

## MATERIALS LICENSE

Amendment No. 25

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee		398590 In accordance with application dated May 17, 1995	
1. Nooter Corporation P.O. Box 451		3. License Number 24-03783-01 is renewed in its entirety to read as follows:	
2. 1400 South Third Street St. Louis, MO 63166		4. Expiration Date October 31, 2001	
		5. Docket or Reference No. 030-05088	
6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License	
A. Iridium-192	A. Sealed source(s) (Technical Operations Model A-424-9)	A. No single source to exceed 100 curies	
B. Cesium-137	B. Sealed source(s) (Technical Operations Model 77302)	B. 1 source not to exceed 165 millicuries	
C. Cobalt-60	C. Sealed sources (Amersham Corp. Model A424-13)	C. No single source to exceed 150 curies	
D. Uranium depleted uranium-235	D. Solid Metal	D. Not to exceed 999 kilograms total possession limit	

## 9. Authorized Use:

- A. For use in Technical Operations Model 660 exposure devices for industrial radiography and in Technical Operations Model 650 source changers for storage and replacement of sources.
- B. For use in Technical Operations Model 773 calibrator device for instrument calibration.
- C. For use in Amersham Model 676/676 System exposure devices for industrial radiography and in Amersham Models 770 and 771 source changers for storage and replacement of sources.
- D. For shielding in radiography exposure devices and source changers.

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**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

24-03783-01

Docket or Reference Number

030-05088

Amendment No. 25

CONDITIONS

10. Licensed material may be used at the licensee's facilities, Building 302, 1400 South Third Street, St. Louis, Missouri and at temporary job sites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.
11. A. Licensed material shall be used by, or under the supervision and in the physical presence of, individuals who have successfully completed the training program outlined in application dated May 17, 1995 and in letter dated September 16, 1996, and have been designated by the licensee's Radiation Protection Officer. The licensee shall maintain records of the individuals who have been designated as authorized users.  
B. The Radiation Safety Officer for this license is Dennis L. Frazier.
12. A. Notwithstanding the periodic leak test required by 10 CFR 34.25(b), the requirement does not apply to radiography sources that are stored and not being used. The sources exempted from this test shall be tested for leakage before use or transfer to another person. No sealed source shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.  
B. Sealed sources authorized for a use other than radiography shall be tested for leakage in accordance with 10 CFR 34.25.
13. The licensee is authorized to receive, possess, and use sealed sources of iridium-192 or cobalt-60 where the radioactivity exceeds the maximum amount of radioactivity specified in this license provided:
  - A. Such possession does not exceed the quantity per source specified in Item 8 by more than 20 percent for iridium-192 or 10 percent for cobalt-60; and
  - B. Records of the licensee show that no more than the maximum amount of radioactivity per source specified in this license was ordered from the supplier or transferor of the byproduct material; and
  - C. The levels of radiation for radiographic exposure devices and storage containers do not exceed those specified in 10 CFR 34.21
14. Sealed sources containing licensed material shall not be opened.

COPY

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SUPPLEMENTARY SHEET

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15. The licensee is authorized to transport licensed material only in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."
16. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d) for establishing decommissioning financial assurance.
17. The licensee shall maintain records of information important to safe and effective decommissioning at the address specified in Item 2. of the license per the provisions of 10 CFR 30.35(g) until this license is terminated by the Commission.
18. When the monitor is inoperable for viewing the roof area above the fixed radiography facility in Building 302 to assure that no one has gained unauthorized access to the roof, a visual check shall be made of the roof area at the beginning of radiographic operations and periodically thereafter, for this purpose.
19. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below, except for minor changes in the medical use radiation safety procedures as provided in 10 CFR 35.31. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.
  - A. Application dated May 17, 1995; and
  - B. Letter dated September 16, 1996.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date OCT 10 1996

By

*Deborah A. Polina*

Nuclear Materials Licensing Branch, Region III

COPY

RECEIVED

MAY 25 1995

REGION III

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM  
AND  
REGIONAL LICENSING SECTIONS(FOR LFMS USE)  
INFORMATION FROM LTSPROGRAM CODE: 03320  
STATUS CODE: 2  
FEE CATEGORY: 30 2B  
EXP. DATE: 19950630  
FEE COMMENTS:  
DECOM FIN ASSUR REQDT R

## LICENSE FEE TRANSMITTAL

## A. REGION

1. APPLICATION ATTACHED  
APPLICANT/LICENSEE: NOOTER CORPORATION  
RECEIVED DATE: 950518  
DOCKET NO: 3005088  
CONTROL NO.: 398590  
LICENSE NO.: 24-03783-01  
ACTION TYPE: RENEWAL

## 2. FEE ATTACHED

AMOUNT: 3060  
CHECK NO.: 190200

## 3. COMMENTS

SIGNED  
DATED. Hershey  
5-17-95B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED ☒)

1. FEE CATEGORY AND AMOUNT: 30 2B \$3060.00

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:  
AMENDMENT  
RENEWAL ☒  
LICENSE

## 3. OTHER

SIGNED  
DATESC  
5/22/95

Log	May 11 1995
Remitter	
Check No.	190200
Amount	\$3060
Fee Category	30 2B
Type of Fee	Renewal
Date Check Rec'd	5/22/95
Date Completed	5/22/95
By	SC



(10-94)  
10 CFR 30, 32, 33  
34, 35, 36, 39 and 40

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 9 HOURS. SUBMITTAL OF THE APPLICATION IS NECESSARY TO DETERMINE THAT THE APPLICANT IS QUALIFIED AND THAT ADEQUATE PROCEDURES EXIST TO PROTECT THE PUBLIC HEALTH AND SAFETY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0120), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

## APPLICATION FOR MATERIAL LICENSE

**INSTRUCTIONS:** SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

## APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY  
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS  
U.S. NUCLEAR REGULATORY COMMISSION  
WASHINGTON, DC 20555-0001

## ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

## IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND,  
MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA,  
RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION  
NUCLEAR MATERIALS SAFETY BRANCH  
U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
475 ALLENDALE ROAD  
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO  
RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,  
SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION II  
101 MARIETTA STREET, NW, SUITE 2900  
ATLANTA, GA 30323-0199

## IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN,  
SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
801 WARRENVILLE RD.  
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS,  
LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA,  
OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH,  
WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV  
611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

## 1. THIS IS AN APPLICATION FOR (Check appropriate item)

- ☐ A. NEW LICENSE  
☐ B. AMENDMENT TO LICENSE NUMBER \_\_\_\_\_  
☒ C. RENEWAL OF LICENSE NUMBER 24-03783-01

## 2. NAME AND MAILING ADDRESS OF APPLICANT (Include Zip code)

Nooter Corporation  
P.O. Box 451  
St. Louis, MO 63166

## 3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Nooter Corporation  
1400 S. Third  
St. Louis, MO 63104

Plus, temporary jobsites  
subject to NRC's  
regulatory authority.

## 4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Dennis L. Frazier

## TELEPHONE NUMBER

314-421-7456

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

## 5. RADIOACTIVE MATERIAL

- a. Element and mass number; b. chemical and/or physical form; and c. maximum amount  
which will be possessed at any one time

## 6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

## 7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE

## 8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

## 9. FACILITIES AND EQUIPMENT

## 10. RADIATION SAFETY PROGRAM

## 11. WASTE MANAGEMENT

## 12. LICENSEE FEES (See 10 CFR 170 and Section 170.31)

FEE CATEGORY 302BC

AMOUNT  
ENCLOSED \$ 3060.00

## 13. CERTIFICATION (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

## CERTIFYING OFFICER - TYPED/PRINTED NAME AND TITLE

Dennis L. Frazier R50

## SIGNATURE

*Dennis L. Frazier*

## DATE

5/17/95

## FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			\$		

## APPROVED BY

## DATE

RECEIVED

MAY 18 1995

398590

REGION III

# NOOTER CORPORATION



1400 South Third Street  
Saint Louis, Missouri U.S.A. 63104  
Mailing Address: P.O. Box 451  
Saint Louis, MO U.S.A. 63166

Telephone: (314) 621-6000  
Fax: (314) 421-7580  
Telex: 44-849  
Cable: NOOTERCORP--St. Louis, (MO)

May 16, 1995

Materials Licensing Section  
USNRC, Region III  
801 Warrenville Road  
Lisle, IL 60532-4351

SUBJECT: RENEWAL OF BY-PRODUCT MATERIAL  
LICENSE 24-03783-01

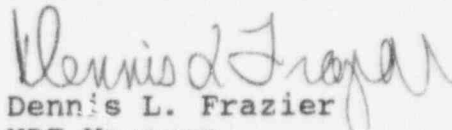
We would like to request renewal of our by-product material license. The only change to the program is the deletion of the T0520 Cobalt 60 projector and the addition of the T0676 Cobalt 60 projector as approved in amendment 24.

Enclosed are two (2) copies of the application and supporting documents. Also enclosed is a check for \$3060 to cover applicable fee.

Thank you.

Very truly yours,

NOOTER CORPORATION

  
Dennis L. Frazier

NDE Manager  
Radiation Safety Officer

DF:sk

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MAY 18 1995  
MAY 18 1995



Steel and Alloy Plate Fabricators and Erectors . . . "BOLLINGER" AREA

ATTACHMENT, ITEM 3

Locations where sealed sources will be used and/or stored.

- A. 150 curies Cobalt 60 in exposure device T0-676 to be used only at the address listed in 1(a) of this form.
- B. 100 curies Iridium 192 in exposure devices T0-660 to be used in any "Compliance State" in the United States.
- C. 165 millicuries Cesium 137 in calibration unit T0-773 to be used only at the address listed in 1(a) of this form.

ATTACHMENT, ITEM 5 & 6

Sealed sources to be used in radiography.

BY-PRODUCT MATERIAL (ELEMENT & MASS NO.)	SOURCE MODEL NUMBER	NAME OF MFG.	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Cobalt 60	A. A-424-13	A. Technical Ops.	A. 150 curies	A. 1*
B. Iridium 192	B. A-424-9	B. Technical Ops.	B. 100 curies	
C. Cesium 137	C. T0 Model 77302	C. Technical Ops.	C. 165 milli- curies	C. 1

\*Two each when sources are being changed.

ATTACHMENT, ITEM 5 & 6

Radiographic exposure devices and/or storage containers to be used with sources listed above.

MODEL NUMBER	SOURCE CHANGER	NAME OF MANUFACTURER
A. 676	A. 770/771	A. Technical Operations
B. 660	B. 650	B. Technical Operations
C. 773	D. Not applicable	D. Technical Operations



## ATTACHMENT 7

### OVERALL ORGANIZATION STRUCTURE

Mr. D. L. Frazier, Radiation Safety Officer, will be responsible for the use of radioactive exposure equipment, and for conducting inspection of Nooter Corporation's radiographic activities.

Mr. Frazier has worked in industrial radiography since 1965. He obtained a B.A. degree in mathematics from University of Missouri in 1974. He has completed Picker X-ray's course "Radiation Safety using Industrial Isotopes", Eastman Kodak's "Industrial Radiography" and Automation Industries course for ASNT T-C-1A level III qualification including radiography and radiation safety.

