MAY [illegible] 1985

NRC Form 313 I (12-81) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

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

	a. NEW LICENSE
X	b. AMENDMENT TO: LICENSE NUMBER 21-00215-04
	c. RENEWAL OF: LICENSE NUMBER

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.)*
Regents of the University of Michigan
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION

3. NAME AND TITLE OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Arthur J. Solari
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
313 764-4420

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
(Address to which NRC correspondence, notices, bulletins, etc., should be sent.)
Ann Arbor, Michigan 48109

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
2D1071 Adult General Care Hospital
University of Michigan
Ann Arbor, Michigan 48109

(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.	Suzanne H. Butch, MA, MT(ASCP)SBB, or	Blood Bank Irradiator Coordinator Chief Technologist of Blood Bank
b.	Others as designated by the Radiation	
c.	Policy Committee	

7. RADIATION PROTECTION OFFICER
Arthur J. Solari, Director
Radiation Control Service

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

RECEIVED BY LFMB
Date 6/7/85
Ltr
By
Orig to
Rdg Compl

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	Atomic Energy of Canada, Limited	nominal 2400 Curies
(2)			Gammacell 1000	
(3)				
(4)				

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E. DESCRIBE USE OF LICENSED MATERIAL

(1) Irradiation of blood and blood components for transfusion to selected patients.
(2)
(3)
(4)

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Ex 10 CFR 170.11(a)(4)
FEE EXEMPT

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NRC FORM 313 I (12-81)

9. STORAGE OF SEALED SOURCES

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED. A.	NAME OF MANUFACTURER B.	MODEL NUMBER C.
(1)	Self-contained, dry source storage irradiator	Atomic Energy of Canada, Limited	Gammacell 1000
(2)			
(3)			
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT A	MANUFACTURER'S NAME B	MODEL NUMBER C	NUMBER AVAILABLE D	RADIATION DETECTED (alpha, beta, gamma, neutron) E	SENSITIVITY RANGE (milliroentgens/hour or counts/minute) F
(1)						
(2)						
(3)						
(4)						

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.

See license attachment

12. PERSONNEL MONITORING DEVICES

TYPE (Check and/or complete as appropriate.) A	SUPPLIER (Service Company) B	EXCHANGE FREQUENCY C
☒ (1) FILM BADGE as area monitors	Radiation Detection Company	☒ 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

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.

UNIVERSITY OF MICHIGAN MEDICAL CENTER

The University of Michigan Hospitals
Ann Arbor, Michigan 48109-2007

Jeptha W. Dalston, Ph.D.
Executive Director

Information Required in Support of an Amendment to License Number 21-00215-04 to Possess and Use a nominal 2,400 curie Cesium-137 Self-contained, Dry, Source-Storage Blood Irradiator

The Blood Bank of the University of Michigan Hospitals plans to purchase an irradiator containing sufficient cesium-137 to deliver a dose rate of 1,710 rad/min. This irradiator will be used by a all blood bank technical personnel to irradiate blood and blood components for transfusion to selected patients.

1.0 Storage and Location of the Irradiator

The irradiator will be installed in the Blood Bank Laboratory, Room 2D1071, of the Adult General Care Hospital (see Figure 1). This room is located off the main corridor of the Adult General Care Hospital.

2.0 Type and Activity of Source

The irradiator will contain four Cesium-137 sources of nominally 600 curies each for a total activity of nominally 2,400 curies (+/- 20%). The sources are Gammacell 1000 Model D manufactured by Atomic Energy of Canada, Limited, of Kanata, Ontario, Canada. The sources are doubly encapsulated in stainless steel and are held in a source holder. The source is permanently installed and sealed within the steel encased biological shield.

3.0 Identification of Manufacturer and Irradiator Model

The device is a Gammacell 1000 Blood Irradiator manufactured by Atomic Energy of Canada, Limited, of Kanata, Ontario, Canada.

4.0 Radiation Detection and Instrumentation

4.1 Eberline Corporation RM 20 area monitor with HP270 probe.

a. One available

b. Range: 0 to 500,000 cpm

c. Detects beta-gamma radiation

4.2 Other equally appropriate detection instrumentation may be obtained and used during the lifetime of this amendment.

5.0 Instrument Calibration and Operational Check

5.1 The survey meter/probe unit will be calibrated by the Radiation Control Service staff using an NBS traceable cesium-137 calibrator. Calibrations will be performed on a regular schedule at approximately six months intervals and also following any repair operations. A record of the calibration data shall be maintained by Radiation Control Service.

5.2 An operating and battery check shall be performed.

6.0 Personnel Monitoring

6.1 Before the irradiator is put into service, Radiation Control Service will make a radiation survey to determine and document the radiation dose rates at several locations in the vicinity of the irradiator. These dose rates will be shown on a diagram of the room. This diagram will be posted near the irradiator.

6.2 Because of the low external radiation levels, individual personnel dosimeters will not be required for the irradiator operators.

a. One or more film badge dosimeters will be placed in the vicinity of the irradiator for area monitoring.

b. Any personnel monitoring equipment will be evaluated through Radiation Control Service. Results will be forwarded to the irradiator coordinator for posting in the workplace.

c. Any estimates of equivalent doses received by personnel will be based upon data from the personnel and area monitors and the operators' history of irradiator use as recorded in the Operators Log. See Section 7.8.

7.0 Security and Control Procedures

7.1 Access to the Blood Bank is limited to authorized personnel. All doors to 2D1071 are locked or attended. The door immediately ajdacent to the irradiator is not keyed and can only be opened from inside 2D1071.

7.2 The Irradiator Coordinator shall maintain the list of approved irradiator operators and shall update this list as necessary.

7.3 The current list of approved irradiator operators shall be posted on the wall next to the irradiator.

7.4 An operators log shall be maintained. Each operator shall record his/her own name, date, time of day, the donor units numbers of the products irradiated and the exposure time in minutes.

8.0 Routine Operation and Emergency Procedures

8 Routine Operations Procedures

a. A key is required to operate the Gammacell 1000. The key will be under the administrative control of the irradiator coordinator. An additional key will be maintained in a locked key box.

b. The operator will load the chamber and then turn the equipment on by turning the power keyswitch to MOMENTARY RESET, and release it. The operator will observe that the switch remains in the ON position with the white POWER RESET light and the green LOAD POSITION lights illuminated.

c. The operator will load the irradiation chamber, set the TURNTABLE switch to ON and observe that the blood bag rotates without interference.

d. The operator will verify that the manual/automatic switch is on automatic, adjust the irradiation timer and depress the START and SAFETY (one at the front and one at the left side) simultaneously and hold until the IRRADIATION POSITION light comes on.

e. The operator will record the data designated in 7.4 in the log.

f. At the end of the exposure time, the chamber will automatically return to the loading position. The key will be switched to the OFF position , removed from the switch and replaced on the hook.

8.2 Emergency Procedures

a. In case of fire, the operator will turn the power keyswitch to OFF, remove the key, retain the key, and exit the building but remain nearby to inform the fire fighters of the existence of the source and its status.

b. The chamber can be manually returned to the load position by inserting the handle stored on the upper shelf of the storage cabinet, into the drive drum. The blind hole for inserting the handle is located in the drum perimeter which is visible in the slot just below the control panel. With the sample chamber in the IRRADIATE position, the hole is on the left-hand side of the drum. By pressing the spring-loaded handle in, and slowly rotating the drum counterclockwise, the chamber can be fully returned to the LOAD POSITION.

c. Should the area monitor indicate a radiation hazard, all employees will immediately evacutae the area. Radiation Control will be notified by using a telephone outside the Blood Bank.

8.3 Emergency Telephone Numbers

Radiation Control Service	764-4420
Security	123 (after hours)
Irradiator Coordinator	764-1274
	764-1270 (after hours)
Hospital Emergency	764-4244

9.0 Administrative Organization

9.1 Irradiation Coordinator

a. The Irradiation Coordinator must be authorized by the Radiation Safety Officer of the University of Michigan to use the licensed material in the source.

b. The responsibilities of the Irradiator Coordinator shall include, but not be limited to the following:

1) Maintain an up-to-date list of persons approved for operating the irradiator. Post the list of approved operators in Room 2D1071.

2) Arrange a training session for new operators prior to and as a condition of use of the irradiator. Maintain a record of their participation in these sessions.

3) Arrange for repairs and maintenance of the irradiator. Preserve pertinent records, diagrams and operations manuals.

4) Oversee procedures and policy revisions.

9.2 Irradiator Operators

a. Each person conducting irradiations must be approved for operating the irradiator by the Irradiator Coordinator.

b. In order to be approved, each person must first attend a training session that includes radiation safety, "hands-on" training in the use of the irradiator, and verbal and written instructions covering normal operating and emergency procedures.

9.3 Radiation Control Service

The Department of Radiation Control Service will oversee the operations program of the irradiator through the following activities:

a. Conduct and document the installation radiation survey of the irradiator prior to the use of the irradiator by the Blood Bank.

b. Assist the Irradiation Coordinator in planning and conducting training sessions for irradiator operators.

c. Assist in emergency situations as needed.

d. Perform required sealed source leak tests at intervals of nominally six months, and in accordance with Radiation Control Service's leak test procedures. Maintain documentation and send copies to the Irradiation Coordinator.

e. Review the irradiator program in conjunction with the University of Michigan's license renewal procedures and whenever the position of Irradiator Coordinator is transferred to another person.

