Mallinckrodt, Inc.

675 McDONNELL BLVD • P.O. BOX 5840 • ST. LOUIS, MO. 63134 • (314) 895-2000

December 19, 1985

Dr. Bruce Mallett
U.S. NRC
Region III
799 Roosevelt Rd.
Glen Ellyn, IL 60137

Dear Doctor Mallett:

Please amend our Nuclear Pharmacy Materials License No. 24-04206-07MD with the following changes:

1. We would like authorization to redistribute unused Mo-99/Tc-99m generators. All generators to be redistributed will have been obtained from a manufacturer authorized to distribute them in accordance with a license issued pursuant to 32.73 of 10 CFR, Part 32 or under equivalent regulations of an Agreement State. Unused generators will be redistributed without altering the manufacturer's packaging.

2. In our license application, dated July 3, 1984, (page 16), we specified model numbers for all the instrumentation in the pharmacy. We do not want to be locked into the model numbers listed in the license application. At any given time we will have in our possession and available for use the following required equipment: a low-level survey meter (capable of detecting 0.1 mR/hr), a high-level survey meter (capable of detecting 1 R/hr), dose calibrator to assay radiopharmaceuticals and a sodium iodide well counter with a single or multi-channel analyzer.

3. Replace SOP-DIS-03, dated August 3, 1985, with revised copy of our Standard Operating Procedure DIS-03, dated November 20, 1985. The following changes have been made to the SOP:

   a. Survey instruments will be calibrated annually.

   b. Nuclear Medicine Associates in Cleveland, Ohio has been added as an instrument calibration firm.

   c. Multichannel analyzer efficiency will be determined on a quarterly basis and after repair.

   Dose calibrator constancy will be entered into a log book rather than graphed.

   Dose calibrator linearity will be entered into a log book and compared to source activity -- values will not be graphed unless they exceed ±5%.

RECEIVED
'85 DEC 30 A11:15
REGION III

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DEC 23 1985
REGION III

Application Fee Collected
Check No. 018907 $150
Amount Fee Collected
Type of Fee annual
Date Check Rec'd 12/30/85
Received By

8604040236 860130
REG3 LIC30
24-04206-07MD PDR

DEC 23 1985

CONTROL NO. 80384

Mallinckrodt, Inc. Diagnostic Imaging Services Pharmacy
9455 Midwest Avenue
Garfield Heights, OH 44125

HOSPITAL: Children's Hospital

PROCEDURE: Generator

RADIOPHARMACEUTICAL: Mo-99/Tc-99m Generator

DATE: 11-13-83	R NUMBER: 111111
LOT NUMBER: G063	ASSAY: 3 Ci/generator
DOSE REQUESTED: 1 Generator	AT (CAL.TIME): 1200 noon 11/6/85
VOLUME DISPENSED: 1 Generator	ACTIVITY DISPENSED: 0.661 Ci
DOCTOR: Casey	PRICE: $
FILLED BY:	MISCELLANEOUS CHARGES: $
PATIENT: MD Use	PURCHASE ORDER NUMBER:

Caution: To be used under the direct supervision of a physician

SPECIAL INSTRUCTIONS:

generator

WARNING: This [redacted] is licensed by the U.S. Nuclear Regulatory Commission for distribution to persons licensed pursuant to 35.14 and 35.100 Group III of 10 CFR Part 35, or appropriate, or under equivalent licenses of Agreement States. Vial or syringe containing drug should be kept in this container or within heavier shield.

ORIGINAL

Mo-99/Tc-99m Generator

DATE 11-13-85	R NO 111111
CAL. TIME 1200	VOL. 1 Generator
EXP. TIME 11-20-85	ACTIVITY 0.661 Ci

DOCTOR Casey
HOSPITAL Children's Hospital
ADDRESS 125 DeSoto Street
PATIENT MD Use

CAUTION: Federal law prohibits dispensing without a prescription

Mallinckrodt, Inc. Diagnostic Imaging Services Pharmacy
9455 Midwest Avenue
Garfield Heights, OH 44125