Mr. R. N. Horton, Chief Radiographer and/or Mr. D. E. Center, Field Safety Officer, will assist and act in the absence of Mr. Frazier.

Mr. Horton has worked in industrial radiography since 1959. His training includes Picker X-ray Corporation course "Radiation Safety using Industrial Isotopes" and Eastman Kodak's course in "Industrial Radiography". He has attended local and national seminars on radiography and radiation safety.

Mr. Center has a B.S. degree in Production Management from Washington University, St. Louis, Missouri. His course of study included courses in nondestructive testing and industrial radiography. Specialized training includes Picker X-ray Corporation's course "Radiation Safety using Industrial Isotopes", and Technical Operations "Administration of Isotope Radiography Safety Programs".

In addition to this inspection, Mr. D. E. Center, Field Safety Director, and Mr. Robert Toenjes, Plant Safety Director, are informed as to whom to contact in the event of an emergency. The safety directors are knowledgeable on the requirements for posting and restricting of radiation areas and will be used, if necessary, in the event of an emergency, to assist in calling the proper authorities and guarding the restricted area.

All inspection findings will be reported directly to management to keep them continually aware of our compliance with established procedures and Title 10, Chapter 1 of the Code of Federal Regulations.

## ATTACHMENT 8

### INITIAL AND PERIODICAL TRAINING FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS EMPLOYED BY LICENSEE

1. Dennis L. Frazier, Chief NDE Engineer, is responsible for initial and periodic training. Mr. Frazier has a B.A. degree in mathematics from the University of Missouri. Mr. Frazier has been employed at Nooter since 1965 and has been a qualified radiographer since 1966. He has successfully completed Picker X-Ray's course on "Radiation Safety Using Industrial Isotopes" and other courses and seminars related to NDT and radiography. His duties include supervision of radiographic operations and dissemination of information regarding new equipment, procedures and techniques.
2. Richard N. Horton, Chief Radiographer, is responsible for the supervision of on-the-job training. Mr. Horton has worked in the industrial radiography field since 1959. He has been Chief Radiographer at Nooter Corporation since 1977. His training includes successful completion of Picker X-Ray Corporation course on "Radiation Safety Using Industrial Isotopes" and Eastman Kodak's course on "Industrial Radiography". He has attended local and national seminars on radiography and radiation safety.
3. Radiographers have the following data available to them and have completed the following requirements:
  - A. Have been instructed in the subjects outlined in Part II of this section and shall receive 40 hours of instruction at Technical Operations in Burlington, Massachusetts.
  - B. Have received copies of an instruction in the regulations contained in Title 10, Chapter 1 of the Code of Federal Regulations, the NRC License, and Licensee's operating and emergency procedures, and shall have demonstrated understanding thereof.
  - C. Have demonstrated competence to use the radiographic exposure devices, sealed sources, related handling tools and survey instruments which will be employed in their assignment.

INITIAL AND PERIODICAL TRAINING FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS EMPLOYED BY LICENSEE

4. Radiographer Assistans have the following data available to them and have completed these requirements:
  - A. Have received copies of and instructions in the licensee's operating and emergency procedures and have demonstrated understanding thereof.
  - B. Have demonstrated competence to use, under the personal supervision of the radiographer, the radiographic exposure devices, sealed sources, related handling tools and radiation survey instruments which will be employed in their assignment.
5. On the job training is used to the greatest extent where all phases of the operation are apparent. All new trainees will work only with X-ray producing equipment during the first 3 months to one year of their employment. This work will be under strict supervision of competent radiographers. During this time they will receive the schooling as outlined in Part II of this section. At the end of this 3 months to one year period, if they have proved to be stable, dependable employees, and if they have completed the training outlined in Part II, they are then allowed to go with a competent radiographer and observe the operation of the exposure decices. At this time the trainee is given written examinations and if he shows to the satisfaction of D. L. Frazier, R. N. Horton, and the radiographer whom he has been observing, that he has a good working knowledge of the operating and emergency procedures, he is designated as a radiographer's assistant and allowed to assist a radiographer. At this time he may be scheduled to attend the 40 hour training course at Technical Operations on "The Safe Use of Isotopes in Industrial Radiography".
6. Radiographers are given written examinations to determine their knowledge and understanding of Commission regulations and licensing requirements in addition to operating and emergency procedures of the licensee (see Part III of this section).
7. Radiographers Assistants will in a like manner be given written examinations to ascertain their knowledge of operating and emergency procedures of the licensee (see Part III of this section).
8. Periodic training will be carried out as new or different equipment and regulations are introduced and will be provided at least once annually. In addition, there is initial and periodic technical training administered to the radiographers and radiographer's assistants. The type of instruction can be found in Parts I, II, and III.
9. Personnel previously qualified as radiographers for another employer will receive the same "in-house" training as those not previously qualified. Previous formal training by another institution will be evaluated with regard to the acceptability of that institution's training program to both the NRC and the Nooter Corporation.

PART I: SCHOOLING ADMINISTERED AT THE TECHNICAL OPERATIONS  
RADIATION TRAINING PROGRAM

PART II: TRAINING PROGRAM FOR RADIOGRAPHERS ADMINISTERED BY  
THE LICENSEE

I. FUNDAMENTALS OF RADIATION SAFETY

A. Characteristics of Gamma Radiation (one hour)

1. Electromagnetic spectrum.
2. Ionization.
3. Photo Effect.
4. Attenuation - Law
  - a. Scattering
  - b. Absorption
5. Radioactivity: Natural and Artificial
  - a. Decay
  - b. Energy of various materials

B. Units of Radiation (one hour)

1. Radiation Dose
  - a. Definition of Roentgens, Milliroentgens.
  - b. Dose rates
2. Quantity of Radiation
  - a. Definition of curie
  - b. Specific Radioactivity
  - c. Relation of dose rate and curie

C. Levels of Radiation from Licensed Material (one hour)

1. R/Hr. values of unshielded Cobalt 60.



ATTACHMENT 3

TRAINING PROGRAM FOR RADIOGRAPHERS (CONTINUED)

2. R/Hr. values of unshielded Iridium 192.

D. Hazards of Excessive Exposure of Radiation (one hour)

1. Structural and functional changes in cells and tissues.
2. Damage of tissue resulting in decrease or increase of its products.
3. Damage to blood and bone marrow cells relating to leukemia and anemia.
4. Large dose effect upon skin.

E. Methods of Controlling Radiation (one and one-half hour)

1. Choice of radiographic technique to obtain lowest possible hazardous radiation level.
2. Reduction of working time at neighborhood of radioactive sources to lowest possible value.
3. Element of distance advantage by use of the inverse square law.
4. Shielding of primary and/or secondary radiation.
  - a. Broadbeam shielding for absorption of Iridium 192 and Cobalt 60 gamma rays in lead.
  - b. Broadbeam shielding for absorption of Iridium 192 and Cobalt 60 gamma rays in steel, concrete, sands, etc.

TRAINING PROGRAM FOR RADIOGRAPHERS (CONTINUED)

II. RADIATION DETECTION INSTRUMENTATION

A. Use of Radiation Survey Instruments (one hour).

1. Operation

a. Use of ionization chambers

b. Use of survey meters

2. Calibration

In accordance with operating and procedure instructions.

3. Limitations

Accuracy and range limits

B. Survey Techniques (one-half hour).

Use of instruments in foregoing paragraph (A) for radiographic setups.

C. Personal Monitoring Equipment (one-half hour).

1. Film badges

2. Pocket dosimeters and chambers

III. USE OF RADIOGRAPHIC EQUIPMENT (EIGHT HOURS)

A. Detailed Instructions in Remote Handling Equipment

B. Radiographic Exposure and Collimator Devices

C. Storage Containers

IV. ADMINISTRATIVE OPERATING AND EMERGENCY INSTRUCTIONS  
FOR RADIOGRAPHERS AND RADIOGRAPHERS ASSISTANTS

- A. Prerequisites necessary before using exposure devices (1/2 hour).
- B. Operation of the various exposure devices (4 hours).
  - 1. Calculation of the radiation areas, posting and restricting of the areas..
  - 2. Equipment maintenance check and records.
  - 3. Proper setup and placement of the equipment.
  - 4. Proper methods of the radiation survey.
  - 5. Records of Survey, dosimeter readings.
  - 6. Instructions in the emergency procedure.
- C. General instructions including but not limited to the following: (4 hours)
  - 1. Requirements pertinent to radiographers and radiographers assistants as outlined in Part 20 "Standards for Protection Against Radiation".
  - 2. Data specific to storage of equipment.
  - 3. Data specific to transport of equipment.
  - 4. Emergency procedures in case of accident.
- D. Survey Meter Calibration and source changes. (This applies to radiographers only).

PART III: EXAMINATIONS ADMINISTERED TO RADIOGRAPHERS AND  
RADIOGRAPHER'S ASSISTANTS BY THE LICENSEE

PART A - General Questions, Radiation Safety for Radiographers

1. Gamma rays are very similar to X-rays.

- (1) True
- (2) False

ANS.: (2)

2. One of the hazards from the use of isotopes in radiography is that the gamma rays induce radioactivity in the objects they strike.

- (1) True
- (2) False

ANS.: (2)

3. The inverse square law applies only approximately to gamma rays because they produce unpredictable scatter conditions.

- (1) True
- (2) False

ANS.: (2)

4. The effect of gamma rays are mainly due to the production of ions.

- (1) True
- (2) False

ANS.: (2)

5. The half life of an isotope is one of the following:

- (1) LD/50.
- (2) Its average life after passing through a half value layer.
- (3) Half of its total life.
- (4) The time for the original activity to decrease by one half.

ANS.: (4)

6. Thulium 170 is not a good radiographic source because of:

- (1) Its low energy gamma rays.
- (2) Low specific activity
- (3) Bremsstrahlung.
- (4) Short half life.

ANS.: (1)

7. Cesium 137 is not an ideal radiographic source because:

- (1) It is a dangerous substance.
- (2) It emits monochromatic radiation.
- (3) The source size per curie is excessive.
- (4) It is diluted with Cesium 134.

ANS.: (3)



8. Iridium 192 emits radiation similar in radiographic quality to:

- (1) 400 KV X-ray.
- (2) One million volt X-ray.
- (3) Two million volt X-ray.

ANS.: (1)

9. The rem, rad, and Roentgen may be considered identical if the radiographer considers X and gamma radiation only.

- (1) True
- (2) False

ANS.: (1)

10. A Curie is:

- (1) Equivalent to the radiation output from 1 gram of Radium.
- (2)  $3.7 \times 10^{10}$  dps.
- (3)  $3.7 \times 10^{10}$  cpm.

ANS.: (2)

11. A radiation intensity of 2 mr per hour is:

- (1) Always safe.
- (2) Sometimes safe.
- (3) Never safe.

ANS.: (2)

12. The genetic effects of radiation are well known.

- (1) True
- (2) False

ANS.: (2)

13. The maximum permissible dose (MPD) is the level at which noticeable physiological effects from radiation take place in the body.

