bolt holds the door locked in its closed position. When the door is locked in its closed position by the bolt, the bolt can be released only by passing electrical current through a solenoid; in series with this solenoid are two switches which are closed only when the source is latched in the OFF position.

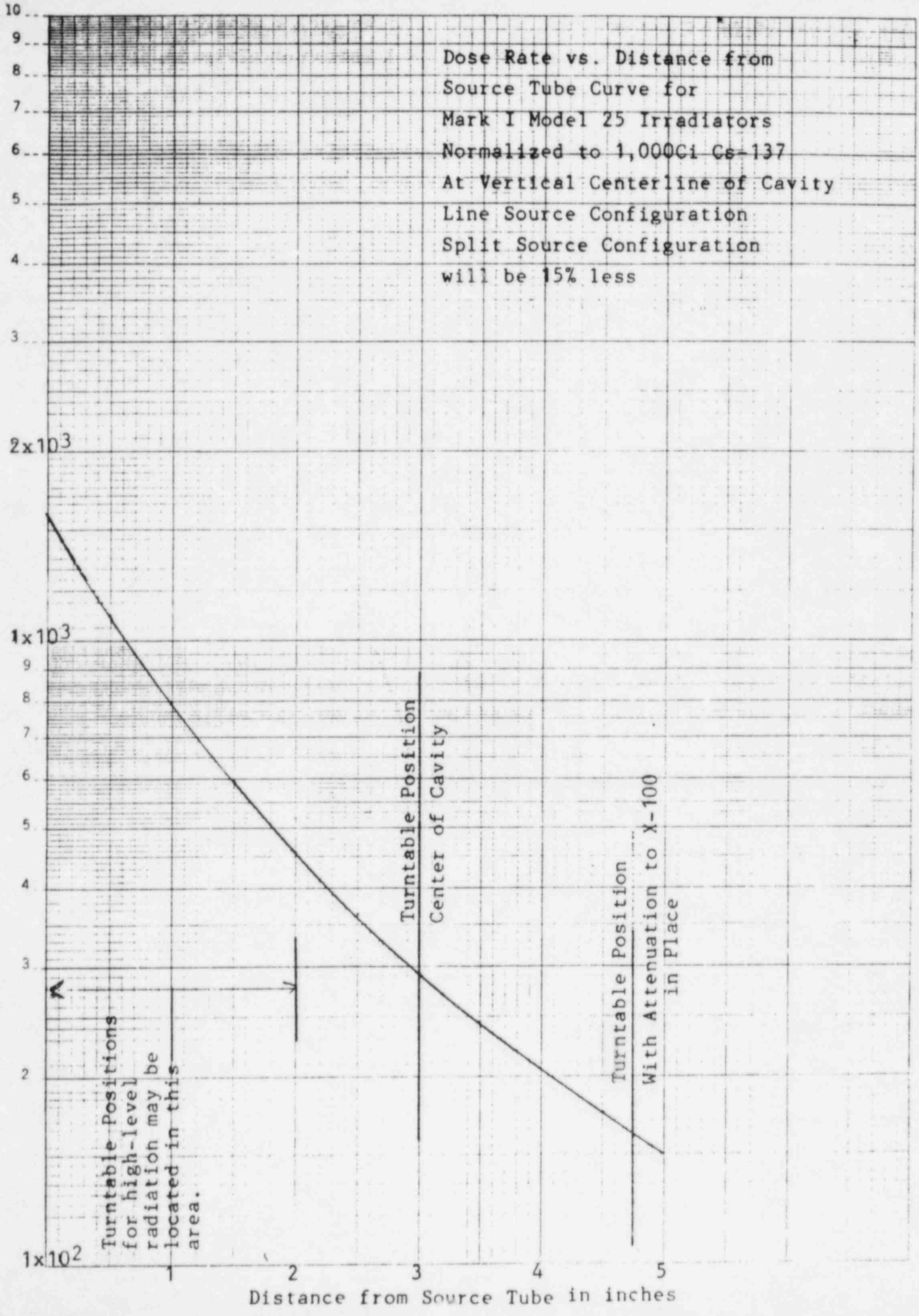
The sources are doubly encapsulated in stainless steel, sealed by heliarc welding, and certified to meet "SPECIAL FORM" requirements, as described in 49 CFR 173.398. J.L. Shepherd and Associates will perform the integrity and leak tests on each capsule in accordance with the standard tests for such sources prior to shipment to the customer.