10.0 Training Program for Irradiator Use

Each operator will attend a User Training Class . The content of the Irradiator Users Class will include, but need not be limited to the following topics:

10.1 Principles of gamma radiation
- a. Primary radiation
- b. Leakage and scattered radiation
- c. Attenuation of radiation
- d. Exposure dose rate, absorbed dose, equivalent dose
- e. Effects of shielding distance and time on dose

10.2 Radiation detection and monitoring
- a. Purpose, use and limitations of area film badge monitors
- b. Purpose, use and limitations of personnel monitoring device.
- c. Area monitor: design and use

10.3 The GAMMACELL 1000
- a. Construction
- b. Operation
- c. Review of Operator's Manual
- d. Proper use of irradiator - demonstration and practice
- e. Determining irradiation times - demonstration and practice

10.4 Administrative procedures for routine use
- a. Irradiator Coordinator
- b. Responsibilities of irradiator operators
- c. Radiation Control Service
- d. Documentation

10.5 Radiation safety and emergency procedures
- a. Operational Checks
- b. Emergency Procedures
  - 1) Fire
  - 2) Malfunction
  - 3) Radiation Leak
- c. Security requirements

10.6 Discussion of questions and completion of the "Statement of Training" document.

11.0 Waste Disposal

The sealed sources will be returned to Atomic Energy of Canada, Limited, in the event that it is no longer needed. See Attachment A.

CURRICULUM VITAE

Suzanne Butch
1508 South Boulevard
Ann Arbor, MI 48104

Phone: (313) 764-1274 W
(313) 668-8346 H

Education:

University of Michigan, 1966-70
B.S. in Medical Technology, 1970

Central Michigan University, 1975-76
M.S. in Management and Supervision, 1976

Eastern Michigan University, 1977-79
Courses in the MBA Program

Professional Certifications:

MT(ASCP), 1970
Certification as a Medical Technologist by the American Society of Clinical Pathologists

SBB(ASCP), 1976
Certification as a Specialist in Blood Bank Technology by the American Society of Clinical Pathologists

CLS(NCA), 1980
Certification as a Generalist Clinical Laboratory Scientist by the National Certification Agency for Clinical Laboratory Personnel

CLSp(IH) (NCA), 1980
Certification as a Specialist in Immunohematology by the National Certification Agency for Clinical Laboratory Personnel

CLDir (NCA), 1984
Certification as a Clinical Laboratory Director by the National Certification Agency for Clinical Laboratory Personnel

Employment History:

Univeristy of Michigan Hosptials
Ann Arbor, Michigan 1970-present

Blood Bank Medical Technologist
1970-1973
Blood Bank Supervisor
1973-1977
Blood Bank Chief Technologist
1977-present

InterQUAL, Inc.
Consultant, 1981-82

Education and Experience with Radiation

Radioimmunoassy ---- 8 hours experience 1976
University Hospital Laboratory
Course in the use of sealed sources with emphasis on brachytherapy ---- 8 hours 1985
Course given by: Radiation Therapy
University Hospital

Course in biological effects radiation and radiation protection-- 8 hours 1985
Course given by: Radiation Therpay
University Hospital

Experience with various irradiators: 1985
---- 16 hours

Shepherd Irradiator - Medical Science Building
Panoramic Irradiator, Phoenix Memorial
Laboratory- License # 21-00215-06
Shepherd Irradiator - Willow Run

All irradiators are connected with the University of Michigan.

Continuing Education:

1978
Scientific Products Symposium, May 23, 1978.
Hyland Management Seminar, Newport Beach, CA, June 5-9, 1978.
American Association of Blood Banks Annual Meeting, November 5-9, 1978.
Statistic Course, Eastern Michigan University.
Michigan Association of Blood Banks Annual Meeting, 1978.

1979
Michigan Association of Blood Banks Annual Meeting, September 13-14, 1979. Plymouth, MI.
Immunohematology Workshop, Dade, Southfield, MI, October 3-5, 1979.
American Association of Blood Banks Annual Meeting, Las Vegas, November 2-7, 1979.
American Association of Blood Banks Inspector's Workshop, August, 1979.

1980
American Society for Medical Technology Annual Meeting, St. Louis, MO, June 22-27, 1980.
Performance Planning and Evaluation, October 30, 1980.
American Association of Blood Bank Annual Meeting, November 6-12, 1980.
Michigan Society for Medical Technology, Lansing, April, 1980.
Michigan Association of Blood Banks Annual Meeting, 1980.

1981
Motivational Dynamics, 20 hours, January-February, 1981.
Computer Evaluation, Long Beach, CA, May 18-20, 1981.
Michigan Association of Blood Banks Annual Meeting, September 24-25, 1981.
Finance for Non-Financial Managers, October-November (12 hrs), 1981.
American Association of Blood Banks Annual Meeting, Chicago, IL, October 29-November 4, 1981.
Pre-employment Interviewing 6 hours, December, 1981.
House Officer Presentations, 5.5 hours, January-December, 1981.
Region IV Annual Meeting, Cincinnati, OH, September 30-October 3, 1981.
Michigan Society for Medical Technology Annual Meeting, Plymouth, MI, April, 1981.
American Association of Blood Banks Inspector's Workshop, 1981.
American Society for Medical Technology, Miami, FL., June, 1981.

1982
Effective Listening, University of Michigan Hospitals, HRD. 3 hours, March 4, 1982.
Michigan Society for Medical Technology Spring Meeting, Grand Rapids, MI, April 15-16, 1982.
Current Topics in Blood Banking, Towsley Center for Continuing Medical Education, Ann Arbor, MI, June 2-4, 1982.
American Society for Medical Technology Annual Meeting and Exhibit, Houston, TX, June 19-25, 1982.
Michigan Association of Blood Banks Annual Meeting, September 30-October 1, 1982.
ASMT Region IV Meeting, South Bend, IN, October 21-22, 1982.
American Assocation of Blood Banks Annual Meeting, Anahiem, CA, November 5-11, 1982.

Continuing Education continued

1983
MSMT-Spring Seminar, Flint Michigan, April 28-29, 1983.
Current Topics in Blood Banking, Ann Arbor, Michigan, June 2,3, 1983.
ASMT Annual Meeting Los Angeles California, June 13-16, 1983.
Michigan Association of Blood Banks, Detroit, Michigan, September 15-16, 1983.
ASMT Region IV, Lexington, Kentucky, September 23, 1983.
American Association of Blood Banks, New York City, October 29 - Nov 2, 1983.

1984
MSMT Spring Seminar '84, Battle Creek, Michigan, April 12-14, 1984.
California Blood Bank Systems Annual Meeting, San Francisco, California, April 18-20, 1984.
Current Topics in Blood Banking, Towsley Center, Ann Arbor, Michigan, June 6-8, 1984.
ASMT/AMT Annual Meeting, Kansas City, Missouri, June 22-30, 1984.
Michigan Association of Blood Banks Annual Meeting, Detroit, Michigan, September 13-14, 1984.
Regional Meeting, Dearborn, Michigan, September 26-29, 1984.
American Association of Blood Banks Annual Meeting, San Antonio, Texas, October 19-25, 1984
Michigan Life Savers Conference, Boyne Falls, Michigan, November 8-9, 1984.

1985
Laboratory Professional of Michigan Spring Meeting, Lansing, MIchigan
April 24-26, 1985
Current Topics in Blood Banking, Towsley Center,
Ann Arbor, Michigan, June 5-7, 1985.
ASMT/AMT Annual Meeting, Orlando, Florida
June 7-14, 1985.

Presentations:

Blood transfusion policy - orientation lecture and in-service presentations to the nursing department of University of Michigan Hospitals, 1976-present.

Management topic lecture series, University of Michigan, Medical Technology Program, 1978-1983.

Forging a link between quality control and blood bank education programs. Towsley Center, Ann Arbor, June, 1978.

Blood bank quality control. Josephine Buss Seminar, Marquette, MI, October, 1978.

How to establish a hepatitis surveillance program in your hospital. Towsley Center, June, 1979.

The qualities of an effective supervisor. Towsley Center, June 1980.

How to prepare for blood bank inspection. Towsley Center Workshop, June, 1980-82.

Pre-transfusion sample labeling errors, ASMT Annual Meeting, June, 1980.

Poster Session, AABB Annual Meeting, November, 1980, MABB, September, 1981.

Preventing transfusion errors in the operating room and at the bedside. Towsley Center, June, 1981.

Blood utilization and inventory management, ASMT Annual Meeting, June, 1981.

Trouble shooting the crossmatch, workshop, ASMT Annual Meeting, June, 1981.

Blood bank quality assurance, Region IV Meeting, Detroit, 1980.

Personnel quality assurance, Northwest Ohio Society for Medical Technology, March, 1981.

Detection of fetomaternal hemorrhage, Michigan Association of Blood Banks Annual Meeting, Troy, MI, September 25, 1981.

Personnel quality assurance, Southeastern Michigan Red Cross Blood Program, First Tuesday Lecture Series, October, 1981.

Laboratory aspects of transfusion, American Association of Blood Banks Workshop, November, 1981. Chicago, IL.

Hospital blood use monitoring and blood banking, Seminar, InterQual Inc., Chicago, New York, Houston, Miami and Cleveland, 1981-82.

Presentations cont.:

Performance evaluation and managing the unsatisfactory performer. Ohio Society for Medical Technology Annual Meeting, April 2, 1982.

Type and screen, Flint-Great Lakes Regional Red Cross Update Series, Flint, Michigan, April 8, 1982.

Preparing for a blood bank inspection, Workshop faculty, Towsley Center, Current Topics in Blood Banking, 1981-82.

Laboratory testing and the transfusion of the neonatal patient, Towsley Center, Current Topics in Blood Banking, June, 1982.

Detection and resolution of ABO and Rh typing problems, Workshop Coordinator and Faculty member, American Society for Medical Technology and American Association of Blood Banks, Houston, TX, June, 1982.

Introductory short course in blood banking: Transfusion techniques and quality control in the blood bank, July 27 and 29, 1982. University of Michigan Hospitals.

Report of a transfusion reaction: Case Study, Michigan Association of Blood Banks Annual Meeting, October 1, 1982, Detroit, MI.

Use of enhancement media, Region IV ASMT Meeting, October 21, 1983, South Bend, IN.

Laboratory aspects of transfusion, American Association of Blood Banks Workshop: Safe Transfusion, November 6-7, 1982, Anahiem, CA.

Management case study, CLEC meeting, Chelsea, MI, May 17, 1983.