- (1) True
- (2) False

ANS.: (2)

14. Physiological effects of radiation are not observable below a dose of five rem.

- (1) True
- (2) False

ANS.: (1)

15. The concepts of MPD do not apply to medical or therapeutic exposures.

- (1) True
- (2) False

ANS.: (1)

16. In the normal shipment of radioactive material, the gamma dose may not exceed 200 mr/hr at any point on the surface of the outer container.

- (1) True
- (2) False

ANS.: (1)

17. Betatrons quite often produce radioactivity in the subject X-rayed.  
(1) True  
(2) False ANS.: (2)
18. In radiography with isotopes using lead screens, most of the image formed is produced from a kind of beta ray rather than the gamma rays from the isotope.  
(1) True  
(2) False ANS.: (2)
19. Which of the following illustrates the best means of protection from external radiation:  
(1) Wearing of film badges and dosimeters and using a survey instrument.  
(2) Lead, concrete, and steel.  
(3) Time, distance, and shielding. ANS.: (3)
20. A person 10 feet from a gamma source reduces his exposure rate to which of the following when he steps back to 20 feet?  
(1) 2X  
(2) 1/2  
(3) 1/4  
(4) 1/10 ANS.: (3)
21. In field work a temporary shield may be easily devised from material at hand.  
(1) True  
(2) False ANS.: (2)
22. Twenty curies of Iridium 192 requires:  
(1) 20 times the concrete protection as 1 curie of Cobalt 60.  
(2) About the same concrete protection as 1 curie of Cobalt 60. ANS.: (2)
23. Six inches of concrete for Iridium 192 offer twice the protection as:  
(1) Three inches.  
(2) Four inches.  
(3) Five inches. ANS.: (2)
24. Two inches of lead offers twice the protection as one inch for Cobalt 60 radiation.  
(1) True  
(2) False ANS.: (2)

ATTACHMENT 8

25. Three feet of concrete ordinarily will provide sufficient protection for radiographic purposes for:

- (1) 10 curies Cobalt 60.
- (2) 100 curies Cobalt 60.
- (3) 1000 curies Cobalt 60.

ANS.: (2)

26. A bag of sand (18" dimension) will reduce Cobalt 60 radiation intensity by a factor of about:

- (1) 1/3
- (2) 1/7
- (3) 1/13
- (4) 1/26

ANS.: (4)

27. A radiographer is working in a radiation area with an intensity of 32 mr/hr. To reduce his exposure rate to 2 mr/hr he should increase his distance from the source by:

- (1) 2X
- (2) 3X
- (3) 4X
- (4) 8X
- (5) 16X

ANS.: (3)

28. The radiation from 1 curie of Cobalt 60 is attenuated in air to approximately 5 mr/hr at a distance of:

- (1) 30 feet.
- (2) 50 feet.
- (3) 100 feet.

ANS.: (2)

29. The radiation from 10 curies of Cobalt 60 is attenuated in air to approximately 5 mr/hr at a distance of about:

- (1) 50 feet.
- (2) 175 feet.
- (3) 500 feet.

ANS.: (2)

30. The radiation from 1000 curies of Cobalt 60 is attenuated in air to approximately 5 mr/hr at a distance of about:

- (1) 1/3 of a mile.
- (2) 1 mile.
- (3) 3 miles.

ANS.: (1)

31. If a radiographer has a radiation room sufficient protection only when the source is in the center of the room and he is required to make an exposure with the source directly against one wall, he should:

- (1) Inform the AEC.
- (2) Stop radiographing.
- (3) Lead brick the source.

ANS.: (3)

32. The calculated exposure rate at any distance is always equal to the measured, assuming all calculations and meter readings are correct.

- (1) True
- (2) False

ANS.: (2)

33. It takes 15 seconds to crank out your T.O. source. The dose you will receive per radiographic exposure will be (no protection):

- (1) 1/30 average field intensity (mr/hr) at that spot.
- (2) 1/60 average field intensity (mr/hr) at that spot.
- (3) 1/120 average field intensity (mr/hr) at that spot.
- (4) 1/240 average field intensity (mr/hr) at that spot.

ANS.: (3)

34. The walls of a thick steel tank may be considered part of the necessary shielding in panoramic exposure:

- (1) True
- (2) False

ANS.: (1)

35. Radiographic exposure times on materials other than steel can be determined quite accurately from a knowledge of the half value absorption layers.

- (1) True
- (2) False

ANS.: (1)

36. One type of unit utilized by survey meters is:

- (1) Cobalt 60.
- (2) Cesium 137.
- (3) Ionization chamber.
- (4) Plasma chamber.

ANS.: (3)

37. A source of Iridium-192, whose half life is 75 days, provides an optimum exposure of a given test object today in a period of twenty minutes. Five months from now, what exposure time would be required for the same radiographic density, under similar exposure conditions?

- (1) 10 minutes.
- (2) 20 minutes.
- (3) 1 hour and 20 minutes.

ANS.: (3)

38. The gamma ray intensity at one foot from a one curie source of radioactive Cobalt-60 is nearest:

- (1) 15 roentgens per hour.
- (2) 1,000 roentgens per hour.
- (3) 1 roentgen per minute.
- (4) 10 milliroentgens per day.

ANS.: (1)



39. You can calibrate your own survey instruments:

- (1) If you use a standard radium source.
- (2) If your procedure has been approved by the NRC.
- (3) Provided you never miss an interval of three months.

ANS.: (2)

40. In a field setup one must first calculate the radiation intensity at various distances and then check with a survey meter. The calculations and the meter readings must check exactly if everything is in working order.

- (1) True
- (2) False

ANS.: (2)

41. In almost all types of remote operated equipment such as T.O., various warning systems indicate the position of the source. The use of a survey instrument then becomes only an NRC requirement.

- (1) True
- (2) False

ANS.: (2)

42. Radiation intensity should be determined before approaching any radioisotope whether it is known the source is in the safe position or not.

- (1) True
- (2) False

ANS.: (1)

43. The film badge is usually used to measure the cumulative personal exposure to radiation.

- (1) True
- (2) False

ANS.: (1)

44. The ion chamber pocket dosimeter is usually used for determining short term (daily) personal exposure to radiation.

- (1) True
- (2) False

ANS.: (1)

45. Pocket dosimeters are more accurate than pocket chambers.

- (1) True
- (2) False

ANS.: (2)

46. Film badge exposure data need be kept on file only if the MPD has been exceeded.

- (1) True
- (2) False

ANS.: (2)

47. When you receive a report from the badge service that you received 500 mr for a period of 2 weeks, you should:

- (1) Inform the NRC
- (2) Call a doctor immediately. This is LD/50.
- (3) Check with your daily dosimeter records to eliminate mistakes.
- (4) See that you do not exceed 1250 mr in the calendar quarter.

ANS.: (4)

48. Pocket dosimeter and film badge readings should check closely.

- (1) True
- (2) False

ANS.: (2)

49. A sudden large increase in your pocket dosimeter reading can be disregarded if everything is known to be safe.

- (1) True
- (2) False

ANS.: (2)

50. Your assistant regularly comes up with high film badge readings and negligible dosimeter readings. You should first check:

- (1) Dosimeter.
- (2) Film badges.
- (3) Where and how he wears and keeps his dosimeter and film badge in relation to the source.

ANS.: (3)

**PART B - SPECIFIC QUESTIONS-EMERGENCY & OPERATING PROCEDURES FOR RADIOGRAPHERS & RADIOGRAPHERS ASSISTANTS**

1. The Radiographer's Assistant may operate exposure devices when the Radiographer is not present.

(1) True  
(2) False

ANS.: (2)

2. Both the Radiographer and the Radiographer's Assistant must have a film badge and pocket dosimeter during setup and exposure.

(1) True  
(2) False

ANS.: (1)

3. Your dosimeter must be charged and zeroed at the start of each shift.

(1) True  
(2) False

ANS.: (1)

4. Where is the dosimeter and film badge worn or carried?

(1) In the shirt pocket.  
(2) Belt at front of body.  
(3) Trouser pocket.  
(4) With the survey meter.

ANS.: (1 & 2)

5. What radiation area boundary must be roped and posted with the sign "CAUTION RADIATION AREA"?

(1) 100 mr/hour  
(2) 100 mr  
(3) 2 mr/hour  
(4) 2 mr

ANS.: (3)

6. Where is the "CAUTION HIGH RADIATION AREA" sign posted?

(1) 100 mr/hour boundary  
(2) 100 mr boundary  
(3) 2 mr/hour boundary  
(4) 2 mr boundary

ANS.: (1)

7. Control cables and guide tubes should lay as straight as possible with no sharp bends.

(1) True  
(2) False

ANS.: (1)

8. When the source is in the exposure position it is not necessary to survey the entire boundary since it was calculated prior to setup.
- (1) True  
(2) False                      ANS.: (2)
9. Describe the physical radiation survey required after the exposure is completed.
- (1) Slowly approach the source container with the survey meter & note the indicated reading.
- (2) Survey the source container.
- (3) Survey the entire guide tube.
10. The "Daily Equipment Check List", form 512 and the "Exposure Duration and Record of Survey", form 279 must be completed after the exposure.
- (1) True  
(2) False                      ANS.: (1)
11. Your dosimeter should be read at what time?
- (1) At the end of your shift.  
(2) At the beginning of your shift.  
(3) Frequently, during your shift.  
(4) After being dropped.                      ANS.: (1,2,3,&4)
12. If your dosimeter is found to be off scale at any time during or after your work shift you should:
- (1) Remember the last known reading and record this.  
(2) Follow the emergency procedure.  
(3) Obtain a new dosimeter.  
(4) Contact your supervisor immediately.                      ANS.: (4)
13. If the source cannot be returned to its shielded condition after exposure due to an equipment malfunction, you should:
- (1) Check your dosimeter reading.  
(2) Contact your supervisor immediately.  
(3) Survey the area.  
(4) Follow the emergency procedure.                      ANS.: (4)

14. It is permissible to use another persons film badge provided he is not using it on that shift.
- (1) True  
(2) False                      ANS.: (2)
15. Your survey meter is tagged with the calibration date and date when calibration is due; however you may exceed this due date since they very seldom go out of calibration.
- (1) True  
(2) False                      ANS.: (2)
16. When the exposure devices are not in use they:
- (1) May be left in the transport vehicle.  
(2) Shall be locked in building 302.  
(3) May be left at the exposure site provided the exposure device is locked.  
(4) Shall be locked in the storage vault at field job sites.                      ANS.: (2&4)
17. Survey meters may be calibrated by Radiographers or Radiographer's Assistants.
- (1) True  
(2) False                      ANS.: (2)
18. Survey meters are calibrated at intervals not to exceed 3 months.
- (1) True  
(2) False                      ANS.: (1)
19. Properly calibrated survey meters are accurate within  $\pm 10\%$ .
- (1) True  
(2) False                      ANS.: (1)
20. Sources may be changed by the Radiographer's Assistant under direct supervision of the Radiographer.
- (1) True  
(2) False                      ANS.: (2)
21. It is not necessary to allow any warm up time prior to zeroing the survey meter.
- (1) True  
(2) False                      ANS.: (2)

ATTACHMENT 8

22. The exposure device is labeled with the type and size of the source it contains.

- (1) True
- (2) False

ANS.: (1)

23. If the identification label becomes unreadable, this is ok since the source decay chart has this information.

- (1) True
- (2) False

ANS.: (2)

24. The exposure devices and source cables should be kept clean and in good repair.

- (1) True
- (2) False

ANS.: (1)

25. If any item of the daily equipment check form is answered no, you should:

- (1) Follow the emergency procedures.
- (2) Repair the damaged part.
- (3) Describe the problem in the "NOTES" section of the form.
- (4) Contact your supervisor.

