MEDICAL & SCIENTIFIC DESIGNS, INC.

REQUIRED PROCEDURES FOR RADIATION PROTECTION

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C. Rogers
President

Revised February 26, 1982

MEDICAL & SCIENTIFIC DESIGNS, INC.

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MEDICAL & SCIENTIFIC DESIGNS, INC.

REQUIRED PROCEDURES FOR RADIATION PROTECTION

I. PURPOSE

The required procedures contained in this document have been established for the following purposes:

(1) To provide for the protection of Company personnel and of the general public against radiation hazards associated with our possession, use, transportation, and disposal of radioactive material.

(2) To provide for the Company's compliance with applicable regulations of Federal, State, and Local Agencies.

II. AUTHORITY

A. The Radiation Safety Officer receives its authority from the President of the Company.

He is charged with the following responsibilities;

(1) The establishment and continuing review of an adequate radiation protection program.

(2) The Company's compliance with radiation protection regulation promulgated by State, Federal, and Local Agencies.

(3) Providing such services as may be required for radiation protection and compliance with governmental regulations.

The services include the following:

(a) Registration and instruction of radiation workers

(b) Personnel monitoring of radiation exposure

(c) Radioisotope laboratory inspections, radiation surveys, and area monitoring.

(d) Radioactive waste collection and disposal

(e) Calibration and repair of radiation protection instruments

(f) Environmental monitoring

(g) Leak-testing of sealed radioactive sources

(h) Monitoring of shipments of radioacitve material

(i) Supervision of radiation emergencies, and special decontamination operations.

(j) Maintenance of radiation protection records

In addition, the Radiation Safety Officer is available for (a) consultation on laboratory design, shielding, and other radiation exposure control methods, and (b) presenting lectures and training exercises on radiation protection techniques.

B. Each Laboratory Supervisor possessing or using radioactive material or radiation sources is respondible for:

(1) Implementing the Company's radiation protection program

(2) Maintaining an up-to-date listing of the names of personnel who may be handling radioactive material, or who may be exposed to ionizing radiation.

(3) Allowing only those persons listed to handle or use radioactive material and/or radiation sources.

(4) The maintenance of an adequate inventory of the amount of radioactive material possessed by the laboratory, and the establishment of an adequate system to ensure that the laboratory does not exceed its radioactive material possession limits.

(5) Keeping adequate records of disposal of radioactive material.

(6) Allowing only authorized persons to enter rooms that are specified as restricted areas for reasons of radiation protection.

(7) Informing the Radiation Safety Officer of new radioactive material work, or changes in existing work which may increase the possibility of radiation exposure.

(8) Ensuring that personnel wear assigned film badges of pocket dosimeters during periods of possible exposure.

(9) Establishing appropriate procedures to ensure compliance with the Caution-sign and labeling requirements of Section III-K of this document.

(10) Establishing a daily radioisotope-laboratory 'close-down' procedure adequate to ensure that at the end of the work-day:

(a) Survey-meter measurements have established that external radiation and contamination levels are within permissible limits.

(b) Radiation sources are properly labeled and stored.

(c) Experiments that will be in progress after normal work hours, will be properly attended.

(d) Each laboratory is secured against unauthorized access.

(11) Notifying the Radiation Safety Officer when a woman, who is or will be working with a source of ionizing radiation under his supervision is known to be pregnant.

C. Each Individual who may use radioactive material or who may use equipment that emits ionizing radiation, is reponsible for complying with the procedures and precautions contained in this document.

III. REQUIRED PROCEDURES PERTAINING TO RADIOACITVE MATERIAL

A. Scope

These procedures apply to all Company personnel that receive, possess, use, transport or dispose of radioactive material.

B. Exemptions

Except for N.R.C. licensed source material and special nuclear material, the following materials are exempt from these required procedures:

(a) Radioactive material of concentrations not exceeding 1×10^{-6} uCi/ml for liquids, 1×10^{-6} uCi/gm for solids, and 1×10^{-10} uCi/ml for gasses.