Detection of fetomaternal hemorrhage, Workshop leader Current Topics in Blood Banking, preconvention seminar, June 1, 1983.

Comparative methods of detecting massive fetomaternal hemorrhage, lecture, Current Topics in Blood Banking, June 2, 1983.

Transfusion and component considerations, lecture, Component Therapy Workshop, Peoria, IL, September 9, 1983.

Detection and nursing management of transfusion reactions, lecture, Component Therapy Workshop, Peoria, IL, September 9, 1983.

Rh Immune Globulin: laboratory aspects, lecture, Michigan Association of Blood Banks, Detroit, MI, September 15, 1983.

Resolution of patient-related technical and administrative problems in the blood bank, Introductory Short Course in Blood Banking, Department of Pathology, University of Michigan, July 28, 1983.

Hemotherapy of the infant and premature: workshop presentation-technical aspects of transfusion, American Association of Blood Banks Annual Meeting, New York, New York, October 28 & 29, 1983.

Presentations cont.:

Simplified protocol for screening Rh immune globulin candidates, Poster Session, Butch, SH and Judd, WJ. American Association of Blood Banks Annual Meeting, New York, New York, November 1, 1983.

Blood components, in the workshop: Blood Transfusion Workshop, Department of Pathology and Educational Service for Nursing, University of Michigan Hospitals, Weber's Inn, Ann Arbor, Michigan, February 3, 1984.

ABO Discrepancies, Indiana State Association of Blood Banks, Indianapolis, Indiana, March 22, 1984.

Microtiterplates, automation, and computerization in the blood bank, Clinical Laboratory Update Series, Detroit Society for Medical Technology, Garden City Osteopathic Hospital, March 28, 1984.

Detection and quantitation of fetomaternal hemorrhage, Kentucky State Society for Medical Technology, Paducah, Kentucky, April 6, 1984.

Fetomaternal hemorrhage: detection and quantitation, California Blood Bank Systems Annual Meeting, San Francisco, California, April 18, 1984.

Visual aids for effective presentations, Towsley Center, Current Topics in Blood Banking, Ann Arbor, Michigan, June 6, 1984.

Implementing changes in blood bank procedures, Towsley Center, Current Topics in Blood Banking, Ann Arbor, Michigan, June 6, 1984.

Inhibition studies, in: The Use of Enzymes, Inhibition and Adsorption Studies in Resolving Serological Problems- A wet workshop, ASMT/AMT Annual Meeting, Kansas City, Missouri, June 28, 1984.

Computers as a management tool, Clinical Laboratory Educational Consortium, Hillsdale, Michigan, September 11, 1984.

Hemotherapy of the infant and premature: workshop presentation - Technical aspects of transfusion, American Association of Blood Banks, San Antonio, Texas, October 20 and 21, 1984.

Chief Technologists' Forum, American Association of Blood Banks Annual Meeting, San Antonio, Texas, October 21, 1984.

Preparation and effective use of visual aids - lecture in workshop Development of Educational Programs, American Red Cross Blood Services Southeastern Michigan Region, Detroit, Michigan, December 12, 1984.

Neonatal and Pediatric transfusions, Gulf Coast Blood Center, Houston, Texas, December 15, 1984.

Presentations continued:

Transfusion techniques: what happens to the blood after it leaves the blook bank?, Milwaukee Association of Blood Banks, Milwakuee, WI., March 22, 1985.

Containing costs within the blood bank: where do I cut the budget?, Milwaukee Association of Blood Banks, Milwaukee, WI., March 22, 1985.

Nobody likes change, Laboratory Professionals of Michigan Spring Meeting, Lansing, MI., April 25, 1985.

Containing cost in the blood bank, Minnesota Association of Blood Banks Spring Meeting, Rochester, MN., May 3, 1985.

Transfusion techniques, Towsley Center - Current Topics in Blood Banking, Ann Arbor, MI., June 7, 1985.

Cost containment in the blood bank: redesigning the workflow, ASMT/AMT Annual Meeting, Orlando, FL., June 11, 1985.

Publications:

Beck, ML, Butch, SH, Armstrong, WD and Oberman, HA. An auto antibody with U-specificity in a patient with myasthenia gravis. Transfusion, 1972, 12:280.

Friedman, BF and Butch, SH. Liven-up your in-service education with your own slide tape program. MLO, Nov., 1976, p. 59.

Butch, SH and Barnes, BA. Immunohematology problem. AJMT, 43:9, 1978, p. 870.

Butch, S, ed., Clinically significant and insignificant antibodies, American Association of Blood Banks, Washington, DC, 1979.

Judd, WJ, Butch, SH, Oberman, HA, Steiner, EA and Bauer, RC. The evaluation of a positive direct antiglobulin test in pretransfusion testing, Transfusion, Jan-Feb., 1980, vol 20:17-23.

Butch, SH. Laboratory aspects of transfusion, In: Safe Transfusion, American Association of Blood Banks, 1981.

LaFerla, JJ, Butch, SH and Cooley, JR. Utilization of specific mixed field agglutination in a case of apparent feto-maternal hemorrhage. AJOG, November 1, 1981.

Butch, SH, Oberman, HA eds. Blood transfusion policies and standard practices of the University of Michigan Hospitals. The University of Michigan, Ann Arbor, Michigan December, 1982.

LaFerla, JJ, and Butch, SH. Fetal Rh blood group determination in pregnancy termination by dilation and evacuation. Transfusion, Jan-Feb, vol 23:1983.

Trudeau, LR, Judd, WJ, Butch, SH, Oberman, HA. Is a room temperature crossmatch necessary for the detection of ABO errors? Transfusion, May-June, vol 23:1983.

Butch, SH, Laboratory aspects, In: Hemotherapy for the Infant and Premature, Keating L and Luban N, eds. American Association of Blood Banks, 1983.

Steiner, EA, Butch SH, Carey JL, and Oberman, HA. Passive anti-D from intravenous immune serum globulin. Transfusion July-August, vol 23:1983.

Judd, JW, and Butch, SH. Cost-containment in the blood bank: eliminating unnecessary serological testing, JMT, 1984, 1:484-495.

Judd, WJ, and Butch, SH. Streamlining serological testing-scientific considerations, In: blood Banking in a changing environment, Smith, DM, and Judd, WJ, eds. American Association of Blood Banks, Arlington, VA, 1984.

Butch, SH. Blood inventory management, Laboratory Medicine, January 1985.

Professional Affiliations:

Michigan Association of Blood Banks - member 1975-present
- Past-president, 1981-1982
- President, 1980-1981
- President-elect, 1979-1980
- Annual Meeting Coordinator, 1975-1976
- Program Committee, 1978, 1981-1985
- Program Committee Chairman, 1977, 1979
- Executive Committee, 1978-1982
- Reporter, Newsletter, 1979-1980
- Nominating Committee, 1982-1984

American Association of Blood Banks - member 1977-present
- Scientific Workshop Committee, 1979-1984
- Inspector, for Inspection and Accreditation Committee, 1977-present
- Committee on Pediatric Hemotherapy, 1984-1985

American Society for Medical Technology - member, 1975-present
- Delegate to the Annual Meeting, 1976, 1980-1985
- Elections Committee, 1976, 1980-1983, 1985
- AJMT, Associate Editor, Immunohematology, 1978-1983

Michigan Society for Medical Technology, member, 1975-present
- Past-president, 1981-82
- President, 1982-1983
- President-elect, 1981-1982
- Scholarship Committee, 1977-1978
- Traveling Seminar Committee Chairman, 1978-1979
- Traveling Seminar Committee, 1980-1981
- Student Bowl Judge, 1978-1983, 1985
- Annual Meeting General Chairman, 1983-84
- Newsletter Editor, 1984-1985
- Hand book Chairman 1983-1985
- Meeting Program Committee 1984-1985

Region IV - ASMT
- Secretary, 1981-1982
- Coordinator of a Workshop, 1980
- Council Chair, 1982-1983, 1983-84
- Meeting Planning Committee, 1984

ASMT Education and Research Fund, Inc., Trustee, 1984 - present

American Society of Clinical Pathologists
- Associate Member, 1982-present
- Question Writer for Proficiency Exam, 1982

International Society for Blood Transfusion
- Member, 1984-present

Society for Hemapheresis Specialists, Ltd.
- Member - 1981-1983

Professional Affiliations cont.:

Washtenaw County League for Planned Parenthood
Member - Medical Advisory Committee, 1981-1984
Board of Directors, 1983-present

National Certifying Agency of Clinical Laboratory Professionals
Question Rater, 1980
Question Reviewer, 1981, 1983
Question Writer, 1982

Clinical Laboratory Education Consortium
Founding Member, 1983-1985

Other Organization Affiliations:

Ann Arbor Jaycee Women, 1980-1984
Treasurer, 1980-1981, 1983-1984
President, 1981-1982
Secretary, 1982-1983

Hospital and Health Service Credit Union
Credit Committee, 1979-present
Personnel Committee, 1981-1983

Ann Arbor Ski Club, 1978, 1981-present

Say Carseats, 1984
Founding Member, 1984-present

Ann Arbor Jaycees, 1984-85

Honors:

Omicron Sigma Award for Service to the American Society for Medical Technology, 1980, 1982, 1983.

Immunohematology/Immunology Scientific Assembly Award for Professional Achievement, 1981.

Keystone Award, for service to the Ann Arbor Jaycee Women, 1981.

Member of the Year Award, Ann Arbor Jaycee Women, 1983, 1984.

Michigan Medical Technologist of the Year, MSMT, 1984.

Certificate of Appreciation, Drunk Driving Prevention Program and Traffic Safety, Washtenaw County Sheriff's Department, September 10, 1984.

Alpha Mu Tau Fraternity, Installation, June, 1984.

National Certification Agency for Medical Laboratory Personnel
1725 DeSales Street, N.W., Suite 403
Washington, D.C. 20036
(202) 429-0149

Here is your NCA Certification Card. It identifies you as a professional whose knowledge and skill has been demonstrated by fulfilling the NCA certification requirements. A certificate is being prepared for all active certificants and will be mailed in four to six weeks.