ANS.: (3 & 4)



PART C - PRACTICAL EXAMINATION FOR RADIOGRAPHERS  
& RADIOGRAPHER'S ASSISTANTS

A practical examination will be conducted by the Chief NDT Engineer or the Chief Radiographer. This examination shall demonstrate that the Radiographer and/or Radiographer's Assistant is familiar with and can operate the necessary equipment to the satisfaction of the Chief NDT Engineer or Chief Radiographer.

The practical examination will consist of, but not be limited to, the following:

- (1) Calculation of the radiation boundaries of a predetermined setup.
- (2) Observation of roping and posting the radiation areas.
- (3) Handling and placement of the exposure devices.
- (4) Handling of survey equipment and performance of surveys.
- (5) Proper execution of records and forms.
- (6) Proper wearing of personnel monitoring equipment.
- (7) General housekeeping and attention to details.

## ATTACHEMENT 9

### RADIOGRAPHIC FACILITIES

When not being used or transported from site to site, Models 676, 773, and 660 are stored in building 302 (See plant layout, page 6).

Building 302 is the X-Ray Building which is used for industrial radiography and storage of source holders. Sketches of this building are attached which show the dimensions, construction, type and location of the safety equipment. The Gammalarm system is activated when a source is out of its source holder and, in turn, triggers four red blinking lights located on the outside corners of the building and an electric eye-horn system in the maze which monitors access to the exposure area. Anyone interrupting the light beam between the projector and the photoelectric tube during the time the lights are activated causes a micro-switch to trigger the horn system.

The approved radiation area signs are posted on the external walls of the building. The roof is posted with high radiation area caution signs. The walls are 31 feet 6 inches high with no access ladder or stair to the roof. Access to the roof is restricted to all without the approval of the radiography supervisor. The locked doors on the room have "panic" type hardware so that they may always be opened from the inside. Surveys have been made of the outer walls during exposure with the Cobalt 60 source and survey meter readings at the outer surface of the wall are less than 2 mr/hr at all points.

The maze has a locking metal door which is opened by a different key than the one required to unlock the door on the outer wall of the control room. Both doors are kept locked and access to these keys is limited to radiographers & radiographer's assistants. The large concrete doors at the front of the building are opened only for moving vessels in or out of the exposure room and are not open when Models 520 or 560 are out of their safes unless the high radiation area is roped off and access is continually monitored by a radiographer.

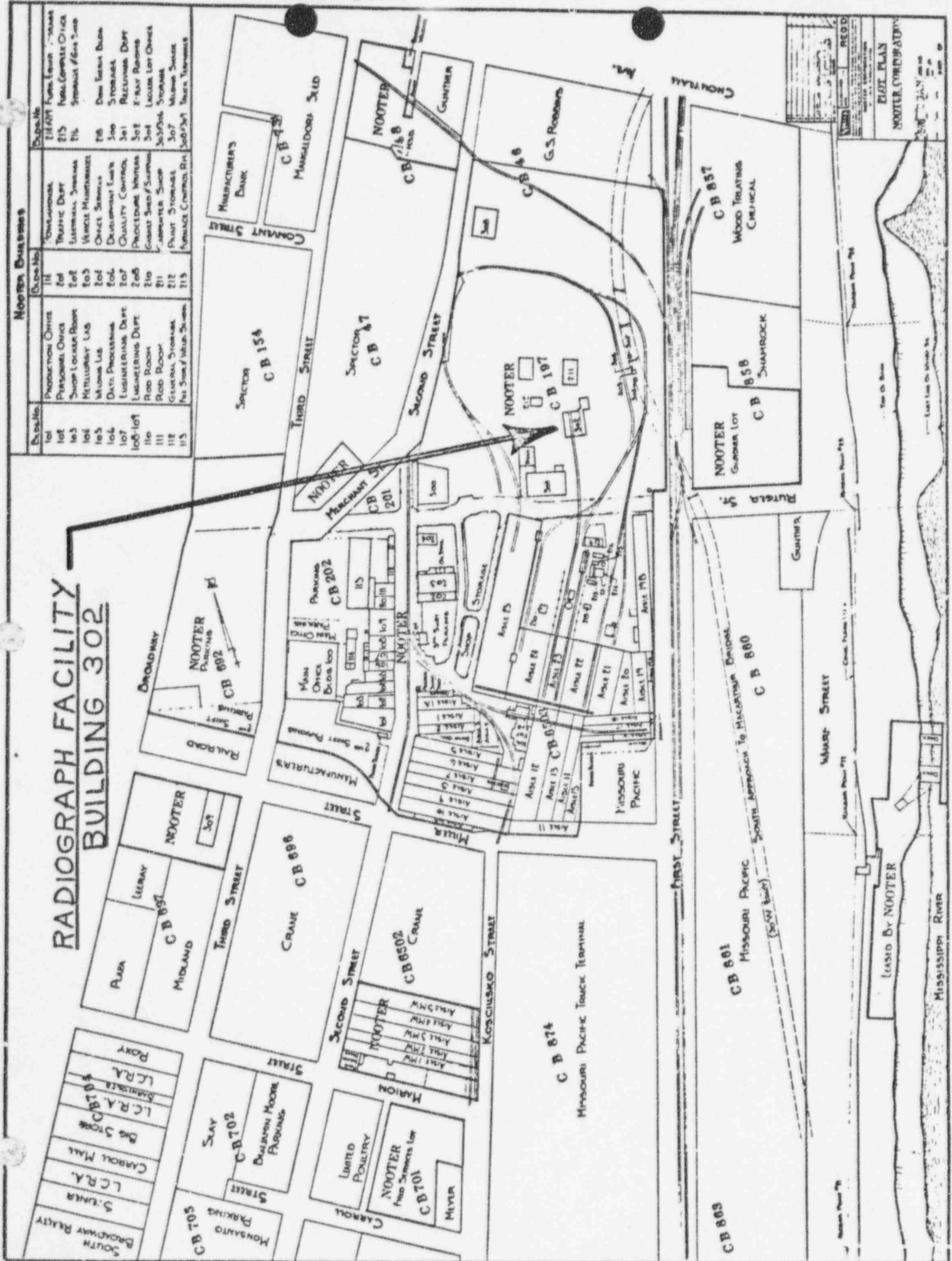
Building 302 is immediately identifiable to anyone in its vicinity and is posted with the radiation symbols and caution signs described in Section 20.203 of the Code of Federal Regulations. In addition, the local police and fire prevention authorities have been notified as to its location.

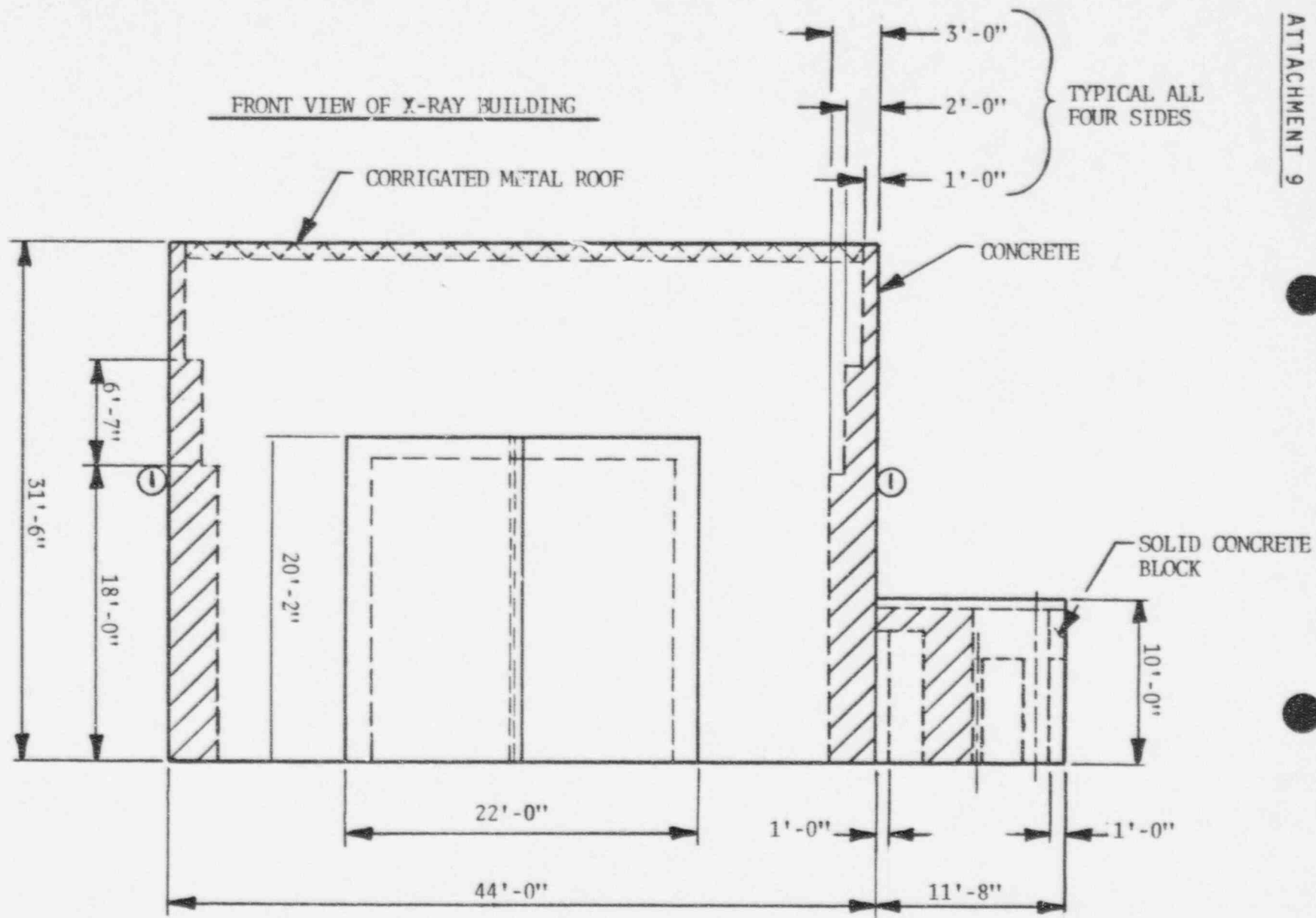
## ATTACHMENT 9

### TEMPORARY JOB SITE STORAGE

Temporary job sites will be provided with a steel "walk in" size vault for storage of the exposure devices. This vault will be placarded with the approved radiation symbol, and the words "CAUTION RADIOACTIVE MATERIAL" on four sides. This vault will be locked and access restricted to radiographic personnel only.