CAUTION
RADIOACTIVE MATERIAL

Mo-99/Tc-99m Generator

DATE 11/13/85	R NO 111111
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DOCTOR Casey
HOSPITAL Children's Hospital
ADDRESS 125 DeSoto Street
PATIENT MD Use

CAUTION: Federal law prohibits dispensing without a prescription

Mallinckrodt, Inc. Diagnostic Imaging Services Pharmacy
9455 Midwest Avenue
Garfield Heights, OH 44125

CAUTION
RADIOACTIVE MATERIAL

Rx No. 111111

CAUTION
RADIOACTIVE MATERIAL

Mallinckrodt, Inc. Diagnostic Imaging Services Pharmacy
9455 Midwest Avenue
Garfield Heights, OH 44125

HOSPITAL
Children's Hospital

PROCEDURE
Generator

RADIOPHARMACEUTICAL
Mo-99/Tc-99m Generator

DATE	R NUMBER
11-13-83	111111
LOT NUMBER	ASSAY
G063	3 Ci/generator
DOSE REQUESTED	AT (CAL. TIME)
1 Generator	1200 noon 11/6/85
VOLUME DISPENSED	ACTIVITY DISPENSED
1 Generator	0.661 Ci
DOCTOR	PRICE
Casey	$
FILLED BY	MISCELLANEOUS CHARGES
	$
PATIENT	PURCHASE ORDER NUMBER
MD Use	

Caution: To be used under the direct supervision of a physician

SPECIAL INSTRUCTIONS:

generator

WARNING: This [illegible] is licensed by the U.S. Nuclear Regulatory Commission for distribution to persons licensed pursuant to 35.14 and 35.100 Group III of 10 CFR Part 35, as appropriate, or under equivalent licenses of Agreement States. Vial or syringe containing drug should be kept in this container or within heavier shield.

DEPARTMENT COPY

Mallinckrodt, Inc. Diagnostic Imaging Services Pharmacy
9455 Midwest Avenue
Garfield Heights, OH 44125

HOSPITAL
Children's Hospital

PROCEDURE
Generator

RADIOPHARMACEUTICAL
Mo-99/Tc-99m Generator

DATE 11-13-85	R NUMBER 111111
LOT NUMBER G063	ASSAY 3 Ci/generator
DOSE REQUESTED 1 Generator	AT (CAL. TIME) 1200 noon 11/6/85
VOLUME DISPENSED 1 Generator	ACTIVITY DISPENSED 0.661 Ci
DOCTOR Casey	PRICE $
FILLED BY	MISCELLANEOUS CHARGES $
PATIENT MD Use	PURCHASE ORDER NUMBER

Caution: To be used under the direct supervision of a physician

SPECIAL INSTRUCTIONS:

generator

WARNING: This [illegible] is licensed by the U.S. Nuclear Regulatory Commission for distribution to persons licensed pursuant to 35.14 and 35.100 Group III of 10 CFR Part 35, as appropriate, or under equivalent licenses of Agreement States. Vial or syringe containing drug should be kept in the container or with in heavier shield.

PACKING SLIP

4. SOP-DIS-06, dated July 3, 1984, has been revised to add the option of sending waste to Mallinckrodt's radiopharmaceutical manufacturing plant for ultimate disposal. In addition, Item 11. Waste Disposal has also been revised. The revised copies are attached.

5. SOP-DIS-08, dated July 3, 1984, has been revised to take out statements which exceeded regulatory requirements for personal contamination surveys. The revised copy is attached.

6. SOP's DIS-07 and DIS-09 have been revised to reflect the procedures published in Appendix N of Regulatory Guide 10.8, Revision 2. Copies of the revised SOP's are attached.

7. Air monitoring procedures have changed in the pharmacy. The computations for calculating activity in the stack effluent and room air have been computerized. Attached is the revised SOP-DIS-15.

8. The packaging and transporting procedures have been revised to reflect a new bill of lading. Procedures are attached.

9. General Rules for the Safe Use of Radioactive Materials (Item 10g. of the license application) have been revised to reflect the actual procedures for assaying doses. Item 6. has been revised to correspond to procedures actually followed in the pharmacy. A revised copy is attached.