PLEASE NOTIFY US OF ANY ERRORS IN SPELLING OR ADDRESS. INCLUDE YOUR CERTIFICATION NUMBER ON ALL CORRESPONDENCE.

925933
SUZANNE H. BUTCH
1508 SOUTH BLVD
ANN ARBOR MI 48104

National Certification Agency for Medical Laboratory Personnel

SUZANNE H. BUTCH

CLDir

VALID THROUGH	CERTIFICATION NO.
09/88	925933

Suzanne H. Butch CLS

has successfully completed

the requirements for recertification from

The National Certification Agency for Medical Laboratory Personnel

Valid through:

July, 1986

NATIONAL CERTIFICATION AGENCY FOR MEDICAL LABORATORY PERSONNEL

NCA

1978

Janet M Bayley

President

Suzanne H. Butch CLSp (IH)

has successfully completed

the requirements for recertification from

The National Certification Agency for Medical Laboratory Personnel

Valid through:

July, 1984

Sara Marie Ciarelli

President

CONTROL NO. 79070

Registry of Medical Technologists

of the

American Society of Clinical Pathologists

To Whom These Presents May Come, This Certifies That:

Suzanne Helene Butch

has qualified as a *Medical Technologist* as defined by the Board of Registry of the American Society of Clinical Pathologists. In witness whereof we have affixed our signatures hereto. Effective: this seventeenth day of July, nineteen hundred and seventy.

George Stewart M.D.
Chairman, Board of Registry

Betty R. Murphy MT(ASCP)
Secretary, Board of Registry

Clyde S. Culbertson M.D.
President, American Society of Clinical Pathologists

Harold K. Joyce
Registrar, Registry of Medical Technologists

Atomic Energy
Of Canada Limited

L'Énergie Atomique
du Canada, Limitée

Radiochemical Company

Société radiochimique

413 March Road,
P.O. Box 13500
Kanata, Ontario,
Canada,
K2K 1X8

413 Chemin March,
C.P. 13500
Kanata, Ontario,
Canada,
K2K 1X8

Tel. (613) 592-2790
Telex 053-4162

November 20, 1984

Mr. Ron Salisbury
University of Michigan Hospital
Dept. of Pathology - Blood Bank
1405 E. Ann Street
Ann Arbor, Michigan
U.S.A. 48109

Dear Ron:

This letter will confirm as per our conversation of November 19, 1984, that Atomic Energy of Canada Limited will dispose of any radioactive source sold by us.

I hope the above fulfills your requirements and I look forward to getting together with you again in the future.

Yours truly,

Paul Moses

Paul Moses
Area Manager

PM/lmg

GAMMACELL 1000

OPERATOR'S MANUAL

EDITION 2
MAY 1983
TECHNICAL PUBLICATIONS
DOCUMENT No. IN-J1100-83-04A
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Atomic Energy
of Canada Limited
Radiochemical Company

413 March Road,
P.O. Box 13500,
Kanata, Ontario,
Canada,
K2K 1X8

RECORD OF REVISIONS

EDITION NO.	ISSUE DATE	PAGE NO.
	NOTE	
	The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the pages.	
1	February 1983	Original Issue
2	May 1983	General Revision

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS AND TABLES

PART 1
INTRODUCTION

1.1 GENERAL

This manual describes the operation of the Gammacell-1000 (GC-1000).
The operator is expected to operate the GC-1000 according to this manual. Any unauthorized deviation from the procedures laid down in this manual, can affect the contractual obligations between buyer and seller as pointed out in paragraphs 1.1.1 and 1.1.2.

1.1.1 IMPORTANT NOTICE

(a) Concerning the Manner of Use of GC-1000

Atomic Energy of Canada Limited, Radiochemical Company (AECL-RCC), assumes no responsibility for the use or misuse of the equipment. Since AECL-RCC cannot control the use of this equipment, they shall not be responsible for personal injury or damage resulting therefrom.

The customer is advised
- to operate the equipment according to the instructions contained herein,
- to observe all cautions and warnings,
- to assure the proper maintenance of the equipment,
- to consult local, state and federal regulations, and
- to ensure that only properly instructed personnel is permitted to operate the unit.

(b) Concerning this Publication

Information contained in this publication is subject to change without notice.

AECL-RCC makes no warranty, either expressed or implied, including but not limited to any implied warranties of merchantability and fitness for a particular purpose, regarding this publication, and makes publications such as this available solely on an 'as is' basis. In no event shall AECL-RCC be liable to anyone for direct, indirect, special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of this publication and the sole and exclusive liability to AECL-RCC shall not exceed the purchase price of this material. Moreover, AECL-RCC shall not be liable for any claim of any kind whatsoever against the user of this publication by any other party.

1.1.2 ABOUT THE WARRANTY OF THE EQUIPMENT

An installed GC-1000 is warranted to the original purchaser to be free from defects in materials or workmanship under prescribed service and operating conditions for a specified period from the date of acceptance. AECL-RCC agrees to repair, adjust, or replace -- as AECL determines -- any part or parts found to be defective.

AECL requires that the operator operates the GC-1000 properly as specified in this manual and assures its proper maintenance. Any misuse, modification or alteration of the GC-1000 cancels this warranty. Warranty service can only be provided by AECL-RCC or its authorized representative.

These terms, more expressly stated in Terms and Conditions (of purchase), constitute the sole and exclusive liability of the company and remedy of the purchaser respecting the GC-1000 and is in lieu of all warranties, whether written, oral, implied or statutory including, but not limited to, warranties of merchantability and fitness for a particular

purpose and all other obligations or liabilities either in contract, tort, or otherwise, including negligence. In no event shall AECL-RCC be liable to anyone for direct, indirect, special, collateral, incidental or consequential damages. Moreover, AECL-RCC shall not be liable for any claim of any kind whatsoever against the user of the GC-1000 by any other party. The product life of the GC-1000 under normal conditions of use with scheduled maintenance is expected to be 20 years.

1.2 DEFINITIONS

Warnings, cautions and notes are included in this manual as a means of bringing crucial information to the operator's attention.

WARNING

A WARNING is a statement describing known situations which could result in injury or death of personnel.

CAUTION

A CAUTION is a statement describing known situations which could result in damage to equipment or product.

NOTE

A NOTE is a statement of additional information about situations known to require special attention.

1.3 RELATED PUBLICATIONS

The following publications are available:

- sales brochures
- selected bibliography related to blood irradiation
- Gammacell-1000 Technical Specification (IN/PR 0009 J1100)

1.4 ABBREVIATIONS AND SYMBOLS

Non-standard abbreviations and symbols used in this manual are explained in the text on first mention. For easy reference these non-standard abbreviations and symbols have also been compiled in Table 1-1.

Table 1-1. Non-standard Abbreviations and Symbols

ABBREVIATION/ SYMBOL	DEFINITION
AECL-RCC	Atomic Energy of Canada Limited (Radiochemical Company)
GC-1000	Gammacell-1000 Irradiator
CDR	Central Dose Rate
ICRP	International Commission on Radiation Protection
ADR	Average Dose Rate

PART 2
DESCRIPTION

2.1 GENERAL

The Gammacell-1000 is a self-contained irradiator designed for small biological samples. The unit consists of stationary Caesium-137 doubly encapsulated radiation source permanently secured within the biological shield. The biological shield is mounted on a steel frame and covered with sheet-metal panels for aesthetic purposes. The biological shield contains the sample chamber rotor. By turning the rotor through an arc of up to 180°, the sample chamber is either exposed to or removed from the radiation field. The movement of the rotor is accomplished by an electrical drive assembly mounted on the top of the biological shield. A control panel is located at the top of the front face of the unit. A cross-sectional view identifying all the main components of the unit is shown in Fig. 2-1.

2.2 RADIOACTIVE SOURCE

The radioactive source consists of an array of up to four pencils, Model ISO-1000, containing Caesium-137. The unit comes in four models depending on the number of ISO-1000 pencils used. Table 2-1 lists the unit model, number of pencils and associated nominal activity.