The steel "walk in" size vault for storage of exposure devices at temporary job sites is 4 feet wide by 6 feet high by 6 feet long, constructed of 10 gauge steel reinforced with 4 inch steel channel framing. The steel door is equipped with padlocks for securing. This vault is used for storage of the Technical Operations Model 660 at field job sites to prevent theft. The vault is taken to temporary job sites by truck prior to shipment of the exposure device. The vault is not moved or transported with the exposure device inside.









FACE

0

3 50'

0 \* RECEIVING  
DEPT.

1.7 10'

2.0 0'

CONT  
RANG  
0.7150 CURIES  
CO<sup>60</sup>1.8  
0' 10'0  
50'1.5 10'  
1.8 0'

2.0 0'

1.8 10'

4 50'

RADIATION LEVEL AROUND  
BLDG. 302 WITH CO<sup>60</sup>  
AT 6' FROM FLOOR IN  
CENTER OF ROOM. 150 CURIES  
READINGS IN MR/HR

Survey Date Sept. 9, 1971  
J. J. J. J.

## ATTACHMENT 10

### RADIATION DETECTION INSTRUMENTS

The following instruments will be used for radiation surveys during and following all radiographic operations:

<u>MODEL</u>	<u>MANUFACTURER</u>	<u>TYPE OF RADIATION</u>	<u>SENSITIVITY RANGE</u>
592B	Victoreen	Gamma	0-1000 MR/HR
692	Victoreen	Gamma	0-10,000 MR/HR
492	Victoreen	Gamma	0-1000 MR/HR

A total of nine (9) instruments will be maintained. Two instruments will be available each time a source is used.

### CALIBRATION METHOD

Survey Instruments will be calibrated as described on pages 8 through 11 of the Operating and Emergency Procedures by radiographers using a Model 773 survey meter calibration unit. If an instrument cannot be calibrated by normal adjustment, it will be removed from service and returned to the factory for service or replacement. All survey instruments will be legibly tagged as to the date of calibration, the date that calibration is due, and the person who performed the calibration. A calibration sheet will be filled out and retained in our files.

### CALIBRATION FREQUENCY

Each survey instrument will be calibrated at intervals not to exceed three months.

## ATTACHMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

#### Survey Meter Calibration (Radiographers Only)

This procedure is for the calibration of the Victoreen Model 592B, 492, and 692 radiation detection instruments employed for radioisotope work using the TO 773 calibration unit.

The Victoreen Model 592B is a battery operated ion chamber instrument for the measurement of X-ray and gamma radiation over the range of 1 to 1000 mr/hr at energies of 50 KEV to 1.3 MEV. Three linear ranges with full scale sensitivities of 1000, 100, and 10 mr/hr are provided. An off-on range selector and a zeroing control are provided, with a guard ring to protect the zeroing control from accidental displacement. The electrical power source is four (3) 1.3 volt cells and six (6) 22.5 volt batteries.

The Victoreen Model 492 is a battery operated halogen quenched energy compensated Geyer tube instrument for the measurement of X-rays and gamma radiation above 60 KEV. Three linear ranges of 0-10, 0-100, and 0-1000 mr/hr are provided with an off and battery test position. Power is provided by two "D" cells.

The Victoreen Model 692 is a battery powered ion chamber instrument for the measurement of X-ray and gamma radiation above 20 KEV. Four linear ranges of 10000, 1000, 100, and 10 mr/hr are provided. An off-on range selector and a zeroing control are provided, with a guard ring to protect the zeroing control from accidental displacement. The electrical power source is two carbon zinc D cells.

The Model 773 is a small, portable radiation survey instrument calibration device. The unit consists of a 165 millicurie 137 Cesium source permanently attached to a movable source rod which is installed in a lead shield casting. The source is exposed by raising the source rod which positions the source in a 36° X 20° collimated beam port.

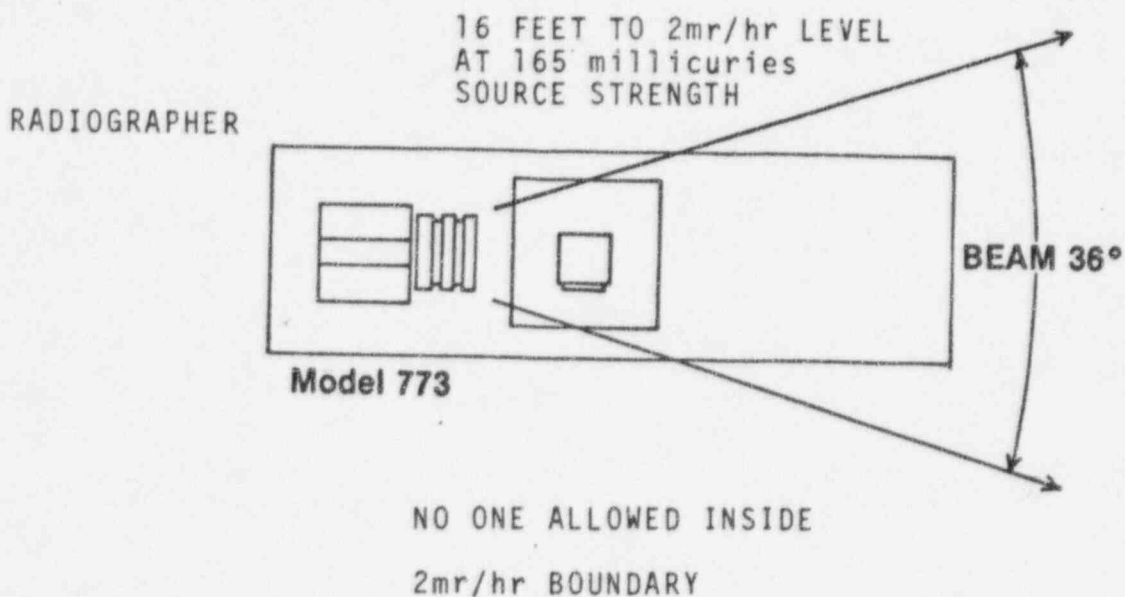
The unit is equipped with three attenuators (Transmission of 0.25, 0.10 and 0.10) to allow a survey instrument with three ranges to be calibrated at 20% and 80% of each range without changing the position of the survey instrument. The Model 773 can be used to calibrate survey instruments with ranges up to 2000 milliroentgens per hour.

The unit is equipped with a carrying handle which also serves as a source locking bar to prevent unauthorized use of the calibrator. A shipping cover is also attached to provide an additional means of securing the source.

1. Frequency of Calibration: The interval between calibration dates shall not exceed three months. Any instruments that have been repaired are recalibrated before use, as are all new instruments received.
2. Personnel Performing Calibration: Only qualified radiographers may calibrate instruments.
3. Calibration Procedure:
  - A. Check all batteries in all instruments with a voltmeter for

ATTACHMENT 10

- A. Continued - proper voltage levels. Discard all batteries not in good condition. Replace with new batteries that have been tested and found acceptable. Turn all instruments on to allow for warm-up period.
- B. Fill out the upper portion of Survey Instrument Calibration sheet, one form for each instrument. Fill in the date, instrument manufacturer and model number, serial number, and distance for each radiation level.
- C. Post the area as shown in Figure 1 to insure no unauthorized entry into the calibration area.



**FIGURE 1**



- D. Determine the activity of the source on the date of calibration from the decay chart provided with the source.
- E. Determine the distance from the source at which the radiation intensity would be 800 mr/hr (use Figure 3).
- F. Using the tape measure attached to the Model 773, place the survey meter such that the axis of the detector is located at the proper distance from the source as determined above.
- G. Unlock the handle of the Model 773. Remove the shipping plate. Remove all the attenuators from the radiation beam.
- H. Standing away from the radiation beam, expose the source by manually raising the source rod. Note and record the survey meter reading, return the source to the stored position. The actual intensity is 800 mr/hr. if the reading is within  $\pm 10\%$  of the actual intensity, continue checking the instrument. If the instrument reading is not within  $\pm 10\%$  of the actual intensity, the instrument must be adjusted and recalibrated.  
  
CAUTION: Do not enter the area of the radiation beam while the source is exposed.
- I. Place the 0.25 attenuator in the beam. Repeat step H; the actual intensity is 200 mr/hr.
- J. Remove the 0.25 attenuator from the beam and place an 0.10 attenuator in the beam. Repeat step H; the actual intensity is 80 mr/hr.
- K. Place the 0.25 attenuator in the beam. Repeat step H; the actual intensity is 20 mr/hr.
- L. Remove the 0.25 attenuator from the beam and place the other 0.10 attenuator in the beam. Repeat step H; the actual intensity is 8 mr/hr.
- M. Place the 0.25 attenuator in the beam. Repeat step H; the actual intensity is 2 mr/hr.
- N. For the 692 instruments, set the meter on the X1000 range and place next to the port on the 773 unit. Raise the control rod and verify that the unit is responsive on this range. The instruments do not have to be calibrated on the X1000 range. If the instrument calibrates within limits on all ranges, affix the calibration tag to the instrument. On the tag, enter the calibration date, the date after which the instrument cannot be used without recalibration (i.e., three months after calibration date) and the name of the radiographer performing the calibration.
- O. After all steps have been completed, lock up the calibration unit and return it to the storage area.

NOOTER CORPORATION  
X-RAY DEPARTMENT  
ST. LOUIS, MISSOURI

## SURVEY INSTRUMENT CALIBRATION SHEET

(Using Model T/O 773 Gamma Survey Meter Calibration Unit)

Date of Calibration \_\_\_\_\_

Instrument Manufacturer \_\_\_\_\_

Instrument Model No. \_\_\_\_\_ Serial No. \_\_\_\_\_

Source Strength of Cesium 137 on Date of Calibration \_\_\_\_\_ Curies

Distance Required for Calibration \_\_\_\_\_ Inches

Check Point	Allowable Range of $\pm 10\%$ Deviation	Actual Reading On Instrument Scale	Mark OK If Reading Is Within Range	Amount Reading is Off Beyond Range + or -
800 mr	720-880			
200 mr	180-220			
80 mr	72-88			
20 mr	18-22			
8 mr	7.2-8.8			
2 mr	1.8-2.2			

1000 mr Range Verification \_\_\_\_\_

Remarks \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



PERSONNEL MONITORING

FILM BADGE SUPPLIER

R. S. Landauer Film Badge Service supplies film badges for determining X-ray and gamma ray dosage. Badges are interpreted after two weeks wearing. Forms NRC-5 are filed in 12-14-12-14 week intervals.

Film badges will be worn by each radiographer and radiographer's assistant on or in the shirt pocket or on the belt toward the front part of the body throughout the work shift.

POCKET DOSIMETERS

Dosimeter Corporation of America Model 862 personal dosimeters are issued to each radiographer and radiographer's assistant. The Model 862 dosimeter may be used for X-ray and gamma radiation and has a range from 0 to 200 mr. Each dosimeter will be charged and zeroed using a Dosimeter Corporation Model 909 charger at the beginning of each shift. Each dosimeter will be read at the end of each shift and the reading recorded. Records of dosimeters will be maintained in our files.

If a dosimeter is found to be discharged at any time during wearing, the person's film badge will be sent for processing immediately.