(b) Self-luminous radium dials on time pieces or other instruments.

C. Control of Radiation Exposure and Contamination

(1) Exposure to ionizing radiation shall be kept at the lowest practical level.

(2) The external and internal exposure from sources of radiation shall be controlled in such a way as to provide reasonable assurance that no individual shall receive an absorbed dose in excess of the values listed in Appendix I.

D. Compliance with Regulation of Governmental Agencies

The use, storage, transportqtion, and disposal of radioactive material must conform with the applicable regulations of the United States Atomic Energy Commission, the Massachusetts Department of Public Health, and the Massachusetts Department of Labor and Industries.

The applicable regulations are as follows:

Agency	Regulation
N.R.C.	Title 10, Code of Federal Reg. Part 20
Mass. Dept. of Public Health	"Rules and Regulations to Control the Radiation Hazards of Radioactive Material and of Machines Which Emit Ionizing Radiation", Section 5B, Chapter III, General Laws.

Agency	Regulation
Mass. Dept. of Labor and Industries	"Rules and Regulations for the Health Safety of Employees from Occupational Diseases", Industrial Bulletin No. 5.

E. Registration and Authorization

(1) Each person who may handle radioactive material or who may be exposed to external radiation must register with the Radiation Safety Officer and receive a radiation protection instruction interview.

(2) Each user must be approved for a proposed use of radioactive material with specific regard to the adequacy, for the proposed use, of his training and experience with radiation.

F Medical Examinations

(1) Each person registered with the Radiation Safety Officer as a radiation worker shall be given an appropriate examination and/or tests. Depending on the individual's exposure history, such tests as urinary assays, controlled background body-burden measurement, or thyroid measurement may be required.

(2) Appropriate bioassays or other tests will be made in the event that an individual may have been subjected to internal or external exposure.

G. Radiation Surveys and Monitoring

(1) Each laboratory using radioactive material must be provided with appropriate radiation detection instruments that are approved by the Radiation Safety Officer.

(2) During and immediately following the use of radioactive material, personnel shall use an appropriate radiation detection instrument to establish that radiation exposure and contamination-spread are being adequately controlled.

(3) Each radiation worker who may receive a radiation dose in excess of *25% of Section 1 of Appendix 1 will be provided by the Radiation Safety Officer with appropriate film badges and/or bioassay services. *(5% for persons under the age of 18).

(4) When provided, film badges shall be worn in the manner specified by the Radiation Safety Officer whenever occupational radiation exposure may be received. When not being worn, film badges shall be stored in a location where they will receive minimal radiation exposure above background.

(5) Each person on completion of an iodination procedure, will monitor himself for ^{125}I ingestion as follows:

a) Urine Assay: A urine sample (20ml) is taken as a background control before the iodination work. Urine is collected for the 6-hour period after the iodination work, the total volume noted and a 20ml sample counted. If the post- and pre- iodination urine sample differ by more than 200 cpm/20ml, urine is collected for the next 18 hours and the above procedure is repeated. The results should be reported immediately to the Radiation Safety Officer

or

b) If a sensitive gamma rate meter is available, you may monitor your thyroid the morning following the iodination work. If the count is greater than 100 cpm above background, notify the Radiation Safety Officer immediately for a follow-up measurement. Note the CPM on the log sheet.

H. Storage of Radioactive Material

Radioactive material shall be kept or stored in a manner that:

(1) Provides adequate radiation shielding.

(2) Provides adequate protection against fire, explosion, or flooding.

(3) Provides adequate protection against accidental breakage of primary storage containers.

(4) Provides adequate protection against unauthorized removal.

I. Transportation of Radioactive Material

(1) Pedestrian transportation of radioactive material:

Radioactive material may be hand-carried outside of laboratory areas provided that the following conditions are met:

(a) The radioactive material is enclosed in a shatter-proof container that is properly labeled

(b) The emitted radiation dose-rate does not exceed:

200 mrem/hr at any point of readily accessible surface of the container, and

10 mrem/hr at one meter from any point on the radioactive source.