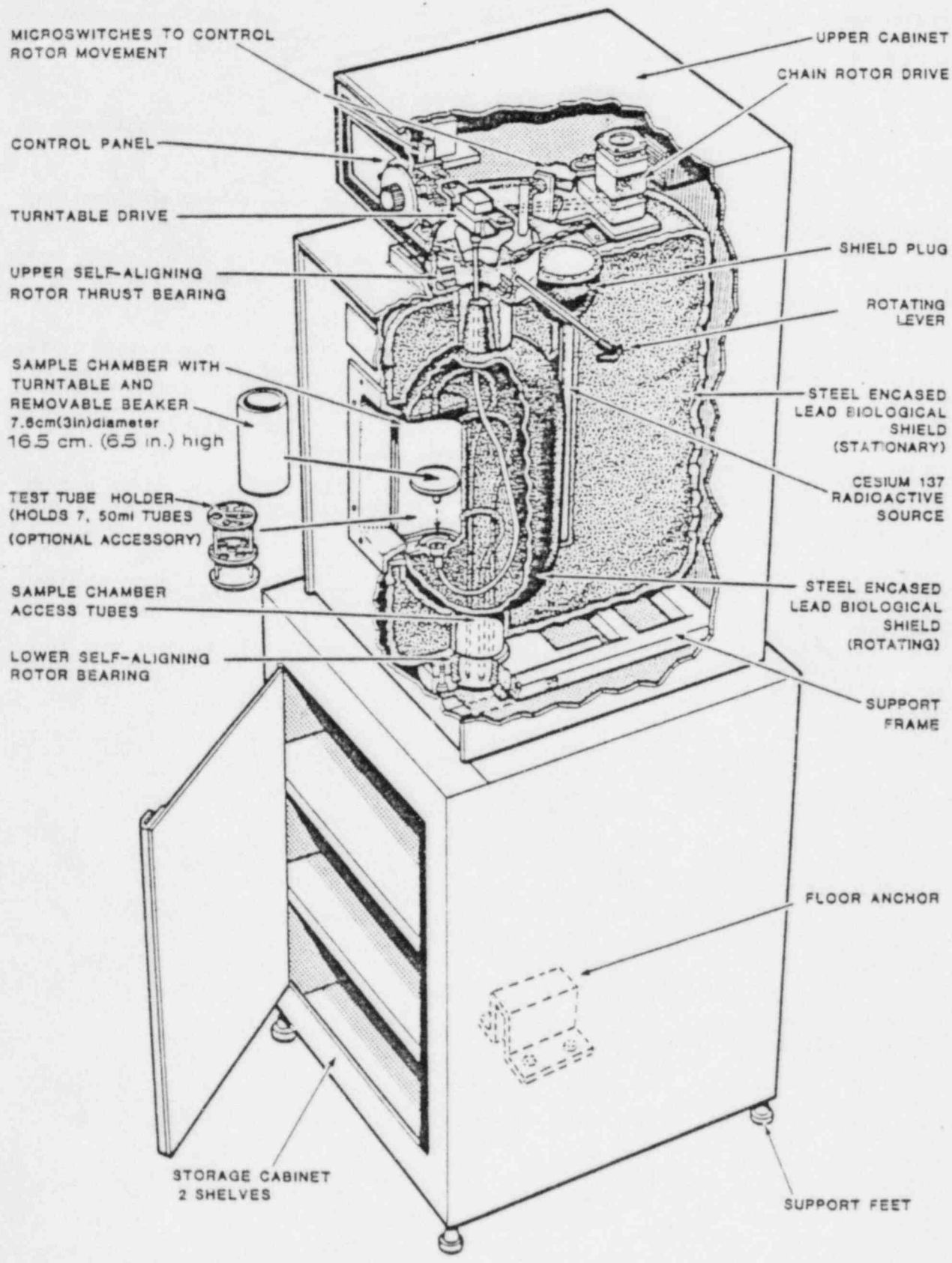

Fig. 2-1. Gammacell-1000 Irradiator

Table 2-1. Gammacell-1000 Radioactivity for Models A,B,C and D

UNIT MODEL	NUMBER OF PENCILS	NOMINAL ACTIVITY [Ci ± 20%]
A	1	600
B	2	1200
C	3	1800
D	4	2400

The radioactive source is stationary and permanently housed within the stator section of the biological shield.

The ISO-1000 pencils consist of Caesium-137, doubly encapsulated in stainless steel.
The Caesium-137 is normally in a form of caesium chloride.

2.3 BIOLOGICAL SHIELD

The biological shield consists of two parts; the stator containing the radiation source, and the rotor containing the sample chamber. Both parts of the shielding are fabricated of lead totally encased in steel jackets. The maximum radiation levels on the outside surface of the fully loaded unit (models) are within the levels specified by ICRP-33 which are summarized in Table 2-2.

Table 2-2. Radiation Leakage Limits

POSITION	RADIATION LEVEL (mrem/h)
5 cm from the surface*	20
100 cm from the source	2

*For this purpose the outside surface of the unit is defined as that of the sheet-metal cabinets.

2.4 CONTROLS AND SAFETY FEATURES

All controls are located at the control panel which is shown in Fig. 2-2.

2.4.1 SAFETY SWITCH (S-5)

The safety switch must be depressed at the same time as the START/STOP switch (S-3) is depressed to the START position. This ensures that both hands of the operator are away from the sample chamber to avoid potential injury.

2.4.2 POWER KEYSWITCH (SW-1)

The keyswitch is a three-position switch (off, on, and momentary). The switch, through its "momentary reset" and "on" contacts activates the control circuitry and primes the unit for use.

2.4.3 POWER RESET LIGHT (WHITE)

This light is turned on by the 'momentary reset' contacts of SW-1. It indicates that the control circuitry is activated and ready. In case of a power failure during irradiation

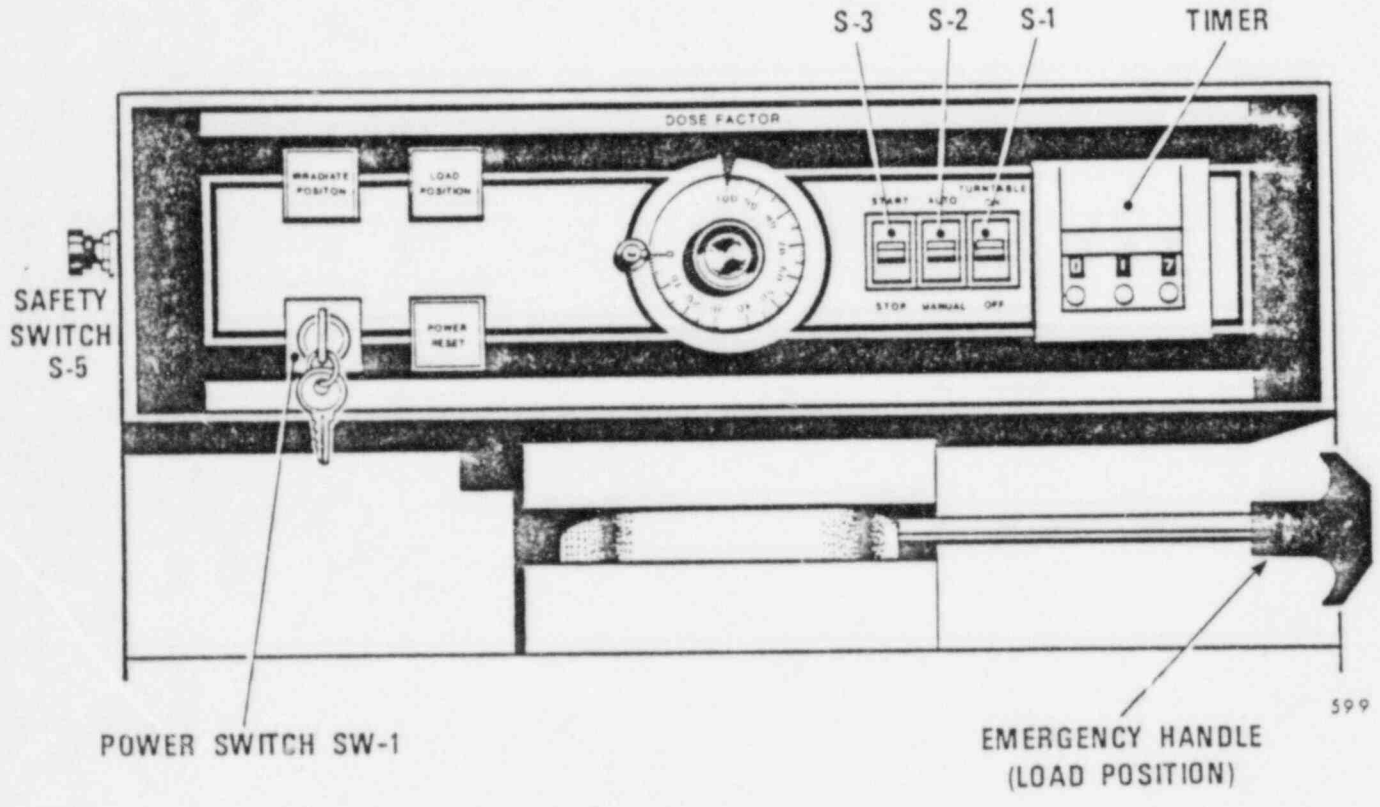

Fig. 2-2. Gammacell-1000, Control Panel

the light goes off, and the sample chamber remains in the irradiate position. The power will not be restored automatically.

CAUTION

This condition could result in overexposure of a sample.

2.4.4 IRRADIATE POSITION LIGHT (RED)

This light, when illuminated, indicates that the sample chamber is exposed to the radiation field.

2.4.5 LOAD POSITION LIGHT (GREEN)

This light, when illuminated, indicates that the sample chamber is out of the radiation field and can be loaded.

2.4.6 VARIABLE DOSE RATE DIAL

This feature allows the operator to apply a lower dose rate to the sample. This is achieved by stopping the sample chamber before the fully irradiate position and thus increasing the distance/shielding factor between the sample and the source array.

The relationship between the guide numbers on the dial (these are not percentages) and the central dose rate is shown in Table 4-2.

2.4.7 TIMER

The timer is internally wired to indicate up to 99.9 minutes in a count-down mode. This means that the desired exposure time is preset on the timer display and when the count reaches zero, the irradiation is automatically terminated.

2.4.8 START/STOP SWITCH (S-3)

Switch S-3 in the START position, together with safety control (S-5) causes the sample chamber to move into the irradiate position. It is used in both the automatic and manual modes of operation. Both switches must be held closed simultaneously until the chamber reaches the irradiate position. The STOP position is used to terminate irradiation.

2.4.9 AUTO/MANUAL SWITCH

This is a selector switch. When switched to MAN, the timer is bypassed and the irradiation period must be terminated by the START/STOP switch (S-3). When the switch is set to AUTO, the irradiation is terminated automatically by the timer.

2.4.10 TURNTABLE SWITCH (S-1)

This switch actuates the turntable inside the sample chamber.

2.4.11 EMERGENCY HANDLE

Should there be a need to retrieve a sample during a power failure, the sample chamber can be returned to its load position manually. For this purpose, the unit is equipped with a handle which, when inserted into the drive drum (visible in a slot just below the control panel), can be used to turn the rotor.

CAUTION

This feature is included to facilitate retrieval of samples. To avoid damage to the equipment, it should not be used under any circumstances for routine operation.

2.5 SAMPLE CHAMBER

The sample chamber is equipped with a turntable and a removable stainless-steel beaker. The combination of the turntable and the beaker ensures that the radiation characteristics of the unit described in Part 4 are attained.

The useable irradiation volume, based on the internal dimensions of the beaker, is 750 cubic centimeters (7.6 cm diameter x 16.5 cm high).