NOOTER CORPORATION  
X-Ray Department  
St. Louis, Missouri

## DAILY DOSIMETER READING COVERING TIME PERIOD OF FILM BADGE

Film Badge Date \_\_\_\_\_ Film Badge Number \_\_\_\_\_

Landsverk Dosimeter No. \_\_\_\_\_

\_\_\_\_\_ Dosimeter No. \_\_\_\_\_

DAY	DATE	READING START OF SHIFT	READING END OF SHIFT	TOTAL DAILY DOSE	X-RAY ONLY ✓	GAMMA RAY ONLY ✓	COMBINATION GAMMA AND X-RAY ✓
MONDAY							
TUESDAY							
WEDNESDAY							
THURSDAY							
FRIDAY							
SATURDAY							
SUNDAY							
MONDAY							
TUESDAY							
WEDNESDAY							
THURSDAY							
FRIDAY							
SATURDAY							
SUNDAY							

2 WEEK TOTAL

Name \_\_\_\_\_

ATTACHMENT 10

BY-PRODUCT LICENSE AUDIT PROCEDURE

1. Audits will be performed at intervals not to exceed three months.
2. The Radiation Safety Officer, Chief Radiographer or Shift Lead Radiographer, shall perform these audits using the attached check-list as a guide.
3. Audits will be unscheduled and unannounced.
4. Copies of audit reports will be sent to D. L. Frazier, Chief NDT Engineer.
5. Any unacceptable findings during the performance of actual radiographic operations shall be cause for the cessation of that operation until the unacceptable condition has been corrected to the satisfaction of the R.S.O.
6. Any equipment found unacceptable shall be tagged and not used until repaired to the satisfaction of the R.S.O.
7. All unacceptable items shall be corrected as soon as possible and reaudited for acceptability.
8. Unacceptable findings of a recurring nature shall be brought to the attention of the Director of Research, Development and Quality Assurance for appropriate corrective action.

QUARTERLY PERSONNEL PERFORMANCE

NAME \_\_\_\_\_ DATE \_\_\_\_\_

LOCATION \_\_\_\_\_

The following items are to be observed:

	YES	NO
1. Dosimeter on & zeroed	_____	_____
2. Film badge on	_____	_____
3. Calibrated & operable survey meter in use	_____	_____
4. Equipment inspected before use	_____	_____
5. Safe radiographic set up made & maintained	_____	_____
6. Area posted & secured as required	_____	_____
7. Proper surveillance of the area maintained	_____	_____
8. Proper survey of projector and guide tubes made	_____	_____
9. Proper storage of projector upon completion	_____	_____
10. Utilization log completed	_____	_____
11. Daily maintenance log completed	_____	_____
12. Dosimeter reading recorded	_____	_____

COMMENTS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OBSERVED BY: \_\_\_\_\_

ATTACHMENT 10

INSPECTION AND MAINTENANCE PROGRAM

The purpose of this program is to provide a positive preventive and corrective maintenance system for all radiographic devices, storage containers for byproduct material, and safety equipment. The program consists of two parts: the first part is a detailed inspection of all byproduct material handling equipment and will be carried out at intervals not to exceed three months; the second part is a daily inspection, by the radiographer, of any radiographic exposure device or storage container that he uses during the work shift.

The detailed inspection of all equipment will be performed by the Chief NDT Engineer and/or the Chief Radiographer. A check list form shall be used to assure thorough inspection and this form shall be signed and dated by the inspector and retained on file as a permanent record of the inspection. A sample of this form is shown on pages 24, 25 & 26.

The daily inspection of individual radiographic exposure devices and storage containers will be performed by the radiographer as the equipment is used. A check list form (see page 23) shall be used and shall be signed and dated by the radiographer using the equipment and retained on file as a permanent record. Radiographers will be given specific instruction on how this inspection should be performed.

If any components essential to the safe operation of the device inspected are found to be defective, or in poor operating condition, the device shall be immediately tagged as defective and removed from service until repairs are made. The tag placed on the equipment may be removed only by the Chief NDT Engineer or the Chief Radiographer after repairs are made.

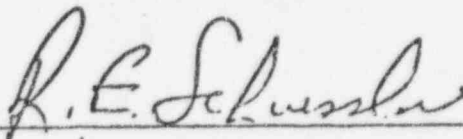
This program shall be implemented and strictly adhered to by the radiographic personnel under the direction of the Chief NDT Engineer.

Signed



Dennis L. Frazier  
Chief NDT Engineer

Approved



R. E. Schuessler  
Director of Research,  
Development & Quality  
Assurance

ATTACHMENT 10

RADIOGRAPHIC DEVICES AND STORAGE CONTAINERS INCLUDED IN THE  
MAINTENANCE PROGRAM

1. Technical Operations Model 676 Panoramic Gamma Ray  
Projector.
2. Technical Operations Model 660 Panoramic Gamma Ray  
Projector.
3. Technical Operations Model 773 Gamma Survey Meter  
Calibration Unit.

ACCESSORIES AND SAFETY EQUIPMENT INCLUDED IN THE MAINTENANCE  
PROGRAM

1. Rayguide Collimator.
2. Guide Tube Extension.
3. Technical Operations Mark II Gammalarm Type 1N93811,  
Electric Eye Audio, and Visual Alarm System (see  
attachment 6-a).
4. Door latches and locks on Building 302 (see attachment  
6-2).



## DAILY EQUIPMENT CHECK

EQUIPMENT USED

<input type="checkbox"/>	T.O. 660 Ser. No. 3484
<input type="checkbox"/>	T.O. 660 Ser. No. B2065
<input type="checkbox"/>	T.O. 660 Ser. No. B1778
<input type="checkbox"/>	T.O. 676B Ser. No. B103
<input type="checkbox"/>	_____

- |                          |     |   |
|--------------------------|-----|---|
| <input type="checkbox"/> | Yes | Labels properly attached and legible.   |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Guide tube free from kinks, dents, and threaded connections okay.                             |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Odometer functioning properly.  |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Source Cable connectors okay.   |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Crank mechanism operating freely.   |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Lock mechanism operating freely.  |
| <input type="checkbox"/> | No  |   |
| <input type="checkbox"/> | Yes | Survey of projector after use indicates safe condition. (If not, follow emergency procedure.) |
| <input type="checkbox"/> | No  |   |

### NOTES:

\_\_\_\_\_  
\_\_\_\_\_

If answer is "No" to any of the above, briefly describe problem in notes, and contact your supervisor immediately.

Radiographer: \_\_\_\_\_  
Date: \_\_\_\_\_



## MAINTENANCE CHECK LIST

INSPECTOR \_\_\_\_\_

DATE \_\_\_\_\_

11. T.O. Model 773 Gamma Survey Meter Calibration Unit.

- |                          |     |                                       |
|--------------------------|-----|---------------------------------------|
| <input type="checkbox"/> | YES | Labels properly attached and legible. |
| <input type="checkbox"/> | NO  |                                       |
| <input type="checkbox"/> | YES | Source identification tag in place.   |
| <input type="checkbox"/> | NO  |                                       |
| <input type="checkbox"/> | YES | Shutter mechanism operating freely.   |
| <input type="checkbox"/> | NO  |                                       |
| <input type="checkbox"/> | YES | Locking mechanism operating properly. |
| <input type="checkbox"/> | NO  |                                       |

12. ☐ YES Rayguide collimator checked and in proper working condition.
- ☐ NO

13. ☐ YES Guide tube extensions checked for inside restrictions and thread connections checked and in proper condition.
- ☐ NO

## MAINTENANCE CHECK LIST

INSPECTOR \_\_\_\_\_

DATE \_\_\_\_\_

14. ☐ YES      Gammalarm functioning properly.  
☐ NO
- ☐ YES      Electric eye & maze warning signal horn  
              functioning properly.  
☐ NO
- ☐ YES      Warning lights in maze and control room  
              working properly.  
☐ NO
- ☐ YES      External warning lights on building 302  
              working properly.  
☐ NO
- ☐ YES      Radiation warning signs in place on  
              building.  
☐ NO
- ☐ YES      Doors, latches, & locks on building 302  
              operating properly.  
☐ NO

### SUMMARY OF INSPECTION:

- ☐ All items in good operating order.
- ☐ Corrective action needed as described  
below:

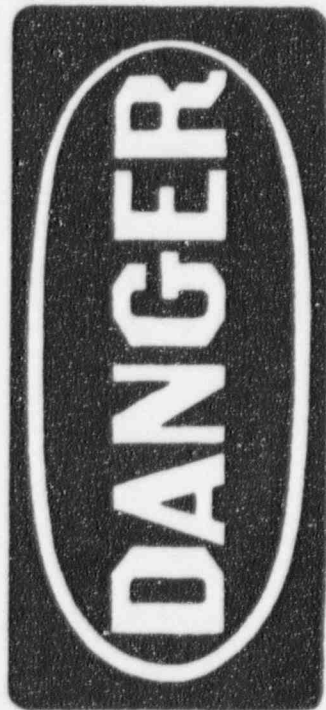
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**DO NOT REMOVE THIS TAG**

**TO DO SO WITHOUT**

**AUTHORITY WILL MEAN**

**IMMEDIATE DISCHARGE.**

**IT IS HERE FOR A PURPOSE**

**SEE OTHER SIDE.**

STONEHOUSE SIGNS, Inc., Denver, Colo.—Accident Prevention Signs & Tags



Do Not USE

Crank not operating  
properly



Signed by

W. J. Jansen

Date

5/30/99

## ATTACHMENT 10

To clean the unit:

1. Insert shipping plug. With the plug inserted it is not possible for the radioactive source to come out of the container in either direction.
2. Untie any clamps or tape on the control cables.
3. Unhook the feed hose at the shield case and pull out the source cable.
4. Crank the guide cable out as if extending the source.
5. Slack source cable should be coiled into a bucket as it is removed from between the loose hose end and the shield case.
6. Pour in vy-thene (Trichlorethylene), gasoline, naptha - No water or detergent.
7. Scrub cable with a bristle brush.
8. Feed into a clean dry box, drying the cable and checking for kinks as this is done.
9. Feed back into bucket (now dry) so as to get proper direction of coiling and oil with 3 in 1 oil or Texaco Unitemp grease as this is done.
10. Disassemble and clean the gear box.
11. Blow out the hoses.
12. Feed source cable back into drive control hose until it is engaged with the gear box and then crank remainder of cable through.
13. Above all, keep the cable clean.



SOURCE ADRIFT

The emergency retrieval of sources is the responsibility of the Radiation Safety Officer and radiographers designated by him. Should outside assistance be needed, Amersham, Inc. will be employed.

Each source tube extension is 7 feet long and up to three such extensions can be added. If additional extensions are used, you can crank the source cable out of the control box. This results in the source being adrift somewhere in the guide hoses.

To remedy this:

1. Stand behind the shield case.
2. Unhook the "drive" control cable hose from the shield case.
3. Pick up the source cable slack.
4. Pull the source back into position in the shield case by hand by walking away with the source cable.
5. Feed the source cable back into the control box by hand. When engaged, use the handle drive to take up the remainder of the slack.
6. Reconnect source cable hose.