(c) There is no detectable contamination on the container's exterior surface as determined by an appropriate wipe-test and survey-meter measurement of the wipe-test.

(d) During transit, the radioactive material is in the possession and responsible charge of an individual who is authorized to use or to transport the material.

(2) Transportation of radioactive material by mail or by vehicle:

(a) The mailing or transporting or radioactive material shall be done in a manner that is approved by the Radiation Safety Officer as being in compliance with the appropriate governmental regulation (i.e. N.R.C., I.C.C., or Postal regulations.)

(b) Vehicular transportation of radioactive material shall be conducted as follows:

(1) For transportation within Massachusetts, a commercial carrier must be used.

(2) For transportation of N.R.C. licensed material outside of Massachusetts, a commercial carrier must be used.

(3) For transportation outside of Massachusetts of radioactive material other than N.R.C. licensed material, a commercial carrier shall be used unless otherwise specifically authorized by the Radiation Safety Officer.

J. Disposal of Radioactive Material

(1) Radioactive material must be disposed of in accordance with the provisions of Appendix 2.

(2) Incineration of radioactive waste shall not be done.

K. Caution Signs and Labels

(1) Laboratory Posting of Caution-Signs

(a) Each laboratory storing or using radioactive material shall be posted by the Radiation Protection Office with appropriate signs, in conformity with 10 C.F.R. 20, Section 20.203. These signs shall be removed only by, or with the approval of, the Radiation Safety Officer.

(b) Each sign that is posted by the Radiation Safety Officer will contain a section in which emergency-notification-information is to be inserted.

(c) The Radiation Safety Officer shall be notified when posted Caution signs need replacement or removal.

(2) Labeling of Containers:

Each container of radioactive material will be labeled by the user in conformity with the following procedures, which meet state and Federal regulations:

(a) Unless exempted by the Radiation Safety Officer, each container holding radioactive material must have a durable, clearly visible label bearing the radiation caution symbol and the words:

"CAUTION RADIOACTIVE MATERIAL"

(Color and design of label are specified in 10 C.F.R. 20.) These Labels must also state the quantities and kinds of radioactive materials in the containers and the date of measurements of the quantities.

(b) Labeling is not required for laboratory containers, such as beakers, flasks, and test tubes used transiently in the laboratory procedures while the user is present.

L. General Radiation Protection Requirements and Precautions

(1) There shall be no smoking, eating, or storage of food in any area where unsealed and unpackaged sources of radioactive materials are being used, handled, transferred or stored, unless otherwise specifically authorized by the Radiation Safety Officer.

(2) There shall be no mouth pipetting of radioactive solutions.

(3) Whenever practical, the user should perform a trial experimental run using stable (or low activity) material to establish the adequacy of procedures and equipment.

(4) Prior to performing operation on a source of radioactive material, radiation levels will be measured. Handling tongs, or a suitable remote-handling device must be used for handling a source or container which emits a dose rate, at contact, in excess of 1 rem/hr, unless otherwise specifically authorized by the Radiation Safety Officer.

(5) When performing operations that might produce airborne contamination (i.e. evaporations, sanding or grinding transfers of unsealed powdered or volatile radioactive material), approved exhaust ventilation shall be used. When recommended by the Radiation Safety Officer, filtration for effluent air shall be provided.

(6) When hand or clothing contamination is possible, protective gloves and a lab-coat shall be worn during operations involving the handling of radioactive materials.

(7) After handling unsealed radioactive material, hands shall be washed before leaving the laboratory, and exposed skin, hair and clothing shall be surveyed for contamination. The Radiation Safety Officer shall be notified immediately if, after decontamination, residual contamination of skin, hair or personal clothing is detected.

(8) Objects and equipment that may have been contaminated with radioactive material shall be surveyed for exterior surface contamination prior to their removal from a laboratory. If surface contamination is detected, the contaminated object shall not be removed from the laboratory without the authorization of the Radiation Safety Officer.