Calibration and isodose curves, as well as leak test and external radiation level certificates are provided with each irradiator. All calibration data is traceable to National Bureau of Standards.

For those users who require both high dose rates and very low dose rates, a dual source - one high level and one low level source - version of the Mark I is available. In the dual source version, all interlocks and safety systems are comparable to the standard Mark I. Source operation is pneumatic (via pneumatic cylinders) with selector switch mounted on the control panel. For this unit, 100 lbs. of compressed air is needed to operate the unit, either via bottled air or a compressor may be built into the unit.

Dual source versions with two high level sources are also available, which permits each model number to be loaded with twice the amount of Cesium-137 as called out in the catalog sheet.

Prices for these dual source, pneumatically oeprated units are available upon request.


Dose Rate vs. Distance from
Source Tube Curve for
Mark I Model 25 Irradiators
Normalized to 1,000Ci Cs-137
At Vertical Centerline of Cavity
Line Source Configuration
Split Source Configuration
will be 15% less
10
9
8
7
6
5
4
3
2x10^3
1x10^3
9
8
7
6
5
4
3
2
1x10^2
Turntable Positions
for high-level
radiation may be
located in this
area.
Turntable Position
Center of Cavity
Turntable Position
With Attenuation to X-100
in Place
1
2
3
4
5
Distance from Source Tube in inches

J L SHEPHERD and Associates

740 Salem Street, Glendale, California 91203 • 213/245-0187

Irradiation & Calibration Equipment • Lead Shielding • Nuclear Applications

DATA SHEET - SPECIAL FORM CAPSULE TESTING

Capsule Type: 6810
Drawing Number: A-0233-9

Capsule was loaded with 360 grams of inert CsCl
Inner and outer capsules were heliarc welded in accordance with drawings and tests performed as below.

Date: March 19, 1984

49CFR 173.398 Special Tests

1.Free Drop - 30' to 1/4" thick steel plate on concrete surface.

Results: No visible damage to capsule or welds.

2.Percussion - 1" diameter steel rod, wt. 3 lbs. dropped end on 4 times through 40" distance on capsule laying on 1/4" lead sheet on concrete surface.
Results: Sides and end of capsule were dented. No fracture of outer capsules or welds.

3.Heating - Capsule heated in air to 1475°F in electric furnace and held at this temperature 15 minutes - then allowed to cool.
Results: Capsule discolored - no fracture of capsule ends, welds or walls.

4.Immersion - 24 hours in distilled water pH 7, maximum conductivity of 10 micro-mhos/cm.
Results: No visible effect on capsule - no leaking of CsCl from inside capsule.

Leak Test:
1. Method: Bubble Test. Capsule heated to 240° in glycol.
2. Results: No bubbles emerged from capsule.

J. L. Shepherd

J.L. Shepherd

J.L. SHEPHERD & ASSOCIATES
MAINTENANCE CONTRACT PROCEDURES

I. SAFETY AND INTERLOCK SYSTEMS

A. All safety and interlock systems will be tested for proper operation. Any problems will be identified and corrected or recommendations will be made for necessary repair.

II. ELECTRICAL SYSTEMS

A. All electrical systems will be tested for proper operation. Any problems will be identified and corrected or recommendations will be made for necessary repair.

III. MECHANICAL SYSTEMS

A. Mechanical systems will be tested for proper operation and all components will be checked for wear, breakage, or any other malfunctions.

B. All nuts, bolts, screws, etc. will be tightened or replaced as required.

IV. RADIOLOGICAL EVALUATIONS

A. Dose rates will be check to verify that they are still within limits.

B. Other evaluations will be made for TLD/Film Badge requirements, such as, area monitors, personnel training, etc.

V. GENERAL APPEARANCE AND LOCATION

A. General check out will be performed to establish overall appearance and efficiency.

VI. CHECK OUT DOCUMENTATION

A. Check out sheet will provide summary of work done and recommendations for additional work as necessary.

J.L. SHEPHERD and Associates

740 Salem Street, Glendale, California 91203 • 213/245-0187

Irradiation & Calibration Equipment • Lead Shielding • Nuclear Applications

CERTIFICATION

SUBJECT: 7,000Ci Cesium-137 source capsule, per J.L. Shepherd & Associates drawing # A-0233-9

This is to certify that a prototype of the source capsule per drawing #A-0233-9 has been subjected to and successfully passed free drop, percussion, heating and immersion tests as called out in 10CFR 173.398.

DATE: March 19, 1984

J.L. Shepherd