10. The product storage and waste rooms are now vented through the glove box stack. Air flow measurements are attached. We will store Xenon-133 in the product storage room from now on, rather than storing it with the liquid I-131 in the glove box.

All attachments are numbered and titled to replace the corresponding pages in our license application, dated July 3, 1984. If you have any questions regarding this amendment, please contact me at (314) 895-2407.

Sincerely,

Kathleen H. Quenelle
Manager, Regulatory Compliance
Diagnostic Imaging Services

Richard J. Costic
Director
Diagnostic Imaging Services

KHQ/lm
attach.

Attachments: Generator Labels
DIS-03
DIS-06
Item 11
DIS-08
DIS-07
DIS-09
DIS-15
Item 10o
Item 10g
Xenon calculations

Mallinckrodt, Inc.
Diagnostic Imaging Services
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Xenon-133 Calculations

2. Accidental Release of Xenon-133 in Pharmacy Area.

Assumptions

- Maximum activity/vial = 20 mCi
- Any reasonable accident would involve 1 vial of 20 mCi.

In the event there is an accidental release of Xenon in the pharmacy area, the glove box and product storage exhaust will be used to clear the pharmacy air to levels less than 1×10^{-5} uCi/ml in less than 60 minutes in accordance with the calculations below:

A = Activity/loss = 20 mCi or 2×10^4 uCi
V = Room volume = $9936 f^3$ (2.832×10^4 ml/f^3) = 2.814×10^8 ml
R = Ventilation rate = 393 f^3/min (total exhaust rate through the stack)
λ = Clearance rate = R/V = 393/9936 = $\frac{393\ f^3/min}{9936\ f^3}$ = 4%/min

C_o = Initial concentration

$$C_o = A/V = \frac{2 \times 10^4\ uCi}{2.814 \times 10^8\ ml} = 7.1 \times 10^{-5}\ uCi/ml$$

t = Evacuation time = 100 minutes

C = Final concentration

$$C = C_o e^{-\lambda t} = 7.1 \times 10^{-5}\ uCi/ml \left(e^{\frac{-0.04}{min} \times 60\ min}\right)$$
$$C = 6.45 \times 10^{-6}\ uCi/ml$$

This value is less than 1×10^{-5} uCi/ml for restricted areas as permit in 10 CFR 20.103.

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Xenon-133 Calculations

1. Leakage of vials stored inside glove box.
   (Exhausted to roof area - unrestricted)

   Assumptions

   - A - Maximum of 1000 mCi used each week (52 Ci/yr)
   - B = Maximum loss of 0.5%/day
   - Flow rate = 275 cfm continuous (measured air flow of the vented product storage room constructed by Mallinckrodt)
   - All escaped Xenon exits to the environment - no recirculation

   Calculations

   - V = Air flow/year = 275 cfm (1.484×10^{10} ml/yr/cfm)
   - V = 4.08×10^{12} ml/yr

   Average concentration to environment = C

   - $C = \frac{A \times B}{V}$

   - $C = \frac{52 \text{ Ci/yr} \times 0.005 \times 10^{6} \text{ uCi/Ci}}{4.08 \times 10^{12} \text{ ml/yr}} = 6.37 \times 10^{-8}$ uCi/ml

The value 6.37×10^{-8} uCi/ml is less than the limit of 3×10^{-7} uCi/ml as stated in 10 CFR 20.106.

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EMERGENCY PLAN FOR PHARMACY EVACUATION - RADIOACTIVE GAS RELEASE

In the event of an accidental release of radioactive gas into the pharmacy:

I. All persons not associated with the accident evacuate the area.

   a. Isolate the area by closing all doors.
   b. If lab air is recirculated into office, turn off HVAC unit.

II. Person(s) associated with the accident shall:

   a. Open glove box and product storage doors, leaving the glove box ON.
   b. Put on waterproof gloves.

III. If a release of radioactive gas has occurred:

   a. Clean up broken container(s) and place in glove box.
   b. Evacuate the pharmacy.
   c. Allow sufficient time for evacuation of the gas before returning to the work area (60 minutes for 20 mCi).
   d. Survey the area before re-entering.
   e. Document the accident, clean-up procedures and survey results.