(9) The Radiation Protection Office shall be notified immediately if any of the following circumstances is known or suspected:

(a) Exposure to external radiation in excess of the values in Appendix I.

(b) Exposure to inhalation, ingestion, or injection of radioactive material.

(c) Accidental release of radioactive material to to laboratory atmosphere, surfaces, drains, or ventilation system.

M. Emergency Procedures

(1) In the event of external exposure in excess of Appendix I, 1-a, or accidental release of radioactive material, the Radiation Safety Officer must be notified immediately.

(2) Emergency procedures to be followed in the event of a radiation contamination accident are specified in Appendix III for the following situations:

(a) Serious injury with contamination

(b) Minor injury with contamination

(c) Contamination incident without injury.

APPENDIX I

I. Maximum Permissible Doses for registered personnel:

(a) Except as provided in paragraph b, radiation doses shall not exceed the following:

	rems per calendar quarter
1. Whole body; head and trunk; active blood forming organs; lens of eyes; or gonads	1.25
2. Hands and forearms, feet and ankles	18.75
3. Skin of whole body	7.5

(b) An individual may exceed (a) 1 provided that it is authorized by the Radiation Safety Officer, and that:

1. During any calendar quarter his whole body dose from all sources of radiation does not exceed 3 rems;

2. The accumulated occupational dose does not exceed 5(N-18)rem, where "N" equals age in years at the individual's last birthday; and

3. There is on file in the Personnel Office an appropriate record (as specified in 10 CFR 20) of the individual's accumulated occupational whole body dose.

II. Maximum permissible doses for minors, and for persons who are not registered:

(a) One-tenth of the values listed in 1(a) of this appendix.

III. The above values in 1. and II are in addition to natural background radiation exposure and radiation exposure administered for medical reasons.

APPENDIX II

LABORATORY DISPOSAL OF RADIOACTIVE WASTES

In order to comply with Title 10, part 20, Sectons 20.303 and 20.106 of the Federal Register, the Company must maintain control of the amounts of radioactivity discharged into the sewerage system, or released to the atmosphere, so that both the required limits on concentration and total activity (per day, and per year) are not exceeded.

The procedures listed below meet Federal regulations and must be followed for laboratory disposal of radioactive wastes.

A. Disposal into Sewerage System

Radioactive wastes must not be discharged into laboratory drains unless special permission has been obtained from the Radiation Safety Officer.

With the special permission noted above, discharge of radioactive wastes into laboratory drains is permitted provided the following conditions are met:

1. The sink or pipe-opening into which the material is to be disposed, has been labeled by the Radiation Safety Officer as being approved for radioactive waste disposal.

2. The radioactive material is readily soluble or dispersible in water.

3. The average concentration of the material being disposed will not exceed, for each nuclide, ten times the value listed in Appendix B, Table 1, Column 2, of Title 10, Code of Federal Regulations, Part 20. (Conversion values are posted by the Radiation Safety Officer on the label that designates that the sink has been approved for waste diaposal.)

4. A record shall be kept of the amount of each nuclide disposed into the laboratory drains, using the forms posted by the Radiation Safety Officer at each approved sink. The record forms are collected periodically by the Radiation Safety Officer.

5. Unless otherwise authorized by the Radiation Safety Officer, the discharge from each building shall not exceed 1 millicurie of total activity per week.