Further, the sample chamber is equipped with three instrumentation access tubes (3/8-inch ID) which terminate at the bottom of the rotor inside the storage cabinet. On the chamber side, one tube terminates at the top, and two terminate at the side wall.

2.6 TEST TUBE HOLDER (optional)

A test tube holder is available with the unit as an option. It is designed to accommodate seven standard 50-ml test tubes. The tube holder may be used to irradiate small liquid samples. It is placed into the sample chamber in the same manner as the standard beaker; i.e., on top of the turntable.

The user is advised to confirm the dose and dose rate distribution within given test samples.

PART 3
OPERATING INSTRUCTIONS

3.1 SWITCHING THE UNIT ON

(1) Ensure that the electrical supply cord (located at the rear of the unit) is plugged into a suitable wall outlet.

(2) Insert the machine key. Turn the power keyswitch to MOMENTARY RESET position, and release it.

(3) Observe that the switch remains in the ON position. The white POWER RESET light and green LOAD POSITION light are illuminated.

The unit is now ready for either manual or automatic control operation.

3.2 LOADING OF SAMPLE INTO THE IRRADIATION CHAMBER

(1) Insert the sample (blood bag) into the beaker provided.

(2) Ensure that there are no parts of the sample protruding outside the edges of the beaker. Tape the sample down, if necessary.

(3) Place the beaker onto the turntable, and set the TURNTABLE switch to ON.

(4) Observe and ensure that the beaker rotates without interference.

CAUTION

Improper loading could cause the beaker not to rotate with consequent non-uniform exposure of the sample.

3.3 VARIABLE DOSE RATE

The variable dose rate feature can be used with either manual or automatic control operation.

(1) Referring to Table 4-2, select the guide number (0 through 100) which corresponds to the desired dose rate.

(2) Loosen the locking screw on the dial (located at 9 o'clock position), and rotate the dial to the selected guide number.

(3) Tighten the locking screw.

3.4 MANUAL CONTROL OPERATION

NOTE

This mode is used only when automatic operation; i.e., 99.9 minutes, would not provide a sufficient dose to the sample.

(1) Ensure that a stopwatch or a suitable clock is on hand.

(2) Load the sample (see 3.2).

(3) Move the selector switch to MANUAL.

(4) Press the START switch and SAFETY switch simultaneously, and hold them until the IRRADIATE POSITION light comes on.

(5) Start the stopwatch or clock.

(6) To terminate the irradiation, push the STOP switch momentarily.

3.5 AUTOMATIC CONTROL OPERATION

(1) Load the sample (see 3.2).

(2) Move the selector switch to AUTO.

(3) Dial the desired irradiation time on the timer by turning the knobs located below each display digit.

(4) Press the START switch and SAFETY switch simultaneously, and hold until the IRRADIATION POSITION light comes on.

WARNING

Failure to keep hand out of the sample chamber while the rotor is turning could result in injury to hands and fingers.

The irradiation is terminated automatically when the timer count reaches zero (00.0).

3.6 EMERGENCY OPERATION

CAUTION

The handle used in an emergency is included to facilitate retrieval of samples. To avoid damage to the equipment, it should not be used under any circumstances for routine operation.

(1) Insert the handle, which is normally stored on the upper shelf of the storage cabinet, into the drive drum. For this purpose, a blind hole is located in the drum perimeter which is visible in the slot just below the control panel. With the sample chamber in the IRRADIATE position, the hole is on the left-hand side of the drum.

(2) Press the spring-loaded handle in, and slowly rotate the drum counterclockwise until the chamber is fully in the LOAD POSITION.

PART 4
RADIATION CHARACTERISTICS

CAUTION

The user is responsible for selecting the correct radiation dose and ensuring that it has been delivered.

4.1 GENERAL

The radiation characteristics of the unit vary with model number and actual radioactive contents. The actual radioactive contents may vary ±20% from the nominal values associated with each model (Table 2-1), hence the central dose rate (CDR) varies accordingly. The actual CDR and the actual radioactive contents (curies) are measured by AECL-RCC for each individual unit and their values are provided to customers in a form of a Measurement Certificate (refer to Appendix A for a sample copy). The dial-a-dose and dose rate distribution values are given as percentages of the CDR. They are not functions of the radioactive content but constants based on the designed configuration of the unit.

NOTE

All information provided on the radiation performance of the unit is for the 'as designed' condition. Therefore, for the data to be applicable, the unit must be used with the beaker and the sample chamber turntable operating.

4.2 CENTRAL DOSE RATE

The central dose rate provided on the Measurement Certificate is measured in air and its location corresponds to the geometrical center of the available irradiation volume.

For liquids (such as a blood bag), which are for all intents and purposes evenly distributed in the beaker, the CDR value in air can be converted to an average dose rate (ADR) to the liquid by the following relation:

Average dose rate = 0.89 x CDR

The CDR and the curie content are functions of time. The rate of Caesium-137 decay with respect to time is shown in Table 4-1. The table lists fractions of the original curie content as a function of time in one-month intervals.

4.3 VARIABLE DOSE RATE

The relationship between the guide number (0-100) and a percentage of a given CDR is shown in Table 4-2. The actual values may vary slightly from unit to unit as a function of manufacturing tolerances. This variation is within ±2 guide numbers from the nominal values shown.

4.4 DOSE RATE DISTRIBUTION

The dose rate distribution in air within the sample beaker with the chamber turntable rotating is shown in Fig. 4-1. It is given as a percentage of a given CDR.

YEARS	Months 0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0
0.00	1.0000	.9980	.9961	.9942	.9923	.9904	.9885	.9866	.9847	.9828	.9809	.9790
1.00	.9771	.9752	.9734	.9715	.9696	.9677	.9659	.9640	.9622	.9603	.9585	.9566
2.00	.9548	.9530	.9511	.9493	.9475	.9456	.9438	.9420	.9402	.9384	.9366	.9348
3.00	.9330	.9312	.9294	.9276	.9258	.9240	.9223	.9205	.9187	.9170	.9152	.9134
4.00	.9117	.9099	.9082	.9064	.9047	.9029	.9012	.8995	.8977	.8960	.8943	.8926
5.00	.8908	.8891	.8874	.8857	.8840	.8823	.8806	.8789	.8772	.8755	.8739	.8722
6.00	.8705	.8688	.8672	.8655	.8638	.8622	.8605	.8588	.8572	.8555	.8539	.8523
7.00	.8506	.8490	.8473	.8457	.8441	.8425	.8408	.8392	.8376	.8360	.8344	.8328
8.00	.8312	.8296	.8280	.8264	.8248	.8232	.8216	.8201	.8185	.8169	.8153	.8138
9.00	.8122	.8106	.8091	.8075	.8060	.8044	.8029	.8013	.7998	.7982	.7967	.7952
10.00	.7937	.7921	.7906	.7891	.7876	.7860	.7845	.7830	.7815	.7800	.7785	.7770
11.00	.7755	.7740	.7725	.7711	.7696	.7681	.7666	.7651	.7637	.7622	.7607	.7593
12.00	.7578	.7564	.7549	.7534	.7520	.7505	.7491	.7477	.7462	.7448	.7434	.7419
13.00	.7405	.7391	.7377	.7362	.7348	.7334	.7320	.7306	.7292	.7278	.7264	.7250
14.00	.7236	.7222	.7208	.7194	.7180	.7167	.7153	.7139	.7125	.7112	.7098	.7084
15.00	.7071	.7057	.7043	.7030	.7016	.7003	.6989	.6976	.6962	.6949	.6936	.6922
16.00	.6909	.6896	.6883	.6869	.6856	.6843	.6830	.6817	.6803	.6790	.6777	.6764
17.00	.6751	.6738	.6725	.6712	.6699	.6687	.6674	.6661	.6648	.6635	.6622	.6610
18.00	.6597	.6584	.6572	.6559	.6546	.6534	.6521	.6509	.6496	.6484	.6471	.6459
19.00	.6446	.6434	.6422	.6409	.6397	.6385	.6372	.6360	.6348	.6336	.6323	.6311
20.00	.6299	.6287	.6275	.6263	.6251	.6239	.6227	.6215	.6203	.6191	.6179	.6167
21.00	.6155	.6143	.6132	.6120	.6108	.6096	.6085	.6073	.6061	.6049	.6038	.6026
22.00	.6015	.6003	.5992	.5980	.5968	.5957	.5946	.5934	.5923	.5911	.5900	.5889
23.00	.5877	.5866	.5855	.5843	.5832	.5821	.5810	.5799	.5787	.5776	.5765	.5754
24.00	.5743	.5732	.5721	.5710	.5699	.5688	.5677	.5666	.5655	.5644	.5633	.5623
25.00	.5612	.5601	.5590	.5579	.5569	.5558	.5547	.5537	.5526	.5515	.5505	.5494
26.00	.5484	.5473	.5463	.5452	.5442	.5431	.5421	.5410	.5400	.5389	.5379	.5369
27.00	.5358	.5348	.5338	.5328	.5317	.5307	.5297	.5287	.5276	.5266	.5256	.5246
28.00	.5236	.5226	.5216	.5206	.5196	.5186	.5176	.5166	.5156	.5146	.5136	.5126
29.00	.5116	.5107	.5097	.5087	.5077	.5067	.5058	.5048	.5038	.5028	.5019	.5009
30.00	.5000	.4990	.4980	.4971	.4961	.4952	.4942	.4933	.4923	.4914	.4904	.4895
31.00	.4885	.4876	.4867	.4857	.4848	.4838	.4829	.4820	.4811	.4801	.4792	.4783
32.00	.4774	.4765	.4755	.4746	.4737	.4728	.4719	.4710	.4701	.4692	.4683	.4674
33.00	.4665	.4656	.4647	.4638	.4629	.4620	.4611	.4602	.4593	.4585	.4576	.4567
34.00	.4558	.4549	.4541	.4532	.4523	.4514	.4506	.4497	.4488	.4480	.4471	.4463

Table 4-1. Caesium-137 Decay Function

Table 4-2. Percentage of CDR as a Function of Guide Number

GUIDE NUMBER SETTING	PERCENTAGE OF CDR FOR EACH MODEL			
	A	B	C	D
100	100	100	100	100
95	99.8	99.8	99.8	99.9
90	99.0	99.2	99.2	99.8
85	97.6	98.0	98.0	99.1
80	95.8	96.3	96.3	97.9
75	93.6	94.3	94.3	96.2
70	91.0	92.1	92.1	94.2
65	88.1	89.4	89.4	92.1
60	85.2	86.6	86.6	89.6
55	82.1	83.8	83.8	85.8
50	79.0	80.5	80.5	79.9
45	76.0	77.1	77.1	72.8
40	72.6	71.9	72.1	65.4
35	69.0	64.0	66.0	58.8
30	64.6	54.2	58.2	52.0
25	59.1	44.2	50.3	45.1
20	49.8	34.2	44.0	38.6
15	34.8	24.1	38.0	33.3
10	23.1	16.2	32.0	28.1
5	15.0	10.0	26.0	23.0
0	9.1	5.9	20.0	17.8

For in-between values, linear interpolations is permissible.