CONTROL NO. 80384

10g. General Procedures for the Safe Use of Radioactive Material

1. Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.

2. Wear disposable gloves at all times while handling radioactive materials.

3. Monitor hands and clothing for contamination after each procedure or before leaving the area.

4. Always use syringe shields and vial shields for preparation, elution, and dispensing of radiopharmaceuticals.

5. a. Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.

   b. Do not store food, drink, or personal effects with radioactive material.

6. Assay each vial, syringe, and capsule containing more than 10 microcuries of a gamma-emmiting radiopharmaceutical in the dose calibrator before distribution for use in humans. Unopened doses that are sent out in original manufacturer labeled shields will not be opened and measured. These doses will be sent with the manufacturer's package insert.

7. Wear personnel monitoring devices (film badge or TLD) at all times while in areas where radioactive materials are used or stored. These devices should be worn at chest or waist level. Personnel monitoring devices when not being worn to monitor occupational exposures should be stored in the designated low background area.

8. Wear TLD (or film) finger badges during elution of generators and preparation or assay of radiopharmaceuticals.

10o. Procedures for Packaging and Transporting Radiopharmaceuticals

Shipping containers are described in Item 10n - Product Shielding.

After the doses are assayed and labeled, they are packaged for shipment in compliance with DOT regulations. Maximum dose transported will not exceed DOT specifications for a Yellow-III label (surface survey less than 200 mR/hr and transport index less than 10 mR/hr). DOT diamond labels (White-I, Yellow-II, and Yellow-III) will be used on the other containers. DOT specifications will be met as to labeling the package for description of material (Type A, Class 7, ID number, upright arrows, etc.) Vehicles will be placarded on all four sides when a shipment of radioactive materials requiring a Yellow-III DOT label is carried.

Bill of lading forms (copy attached) will be used for shipments. These forms conform to DOT standards. One form will be filled out for each driver. The form covers up to 15 packages. As the packages are delivered, they will be signed for and the completed form will be returned to the pharmacy and filed.

Delivery instructions will be obtained from customers for shipments of radioactive materials. The drivers will be instructed to leave the packages only in secure areas designated by the customers. Wherever possible a lock box or locked delivery room will be used.

Radioactive shipments will be carried in the trunk area of the Mallinckrodt delivery vehicle. Unauthorized passengers are not permitted to accompany the driver. Vehicles will be locked when unattended.

A description of the Emergency Spill Kit which will be carried in the passenger area of each vehicleis on page 40. Drivers will be trained in the use of this kit.

WASTE DISPOSAL

1. Mo-99/Tc-99m generators will be:

   A. Returned to the manufacturer (shipped in compliance with DOT regulations), OR
   B. Held for decay until radiation levels, as measured in a low background area with a low-level survey meter and with all shielding removed, have reached background levels.

   Radiation labels will be removed or obliterated before disposal in normal trash. Generator columns will be segregated in storage so that they may be monitored separately to ensure decay to background levels.

2. Other radioactive waste will be held in storage for approximately 10 half-lives until radiation levels (measured as stated above) have reached background levels. Waste is segregated by half-life in the storage area. Radioactive waste will be entered in the waste disposal/storage record, as it is put into storage. Waste will be stored in the respective half-life container which has been properly labeled.

3. After decay, the waste will be monitored with a low level survey meter. If background levels have been reached, the waste will be signed out and disposed of in one of the following ways:

   A. After destruction of radiation labels, waste will be disposed of in normal trash.

   B. Waste will be boxed, sealed and taken to a local incinerator with the labels intact. Incineration will obliterate the labels and destroy the syringes and vials.

   C. Decayed waste with the labels intact will be boxed, sealed and shipped according to DOT Regulations to the Mallinckrodt Radiopharmaceutical plant in Maryland Heights, MO. The waste management building at the plant has a shredder equipped with radiation monitors. The syringes and vials will be shredded, surveyed for radioactivity and then disposed of through normal trash if survey readings do not exceed background levels.

4. Disposals to the sanitory sewer are not made on a routine basis. If any sewer disposals are performed, they will be in compliance with NRC Regulations. A log book will be kept to document these disposals.