B. Disposal into Waste Collection Containers

All radioactive waste not discharged into the laboratory drains shall be put into special collection containers (solid or liquid) supplied according to the following rules:

1. General Rules:

a. The total amount of radioactive material put into any container must be controlled so that the radiation level at one foot from the container is less than 5 mrads/hr, and the radiation level at contact with any surface of the container is less than 200 mrad/hr.

b. Material must not be put into the waste collection containers if there is any possibility of a chemical reaction during storage that might cause fire or explosion, or cause the release of chemically toxic or radioactive gases. Solutions must be adjusted to pH 4-10 prior to disposal into a liquid-waste container.

c. Animal tissue, excreta, or material containing aflotoxin, live viruses, etc., shall not be put into a radioactive material waste collection container, unless the procedure has been specifically authorized by the Radiation Safety Officer. Special disposal procedures must be arranged with the Radiation Safety Officer prior to the start of work that will produce this kind of waste material.

d. A record must be kept of the quantity and kinds of radioactive material disposed into each collection container.

e. When a container is full* or its emitted radiation is approaching the limits specified in 1.a., the Radiation Safety Officer shall be notified.

2. Specific Rules for Disposal into "Solid Radioactive-Waste" Collection Containers:

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*A liquid waste container for aqueous solutions must not be filled greater that about one-half of its capacity. The remaining void is needed for solidifying the liquid.

a. Do not put liquids into a collection container designated for solid waste.

b. Put powdered material into a metal or plastic container that is sealed prior to disposal.

c. Prior to disposal, put hypodermic needles (or other sharp objects) inside shatterproof containers.

3. Specific Rules for Disposal into "Liquid Radioactive-Waste" Collection Containers:

a. Do not put solid objects, including test-tubes and bottles, into a liquid-waste collection container.

b. Put organic radioactive-waste solution (including contaminated scintillation solutions) into containers that are specifically designated for the collection of such solutions.

c. Put aqueous radioactive waste into containers that are designated for the collection of aqueous waste.

4. The Radiation Safety Officer must be notified prior to the start of work which will produce radioactive waste material not covered by the above regulations.

C. Release of Radioactive Material into Ventilation Exhaust Systems

1. Unless otherwise authorized by the Radiation Safety Officer the 24-hour average concentration of radioactive material entering the duct system of each laboratory must not exceed the limits of Appendix B, Table II of 10 C.F.R. 20.

2. The Radiation Safety Officer must be motified immediately if there is a release into the environs of airborne radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed the limits specified for such material in Appendix B, Table 11, 10 C.F.R. 20.

3. Determinations of the average concentration of radioactive material may be made with respect to the point where the material leaves the exhaust duct. Concentrations may not be averaged over a period longer than one day, without prior authorization of the Radiation Safety Officer.

APPENDIX III

EMERGENCY PROCEDURES FOR A RADIATION CONTAMINATION INCIDENT

1. SERIOUS INJURY WITH CONTAMINATION INVOLVED

   A. Notification: (any time of day)

      1. Dial 871-4442 and ask for Dr. George Parsons, or Mark Muenze, during working hours; otherwise Dr. Parsons 646-9309, or Mr. Muenze 934-6378.

      2. Tell them:

         (a) Somebody has been seriously injured at Medical & Scientific Designs, Inc.

         (b) Radioactivity is involved.

         (c) Your name.

   B. Care of the injured:

      1. Apply first aid, if necessary.

      2. Stay with the patient until help arrives.

   C. Contamination control procedures while waiting for help:

      1. For a localized non-volatile liquid spill:

         (a) Rope off or guard spill area against re-entry.

         (b) Assemble potentially contaminated persons in one locations of laboratory and monitor them for contamination.

         (c) Wait for Radiation Safety Officer to arrive.

      2. For a release of powdered volatile-liquid, or gaseous activity:

         (a) Evacuate personnel immediately, turning off any laboratory apparatus that needs constant attention.

         (b) Assemble personnel immediately outside the room and instruct them to stay in one location, to prevent the spread of contamination.

(c) Close and lock the room doors to prevent re-entry. If the hood fans are off, try to seal accessible openings into the laboratory to prevent further escape of airborne activity into the corridor.

(d) Isolate the adjacent corridor against traffic, and spectators.

II. MINOR INJURY WITH CONTAMINATION INVOLVED

A. Notification:

1. During work hours:

(a) Call 871-4442 and ask for Dr. George Parsons or Mark Muenze

2. After work hours:

Dr. Parsons 646-9309, Mr. Muenze 934-6378

3. Tell them:

(a) Radiation contamination incident at MSD with minor injury.