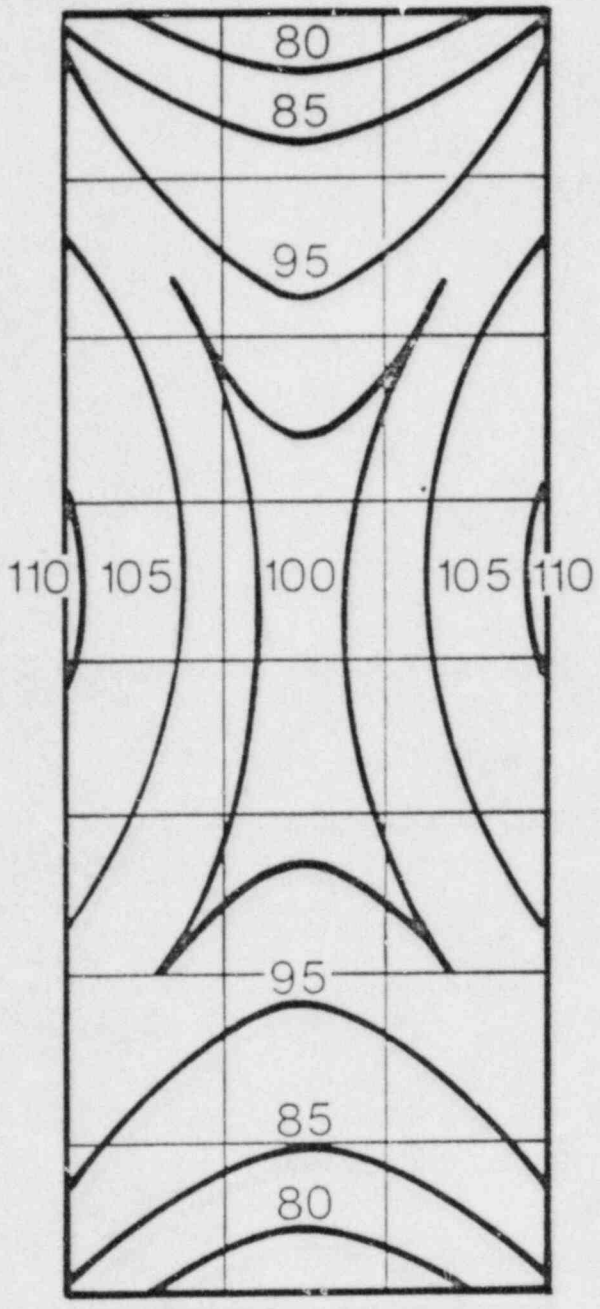

Fig. 4-1. Dose Rate Distribution as a Percentage of CDR

PART 5
PERIODIC MAINTENANCE AND INSPECTION

5.1 GENERAL

The unit, when operated in normal room conditions (room temperatures and no excessive dust), requires minimum maintenance. The unit should be kept in clean condition, and any spills of liquids or powders inside the sample chamber should be cleaned thoroughly and immediately.

CAUTION

Spills of materials inside the sample chamber could result in seizing of the turntable with subsequent loss of the uniformity of exposure to samples.

5.2 PERIODIC LUBRICATION AND INSPECTION

Several moving parts require lubrication, electrical connections require inspection, and electrical switches may require adjustment or replacement.

5.2.1 EVERY 6 MONTHS

For component layout and identification, refer to Fig. 5-1.

(1) Disconnect the unit from the wall outlet.

(2) Remove the top panel of the upper cabinet.

(3) Inspect all electrical connections for looseness.

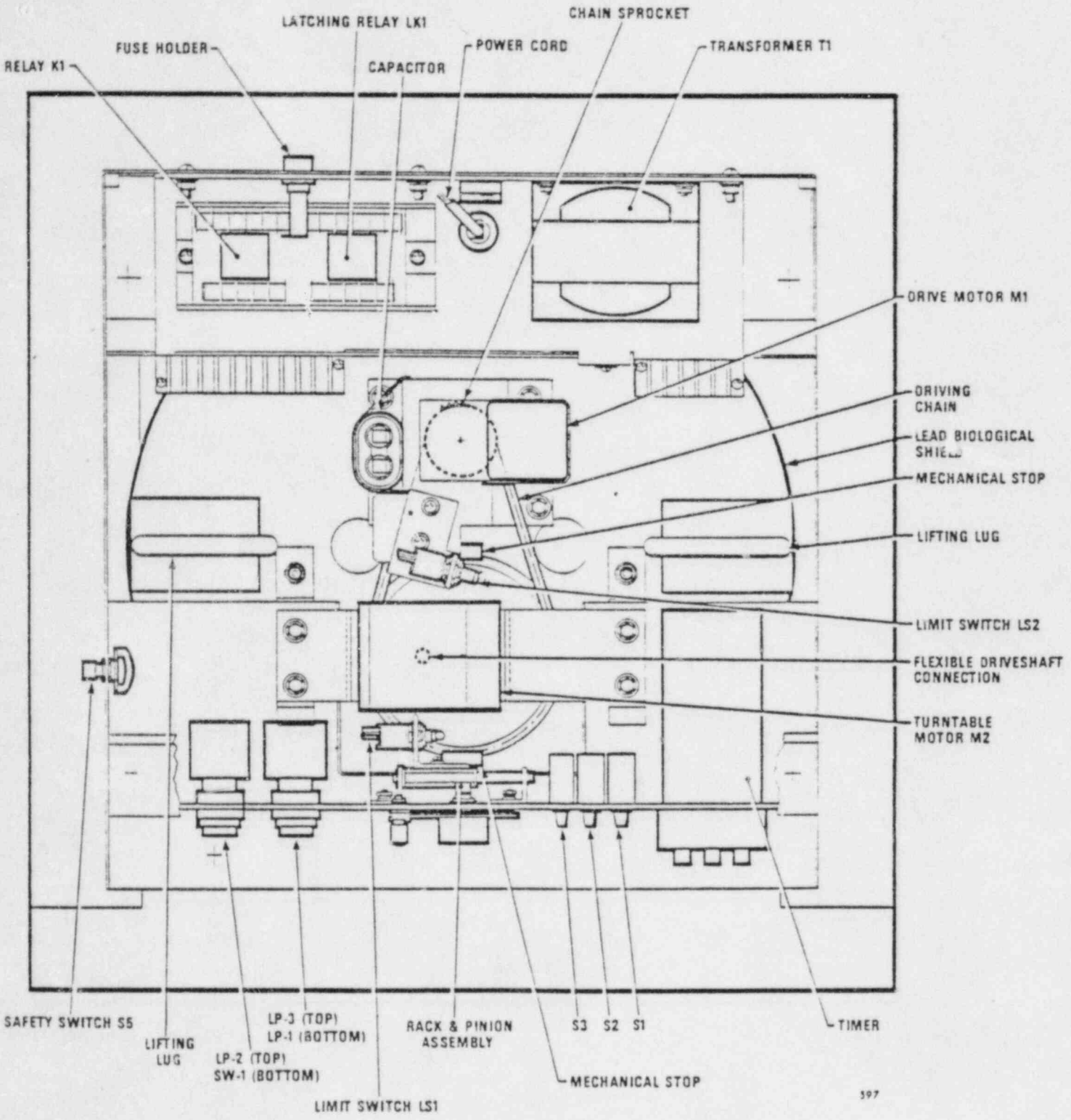

Fig. 5-1. Gammacell-1000 Identification of Control Components

(4) Wipe clean and lightly lubricate (with SAE10 oil) the driving chain.

(5) Wipe clean and lightly lubricate (with SAE10 oil) the rack-pinion mechanism and its guiding rails.

(6) Replace the top panel, and reconnect the cord of the unit to the power outlet.

(7) Switch the unit to manual mode of operation. With the dial-a-dose set at 100, observe the mechanical stops on the drive drum (visible in a slot below the control panel). For both load and irradiate positions the stops should come to a near contact (0.010-inch separation). If "hard" contact is observed at either position, the limit switches (LS-1 and LS-2) must be readjusted.

5.2.2 ANNUALLY

Replace rotor limit switches (LS1 and LS2).

PART 6
CONTAMINATION CHECK

6.1 GENERAL

The installation and use of the GC-1000 are subject to conditions of a license issued by the local regulatory or health authority. A usual condition of such license is a periodic contamination check. Any (real or suspected) contamination must be immediately reported to the local regulatory or health authority and AECL-RCC. Since all accessible surfaces of the unit are by design essentially contamination-free, presence of Caesium-137 on the wipes represents a potentially hazardous situation. Notwithstanding conditions of a license, AECL-RCC recommends that the contamination check is carried out and documented at least every six months.

The following paragraph describes a recommended contamination check procedure and instrumentation requirements.