(b) Your name.

B. Care of the injured:

1. Measure clothing for contamination

2. Remove significantly contaminated clothing, and, if necessary, clothe patient in an uncontaminated laboratory coat.

C. Contamination control procedures:

Same procedures as 1.C., above.

III. CONTAMINATION INCIDENT WITHOUT INJURY

A. Notification:

Same procedures as II.A., above.

B. Contamination control procedures:

Same procedures as I.C., above.

STANDARD OPERATING PROCEDURE

PORTABLE SURVEY METER CALIBRATION

Appendix A

PURPOSE

To establish a routine procedure for calibration of all portable survey meters.

To assure compliance with government regulations.

SCOPE

As of 3/1/82, this includes:

Ladlum 177 Alarm ratemeters with 44-3 gamma scintillation probes.
(1) Ludlum Model 3 Survey meter with Model 44-7 Thin Wall G/M probe.

PROCEDURE

1. Calibration is to be performed at least twice yearly by the Health Physicist. All calibration, service and performance records are to be maintained by the Health Physicist.

2. Ludlum Maintenance

   a. Batteries are to be tested for proper operation using battery test switch on front panel of survey meter. Scale needle should move to "Battery OK" position when switch is pressed. Remove cover and check for battery spillage at least every six months.

      Cords are to be inspected for fraying or loose connections. If the survey meter shows a high count rate when the cord is moved, in the absence of any source of radiation, the cords shall be replaced and the meter rechecked.

      Replacement batteries and cords shall be kept on hand for emergency use.

3. Calibration

a. Measurements are to be taken in an open area away from all sources of radiation. Measurements are made with Ludlum 177 and 44-3 gamma scintillation probe on a piece of cardboard or a cardboard box to reduce scattered radiation. Air attenuation is assumed to be minimal.

b. Ludlum 177 is set to operate, A.C. is on, Background subtract is off, response is set to Slow. Before starting calibration, make certain that plastic cover to probe is free from any radioactive contamination. Remove and clean with soap and water, if necessary.

c. An 129I 0.1 uCi source is used for the calibration. Individual calibration controls for each range are located on the front panel of the survey meter. Readings are adjusted by turning the calibration control set screws in small increments until desired reading is located.

Readings are taken at the probe surface and at regular distance from the probe, 1", 2", 4", 8" etc.. Two reading should be obtained for each scale, X1000, X100, X10, X1. Care should be taken to insure that the source remains an even height from the probe at varied distances.

d. Readings are checked to see that they follow the inverse square law. That is, the radiation from a point source is inversely proportional to the square of the distance from the source to the detector (probe).
The % efficiency of the meter is calculated by

$$\text{cpm of } {}^{129}\text{I source at surface of probe} \div 2.22 \times 10^{5} \text{ dpm for 0.1 uCi}$$

e. Results of the calibration are to be entered on the form provided and maintained on file by the MSD representative. This form shall note: date of calibration, person performing calibration, source used, natural background of survey meter, meter readings at varied distances and scales, adjustments to scales, % Efficiency of meter based on source dpm.

f. A calibration certificate shall be attached to each survey meter after each calibration stating;

This instrument was calibrated by _____

on _____. Normal Background is _____.

Efficiency based on a 0.1 uCi of ^{129}I is _____%.

STANDARD OPERATING PROCEDURE

RADIOACTIVITY COUNTER MAINTENANCE AND STANDARDIZATION

Appendix B

PURPOSE

To establish a routine procedure for standardizing radioactive counter efficiencies in order to insure consistent performance of all counting equipment.

To assure compliance with corporate and government regulations.

To provide personnel with operating information and counter performance standards.

SCOPE

All radioactivity counting equipment. As of 2-15-82. These include:

(1) Abbott Autologic Model 111B

PROCEDURE

1. Apparatus: The following standard sources are used to calibrate counters and calculate efficiencies:

   NEN ^{137}Cs rod source 7.0 uCi
   NEN ^{57}Co rod source 0.138 uCi
   NEN ^{129}I simulated ^{125}I rod source 0.1 uCi

2. All counters are checked weekly for efficiency and background under the supervision of the Health Physicist. The tracer production gamma counter is to be checked daily.

   Counters are calibrated for optimum window seetings monthly, using methods recommended by the manufacturuer.

3. Gamma Counter Calibration

   Counters are standardized for ^{125}I. NEN ^{129}I simulated ^{125}I 12x75mm tube sources are counted for linearity. Standards are counted for one minute and % efficiency is calculated at net CPM of standard ÷ known dpm of standard X 100.

   Monthly calibration of counters is made using the ^{137}Cs sources to adjust the pulse height analyzers and voltage. The gamma ray spectrum is plotted for ^{125}I and ^{57}Co to assist in selecting the proper window settings.

STANDARD OPERATING PROCEDURE

HOODS, AIR FLOW AND MAINTENANCE

Appendix C

PURPOSE

To establish a routine procedure for measuring hood air flow rates.

To establish a maintenance schedule and procedure for blower, lights and other hood components.

SCOPE

All hoods in use at Medical & Scientific Designs, Inc. As of 3/1/82, this includes:

(1) Custom iodination hood supplied by Atlantic Nuclear

PROCEDURE

1. Air Flow

Measurements of the flow rates are made for each hood on a monthly schedule by the Health Physicist. A velometer is placed in the center of the hood sash at the front of the hood and readings are taken at various sash openings. Readings are recorded in a log book and records are maintained by the Health Physicist.

If the face velocity of any hood should drop below 100 feet per minute, the hood shall be closed from use and serviced.

Radiation lab hood charcoal filters are to be changed by the Health Physicist in accordance with Health Physics procedures.

2. Maintenance

Hood motors and fan bearing are to be lubricated on a regular preventive maintenance schedule.

4. Liquid Scintillation Counter Calibration

Counters are standardized for tritium. Efficiency is determined by the Internal Standardization method or by the channels ratio method. Using the Internal Standardization method, a sample is counted, then a known amount of activity (dpm) from the NEN calibration compound is added to the sample and it is recounted. The incremental increase in the count rate is used to compute the counter efficiency for the sample. % Efficiency = incremental increase in count rate ÷ activity of internal standard (dpm) x 100.

A quench curve drawn by using a ratio of two counting channels is also used to calculate efficiency. The quench curve is to be used for placing samples within an indexed range by plotting the ratio of two channels vs. the % efficiency. Personnel using liquid scintillation counters are instructed in the use and construction of quench correction curves by the Health Physicist.

5. Record Keeping

Operating efficiences, optimum window settings and quench curves are posted on each counter. Values of standards in each counter are entered in the radioactivity counter log book. All records and related instructional material are maintained by the Health Physicist. Personnel using counting equipment are immediately notified of any counter malfunction of fluctuation in performance. Counters are recalibrated immediately following any required service before returning them to normal use.

6. Service

All radioactivity counters are maintained appropriately according to manufacturers specifications. Service is performed only by a representative of the manufacturer. All service records are maintained by the Health Physicist.

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

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

0301 9645
03214
7/87

LICENSE FEE TRANSMITTAL

A. REGION 1

1. APPLICATION ATTACHED

Applicant/Licensee: Medical & Scientific Designs, Inc.

Application Dated: 6-24-87

Control No.: 107465

License No.: 20-19999-01

2. FEE ATTACHED

Amount: $460.00

Check No.: 15487

3. COMMENTS

Signed SLJ

Date 6-30-87

B. LICENSE FEE MANAGEMENT BRANCH

1. Fee Category and Amount: ~~3A~~ 3B $460

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

Amendment _____

Renewal ✓

License _____

Signed J. Kimberley

Date 7/9/87

REGION I FORM 213
(MARCH 1987)