6.2 REMOVABLE CONTAMINATION

Usually the maximum permissible level of removable radioactive contamination from the unit is 0.050 microcuries from components most likely to be contaminated. (See 6.4.)

6.3 INSTRUMENTATION

Most detection instruments read in counts per minute rather than curies. To convert counts per minute into curies, one must use the following relationship:

Permissible Rate* (c/min) = 0.050 (μCi)/IDE (μCi/min/c)

where IDE is the calibrated instrument detection efficiency for Caesium-137 (beta/gamma).

6.4 WIPE PROCEDURE

(1) Thoroughly wipe the entire surface of the sample chamber cavity with high wet strength material and outside of rotor with sample chamber in IRRADIATE position.

(2) With new piece of material repeat the wipe on the top and bottom of the biological shield.

WARNING

To access the top of the biological shield, the top cabinet panel must be removed. Before the panel is removed, ensure that the power supply cord has been disconnected to avoid electrical shock.

(3) Count all three wipes in the area where there is background radiation only.

If the count rate is below the permissible rate but above background, repeat the test. If same results are obtained, notify local regulatory or health authority and AECL-RCC immediately.

If the count rate exceeds the permissible rate, take the unit out of service and notify the local regulatory or health authority and AECL-RCC immediately. In this case, isolate the unit by covering it with a plastic sheet and close off the surrounding area. Begin monitoring personnel for potential contamination.

*Above background.

PART 7
TROUBLESHOOTING GUIDE

In case the unit or any of its components malfunction Table 7-1 (Troubleshooting Chart) can help identify the cause of the problem and suggests possible corrective actions. Should the problem remain unresolved or be more complex than any of the possibilities listed in Table 7-1, contact AECL-RCC or its authorized representative for further advice.

NOTE

Before proceeding with the steps listed in Table 7-1, ensure that the correct operating procedure, described in Part 3, has been followed.

For component identification and schematic of electrical wiring, refer to Fig. 5-1 and Fig. 7-1.

Table 7.1. Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
POWER RESET light does not come ON	Faulty fuse	Replace
	Burned light bulb	Replace
	Faulty switch (SW-1)	Replace
	Faulty relay (K-1)	Replace
TURNTABLE does not turn	Slipping or worn flexible drive shaft	Tighten set screw on motor shaft Replace
	Faulty drive motor	Replace
	Foreign matter built-up at the bottom of the cavity	Clean up
SAMPLE CHAMBER does not turn	Faulty safety switch (S5)	Replace
	Faulty start switch (S3)	Replace
	Faulty limit switches (LS-1 and/or LS-2)	Replace
	Faulty drive mechanism - broken chain - chain sprocket slipping on the motor shaft - burnt-up motor	 Replace Tighten sprocket set screw Replace
	Faulty latching relay (LK-1)	Replace
	Faulty relay (K-1)	Replace
TIMER not counting	Faulty limit switch (LS-1)	Replace
	Faulty timer	Replace/repair

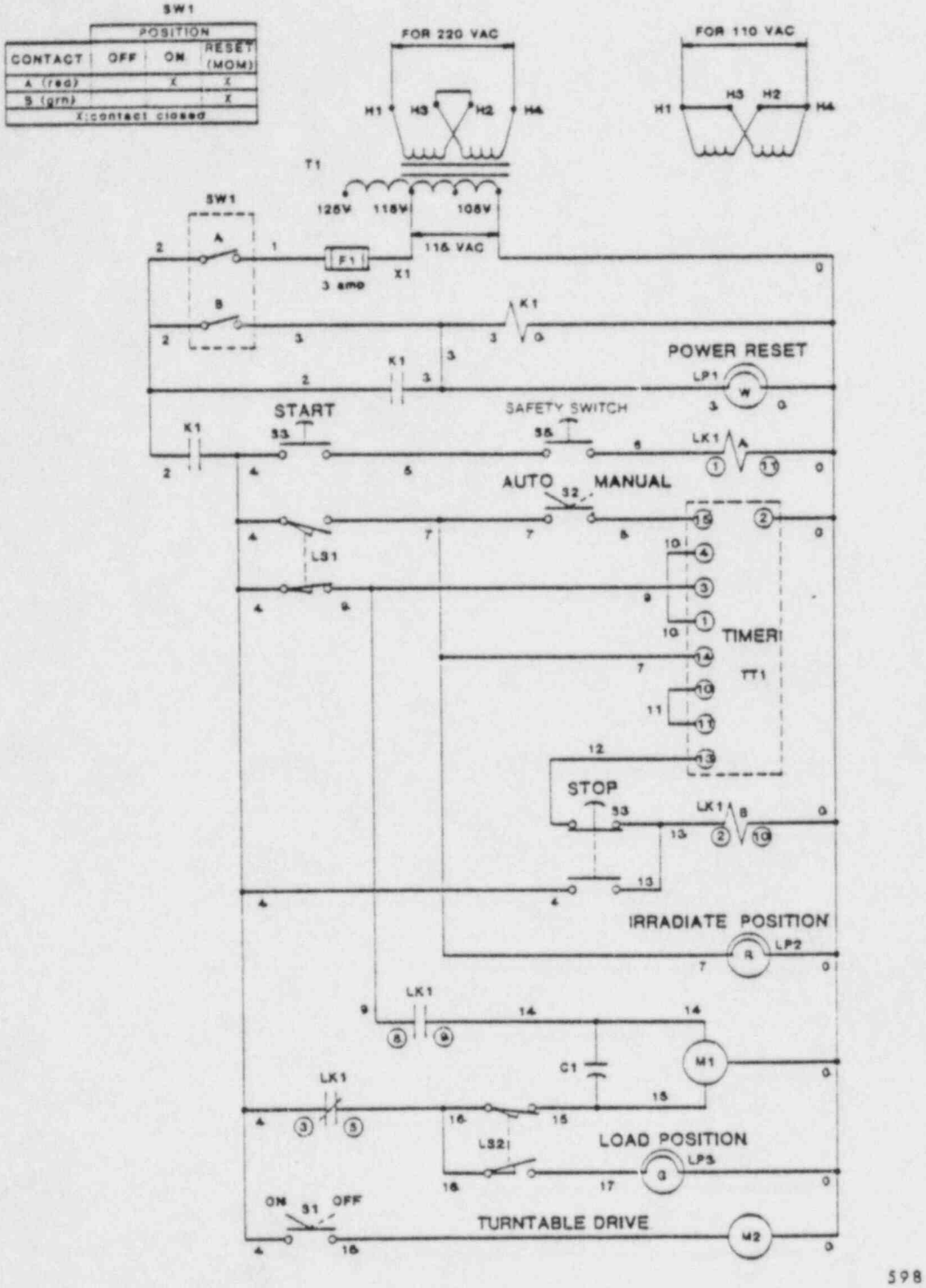

Fig. 7-1. Gammacell-1000 Schematic of Electrical Wiring

APPENDIX A

Certificate Of Measurement

GAMMACELL 1000 No.

This Gammacell is loaded with source no.
containing curies of Cesium-137 in Pencil
( ).

When the dose rate at the centre of the chamber
was measured on , it was:

The dose rate at the centre of the chamber was measured by Ferrous Sulphate dosimetry placed in a stainless steel beaker provided, as per Quality Control Specification QC-16-3516.

Accuracy of estimated dose rate is ± % at the % confidence limits.

ISSUED_____ _____Quality Control

M.T. Antoniades

ATOMIC ENERGY OF CANADA LTD., RADIOCHEMICAL COMPANY,
KANATA, ONTARIO, CANADA

CONTROL NO. 7 9 0 7 0

QUALITY CONTROL SPECIFICATION QA3-2

TITLE: CHEMICAL DOSIMETRY

The absorbed gamma radiation dose rate was measured by Fricke dosimetry (ASTM D1671-63) which is calibrated spectrophotometrically with acidified ferric sulphate at a constant temperature.

QUALITY CONTROL SPECIFICATION QM2 (DG 0295)

TITLE: CAVITY ION CHAMBER.

The photon exposure rate was measured with a cavity ionization chamber which has been calibrated in a cobalt 60 exposure rate certified by the National Research Council of Canada.

QUALITY CONTROL SPECIFICATION QM6

TITLE: NEUTRON MEASUREMENT.

The neutron output was compared to that from a radium: beryllium neutron standard which has been certified by the National Research Council of Canada. A boron trifluoride gas counter in a wax moderator was used.

NOTES:

1. CHAMBER CALIBRATION. All ion chamber calibrations are based on graphite walled ionization chamber measurements of the photon emissions from cobalt 60, and are consistent with the internationally agreed output from radium of 0.825 roentgens per hour at one metre from 1 gram in 0.5 mm platinum.
2. COMPARATIVE MEASUREMENTS. In all comparative measurements identical geometry is used for the source and standard and a standard of similar output to the source is chosen.
3. DISTANCE. All quotations of gamma output are corrected by inverse square law to 1 metre from the reference point on the source. The measurement distance used is large compared to the longest dimension of source or detector.
4. SCATTER. All quotations of photon exposure rate and corresponding curie values have been corrected for the contribution to the reading by the scatter radiation inherent in the measurement position, unless otherwise stated.
5. RADIUM. Sources sealed less than 30 days prior to measurement and which are not at equilibrium are measured several times during the growth period and the maximum value of the output and content extrapolated to the equilibrium value.
6. NEUTRON SOURCES. Note 5 applies to sources of radium: beryllium. The neutron output is also extrapolated to the equilibrium value.
7. THE CURIE. Curie content values have been corrected for self absorption of the photon exposure rate by the source and its encapsulation. Curie effective values are the product of this corrected exposure rate and the appropriate specific gamma ray emission for the isotope.
8. SI UNITS. The curie or rad quantities shown on this certificate may be converted to the special S.I. units, becquerel (Bq) and gray (Gy) using the following factors:

   for activity: 1 curie = 37 gigabecquerels (GBq)
   for absorbed dose: 1 rad = 10 milligrays (mGy)

CONTROL NO. 7 9070