BROKEN SOURCE CABLE

A heavy weight such as a dropped casting or metal wheeled truck on the control cables or source tube extensions could conceivably sever the housing and the source cable inside. Also, if the source cable is kinked and severely jammed, you will have to cut the cable and treat it as if it has been severed or broken. Usually such damage would occur on the control side of the shield case since the source side is either roped off or in a protected area.

- A. If the source cable is cut on the control box side of the shield case, follow the procedure described in the "Source Adrift" section.
- B. If the cable is cut on the source side of the shield case, you will be confronted with one of two situations:
  - a. Cable cut near shield case -- Disconnect the "drive" control cable and remove the remainder of the control cable still attached to the control box assembly from the shield case. Now feed the section of the source through the shield case by hand. As quickly as possible, pull the source into the safe position within the shield case.
  - b. Cable cut near source -- Cover the source with a material such as sand so as to reduce the radiation hazard. After obtaining long handling tools and a source changer, you can then put the source into the source changer.

If the cable is cut very close to the source, the entire iridium source can be dumped into a barrel of water for purposes of reducing radiation.

## ATTACHMENT 10

### LEAK-TESTING OF SEALED SOURCES

Sealed sources will be tested for leakage and/or contamination in accordance with the following:

1. Leak tests will be performed by persons specifically licensed by the Commission to perform such tests. Pursuant to Section 34.25 of Part 34, the licensee will perform test for leakage or contamination of the sealed sources authorized by this license in accordance with procedures contained in Technical Operations Model 518 Leak Test Kit.
2. Each sealed source containing byproduct material with a half-life greater than thirty (30) days and in any form other than gas, shall be tested for leakage and/or contamination as follows:
  - A. As appropriate test for leakage and/or contamination shall be performed on the sealed source surface, or on the accessible surfaces of the device in which such a sealed source is permanently or semipermanently mounted. The test shall be performed upon receipt of a source from another person, unless the licensee receives certification from the person making the transfer that the sealed source has been tested within thirty (30) days prior to transfer and found free of any removable radioactive material.
  - B. Following completion of the test prescribed in 2A, each sealed source shall be tested for leakage and/or contamination at intervals not to exceed six (6) months.
3. The test performed pursuant to 2 shall be sufficiently sensitive to detect 0.005 microcuries of removable beta and/or gamma emitting radioactive material. Records of leak test results shall be maintained by the licensee.
4. If the test performed pursuant to 2A or 2B reveals removable radioactive material, the licensee shall take immediate action to prevent spread of contamination and, within five (5) days after completion of the test, shall notify the Isotopes Branch, Division of Licensing and Regulation, U.S. Nuclear Regulatory Commission, Washington, D. C. 20525.
5. Repair of sources shall be performed by the manufacturers of the source or by persons specifically licensed by the commission to perform such repairs.
6. Leak tests at Nooter Corporation will be made by R. N. Horton Chief Radiographer, or D. L. Frazier Chief NDT Engineer, using the Technical Operations Model 518 Test Kit. Data will be analyzed and reported by Technical Operations and will be maintained in the Nooter files.

LEAK TESTING OF SEALED SOURCE (CONTINUED)

## 7. The test procedure will be as follows:

## A. Check contents of the Model 518 Kit for the following:

Contents:       Flexible swab holder with swab  
                  Vial of EDTA solution  
                  Plastic envelope  
                  Mailing box  
                  Identification sheet

- B. Be sure source is fully retracted into projector. (Use a survey meter to be sure that radiation levels are normal.)
- C. Remove source tube from face of shield or remove shipping plug.
- D. Wet the swab with EDTA solution. Shake off excess and insert the swab into the hole in the shield. Wipe the interior of the hole thoroughly by rotating swab holder.
- E. Withdraw swab and place in plastic envelope.
- F. The swab should not be monitored by turning the survey meter to its most sensitive range. Place the meter in a low background area and move the swab in its plastic envelope to the meter, not the meter to the swab.
- G. If there is no indication on the meter, or if the indication is no more than 0.2 MR per hour above background, put the plastic envelope with the swab in the mailing box and mail to Technical Operations, Incorporated, Burlington, Massachusetts. Be sure to fill out and return the identification sheet.
- H. If the swab should show more than 0.2 MR per hour, do not mail. Contact the Radiation Safety Officer who will notify Technical Operations, Inc., for specific instructions.

EMERGENCY      PROCEDURE

CO<sup>60</sup>      AND      IR<sup>192</sup>

IN CASE OF FAILURE OF EQUIPMENT TO RETURN SOURCE TO SAFE

1. ROPE OFF, POST, AND RESTRICT THE 2 MR/HR RADIATION LEVEL BOUNDARY.
2. POST GUARDS TO KEEP PERSONNEL AWAY.
3. NOTIFY:

D. L. FRAZIER	314-441-0967
D. E. CENTER	314-775-5747
R. N. HORTON	314-771-9637
R. J. TOENJES	618-233-2002
AMERSHAM REP.	800-225-1383
4. START AT THE TOP OF THE LIST AND CALL UNTIL ONE OF THE ABOVE PEOPLE IS CONTACTED. EXPLAIN THE PROBLEM, THEN RETURN TO THE ACCIDENT SITE AND STAND GUARD UNTIL HELP ARRIVES.

NOOTER CORPORATION  
X-Ray Department  
St. Louis, MissouriUTILIZATION LOG FOR ISOTOPE RADIOGRAPHY

Date \_\_\_\_\_ Shop Order No. \_\_\_\_\_ Exposure No. \_\_\_\_\_

Type of isotope \_\_\_\_\_ Curies \_\_\_\_\_

Projector type \_\_\_\_\_

Time source was out of safe \_\_\_\_\_  
a.m. \_\_\_\_\_  
p.m. \_\_\_\_\_

Exposure time (in hours or minutes) \_\_\_\_\_

Time source was back in safe \_\_\_\_\_  
a.m. \_\_\_\_\_  
p.m. \_\_\_\_\_Survey meter reading at surface of projector  
when source is back in safe \_\_\_\_\_ mr/hr

Survey meter reading at control box during exposure \_\_\_\_\_ mr/hr

Radiation area boundary survey during exposure,  
maximum hourly exposure at boundary \_\_\_\_\_ mr

Radiographer's name \_\_\_\_\_

Radiographer's assistants name \_\_\_\_\_

Location (plant or field) \_\_\_\_\_

Survey meters used Ser. No. \_\_\_\_\_

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## ATTACHMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

Prerequisites necessary before using exposure devices:

1. Two radiographers or one radiographer and one radiographer's assistant must be on site during each usage.
2. Each operator must have a film badge and pocket dosimeter in either the shirt pocket or on the belt at the front part of the body. The dosimeter must be charged and zeroed at the start of the shift.
3. Each operator must have a Victoreen Model 592B, Victoreen Model 492 or Victoreen Model 692 Survey Meter during each usage of any exposure device. Check the calibration due date and the tag on each instrument to be sure that it is properly calibrated.
4. Check the area where you are to make the exposure to assure that no personnel are present.
5. Check the source strength from the source decay chart on the specific source which you will use and calculate the exposure time and the theoretical distance to the 2 mr/hr boundary. This calculation should account for any existing shielding. If the source is used in building 302 with the control behind the maze, the boundary calculation is not necessary.
6. Procure the following forms to be completed during and after each usage of the exposure device.  
  
Nooter Form 279 Exposure Duration & Record of Survey  
Nooter Form 512 Daily Equipment Check
7. If the above prerequisites are met then proceed to the operating instructions for the equipment which you will use.



## ATTACHMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

#### Operation of the T/O Model 660 and 676 Exposure Devices

1. Locate the exposure device in the area where the exposure is to be made and turn on your survey meter so that it is operating.
2. Rope the boundary of the 2 mr/hr area as theoretically calculated and post "CAUTION RADIATION AREA" signs at the boundary. Post a "CAUTION HIGH RADIATION AREA" sign at the 100 mr/hr boundary. If the exposure device is to be used in Building 302 with the control in the maze, these signs are permanently posted; however, check all doors to assure they are closed and locked.
3. Take the "Daily Equipment Check List," Form 512, and complete the entire daily check procedure as outlined on the form. This daily inspection must be done in its entirety prior to the use of an exposure device on each shift in which it is used.
4. Locate the source shield at the desired distance from the specimen to be radiographed. Place the control unit at the maximum distance allowed by the cables from the shield and behind a protective shield. Lay out the control cables and guide tube cable in as straight a line as possible. (Too many bends or a small radius bend may restrict movement of the drive cable.)
5. Remove the shipping plug and connect the source guide tube in its place. Connect the signal light cable. As soon as the signal cables are connected, the "SAFE" lamp on the model 533 and 520 control units should begin flashing. Note: Use your survey meter to assure that your work area is 2 mr/hr or less during this operation.
6. Mount the source stop firmly (using a tripod stand and clamp, or a permanent mounting jig) with the tip of the stop in the exact exposure position.
7. Check to see that no personnel are near the 2 mr/hr boundary and go with your assistant to the control unit. Turn the hand crank steadily in a counter clockwise direction to move the source out of the source shield to the exposure position. If undue resistance is encountered, reverse the direction until the unit operates smoothly. DO NOT FORCE THE CRANK. If after several reversals, cranking is still difficult, return the source to the safe position and secure. Use your survey meter to determine that the area is less than 2 mr/hr, and contact your supervisor.

## ATTACHMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

8. When the source reaches the exposure position, note the survey meter readings to assure that you are in a 2 mr/hr or less area and survey the perimeter of the theoretically calculated boundary. If the boundary must be adjusted, retract the source and do so.  
REMEMBER: ALWAYS CARRY YOUR SURVEY METER WITH YOU.
9. When the exposure is completed, retract the source by turning the crank clockwise until "SAFE" storage is indicated. With your survey meter, slowly approach the source shield and perform a physical radiation survey of the source shield and the entire guide tube to determine that the sealed source has been returned to its shielded position.
10. Disconnect the guide tube, insert the shipping plug and lock and return equipment to storage area. NOTE: The exposure device is to be locked between each exposure so that there can be no accidental exposure while setting up the next exposure.
11. Perform a physical radiation survey to determine that the sealed source is in its shielded condition prior to securing the radiographic exposure device and storage container.
12. Complete and sign the "Daily Equipment Check List" Form 512.
13. Complete the "Exposure Duration and Record of Survey," Form 279, and record the boundary survey.
14. Check and record your dosimeter reading at the end of the work shift. Read your dosimeter frequently during the course of your work shift.
15. If, at any time during operation of an exposure device or at the end of the work shift, your dosimeter is found to be off scale, immediately contact your supervisor.
16. At any time should a source manipulator malfunction in such a manner that it cannot be returned to its shielded condition, the operating personnel shall follow the emergency procedure on the following page.

## ATTACHMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

#### General Instructions:

1. The maximum permissible dose for radiological personnel shall not, in general, exceed 1-1/4 Roentgens per calendar quarter. This maximum may be as high as 3 rems per quarter provided the accumulated dose to the whole body does not exceed 5(N-18) rems where "N" equals the individual's age at his last birthday and Form NRC-4 has been completed for the individual. Forms NRC-4, completed for each individual, are on file in the NDT Office.
2. The maximum permissible exposure for non-radiological personnel is 1/10 that of the foregoing paragraph.
3. Personnel using sealed sources in any radiographic setup shall be required to wear a film badge and a pocket dosimeter.
  - A. The film badge shall be assigned to and worn by only one person.
  - B. Pocket dosimeters, whether direct or indirect readings, shall be capable of measuring doses of from zero to at least 200 milliroentgens.
4. Pocket dosimeters shall be read and doses recorded at the end of each shift. A film badge shall be immediately processed if a pocket dosimeter is discharged beyond its range. All records shall be maintained for inspection by the Nuclear Regulatory Commission.
5. During each radiographic operation the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area.
6. Areas will be roped off, restricted, and "CAUTION RADIATION AREA" signs displayed at the 2 mr level. A "HIGH RADIATION AREA" sign will be placed at the location where the source will be during the exposure. Only signs as described in 10 CFR Part 20 will be used. At night, red warning lights will supplement the signs.
7. Calibrated and operable radiation survey instrumentation shall be used on each radiographic exposure.
  - A. The range of this instrument shall be from 2 mr/hr through 1 Roentgen/hr.
  - B. At three month intervals the instruments must be recalibrated.
  - C. All survey instruments will be marked with their latest date of calibration.

OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

8. A physical radiation survey shall be made after each radiographic exposure during a radiographic operation to determine that the sealed source has been returned to its shielded condition.
9. Likewise a similar survey shall be made to determine that the source is in its shielded condition prior to removing control cables and locking and securing the exposure device.
10. Records shall be kept of the surveys required by foregoing paragraph (9) of this section and maintained for inspection by the licensor.
11. When the exposure devices are not in use, they shall be locked in building 302.
  - A. Building 302 shall be accessible only to radiographic personnel.
  - B. Temporary job sites will be provided with a steel "walk in" size vault for storage of the exposure devices. This vault will be placarded with the approved radiation symbol, and the words "CAUTION RADIOACTIVE MATERIAL," on four sides. This vault will be locked and access restricted to radiographic personnel only.

The steel "walk in" size vault for storage of exposure devices at temporary job sites is 4 feet wide by 6 feet high by 6 feet long, constructed of 10 gauge steel reinforced with 4 inch steel channel framing. The steel door is equipped with padlocks for securing. This vault is used for storage of the Technical Operations Model 660 at field job sites to prevent theft. The vault is taken to temporary job sites by truck prior to shipment of the exposure device. The vault is not moved or transported with the exposure device inside.

12. Exposure devices, preparatory to transporting to field locations, shall be guyed down to the floor of the vehicles conveying them. They must be isolated so that no heavy objects can fall or be caused to slide into them.
13. Vehicles carrying exposure devices which require the "RADIOACTIVE YELLOW III" label will be placarded "RADIOACTIVE" with black letters on a yellow background.

Each marking or placard shall consist of letters not less than 4 inches high using approximately a 5/8 inch stroke. The placard will be larger than the lettering by at least one inch and will be in an area on the vehicle free from other marking or graphic display. Marking or placard will be placed on all four sides of the carrier vehicle.

ATTACHMENT 10

OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

14. A radiation survey of the shipping container, the exterior of the vehicles, and the passenger compartment shall be made. The dose rate at the surface of the shipping containers shall not exceed 200 mr/hr at any point. All passenger areas and exterior surfaces of the carrier vehicle shall be 2 mr/hr or less prior to transporting.
15. In case of a vehicular accident, particularly one resulting in a fire, obtain survey instrumentation and perform a physical radiation survey of the device. If a fire is eminent or occurring strive to extinguish it by use of portable fire fighting equipment and call the nearest fire department.
16. If dangerous exposure should exist subsequent to an accident, the personnel shall take proper measures with ropes and signs to restrict the area from onlookers until such time as Technical Operations - Radiation Products Div. - Burlington, Mass. 01803 (800-225-1383) is contacted.



## ATTACHEMENT 10

### OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

#### Replacement of Sources: (Radiographers Only)

This procedure is for the replacement of Iridium 192 sources using Technical Operations Source Changers. It is also applicable to the storage of Iridium 192 sources in the source changer while performing maintenance and/or inspection checks on various components of Iridium 192 projectors.

1. Obtain survey meter and allow for warm up before zeroing.
2. Monitor the source changer. Surface radiation should be less than 2 mr/hr per curie of source strength contained within. If radiation level is higher, proceed as directed in the Operating and Emergency Procedures.
3. Move the source changer to the desired area and post and restrict this area in order to prohibit entry by unauthorized personnel.
4. Set up the source projector with the source to be replaced within one source guide tube length (approximately seven feet) of the source changer.
5. Remove the cover from the source changer.
6. Remove the source guide safety retainer plates from the changer.
7. Open the source guides on the channel without the source identification tag. This channel should be empty.
8. Remove the cap and hold down rod from the empty channel.
9. Connect the source guide tube to the empty channel and close source guides.
10. While monitoring the survey instrument, connect the source guide tube to the projector. Check the guide tube for sharp bends to insure proper travel of the source into the changer.
11. While continuously monitoring, crank the source into the changer as far as it will go.
12. If the radiation level is 2 mr/hr or less, it is safe to enter the area and monitor the changer for proper radiation level. (Keep in mind that the changer now contains two sources, and the radiation level will be higher accordingly.)
13. Open the source guides and disengage the source drive cable from the source. Do not pull up on the drive cable while the source is engaged.






OPERATING AND EMERGENCY PROCEDURES FOR RADIOGRAPHERS AND RADIOGRAPHER'S ASSISTANTS

14. Disconnect the source guide tube, close the source guides and replace the cap and hold down rod.
15. Open the source guide and remove the cap and hold down rod from the other channel.
16. Connect the source guide tube and engage the new source on the drive cable.
17. Retrieve the new source into the projector.
18. If the radiation level is 2 mr/hr or less, enter the area and disconnect the source guide tube and secure the projector.
19. Close source guides and replace cap and hold down rod on empty channel. Remove new source identification tag.
20. Affix old source identification tag to the channel containing the old source with seal wire.
21. Replace source guide safety retainer plates and changer cover and seal with tamperproof seals provided.
22. Affix new source identification plate to the projector.
23. Survey the package at the surface and at three feet from the surface to determine the proper radioactive shipping labels to be applied to the package. Use the criteria of Table 1.
24. Properly complete two shipping labels indicating the contents (<sup>192</sup>Iridium, <sup>60</sup>Cobalt, etc.), the number of curies and the Transport Index (maximum radiation level measured at three feet from the surface of the package; used on Yellow II and Yellow III labels only).
25. Insure that any old shipping labels have been removed from the package. Apply the two properly completed radioactive shipping labels to two opposite sides of the package.
26. Mark the outside of the package with the proper shipping name (Radioactive Material, Special Form, n.o.s.) if not already marked.
27. If a shipping container is packaged inside a crate or other packaging mark the outside package "Inside Container in Accordance with \_\_\_\_\_". (Fill in the blank space with the appropriate DOT Specification Number of Type B Certificate Number) and the words "TYPE B" or "TYPE A" if applicable.

28. Perform a radioactive contamination wipe test of the shipping package and insure that the wipe test does not exceed 0.001 microcuries per 100 square centimeters.
29. Properly complete the shipping papers indicating:
  - a. Proper shipping name (i.e. Radioactive Material, Special Form, n.o.s.)
  - b. Name of Radionuclide (i.e.  $^{192}\text{Iridium}$ ,  $^{60}\text{Cobalt}$ )
  - c. Physical or chemical form (or Special Form)
  - d. Activity of Source (expressed in curies or millicuries)
  - e. Category of Label applied (i.e. Radioactive Yellow III)
  - f. Transport Index
  - g. USNRC Identification Number or DOT Specification Number (i.e. USNRC: USA/9032/B or DOT-7A)
  - h. Shipper's Certification:

"This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation."

TABLE 1

	Surface	3 Feet
RADIOACTIVE-WHITE I. 	0.5mR/hr	None
RADIOACTIVE-YELLOW II 	50mR/hr	1.0mR/hr
RADIOACTIVE-YELLOW III 	200mR/hr	10mR/hr

## 7. SOURCE CHANGES

### 7.1 General

Source changers are used to transport sources between manufacturer to user.

Using guide tubes the changer is coupled to a projector and the old source is transferred from the projector to an empty channel in the changer. [The empty projector may be serviced now].

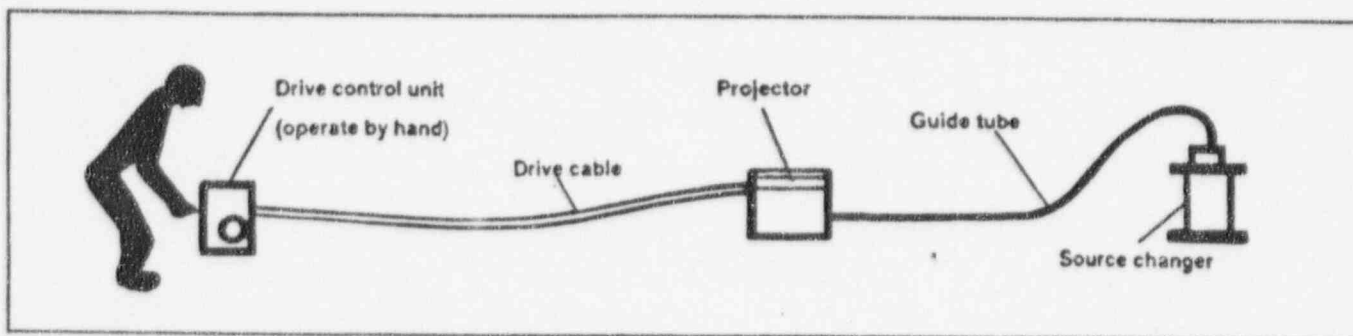
Then the new source is transferred from changer to projector. Finally the changer is returned to the manufacturer.

**KEEP THE CHANGER UPRIGHT** to retain the source inside the shield.

- (c) Remove the shipping plug from the source projector. Attach an intermediate source guide tube.

Remove the source changer cover and attach the other end of the tube to an empty channel of the changer as described in the source changer manual.

- (d) Attach a drive cable control to the projector as in Section 5.5



Source changes must be carried out in a restricted area. [see Section 3]

The user must be trained and qualified to carry out this operation. In the USA, the user must be specifically licensed to do this operation by the USNRC or Agreement State.

A source change can be arranged on request at one of Amersham's service centers or in the field.

**See the appropriate manual for information specific to the source changer used.**

(This is shipped with the changer, usually inside the cover with return labels etc.).

### 7.2 Transfer: projector to changer

- (a) Survey the source changer to ensure the source is in the proper storage position. The dose rate at the surface should be less than 2mSv/h (200mR/h).

Check that there is no visible damage and that all seals are intact.

**Report damage or excessive radiation to the Supervisor and to Amersham.**

- (b) Position the changer and projector close together so that one section of source guide tube will connect them with no sharp bends. The bend radius of the guide tube should never be less than about half a meter (20 inches). Smaller bend radii can restrict movement in the guide tube.

Note that if a Model 957 automatic control unit is used, the power key must be removed and the handle fitted to operate the unit manually.

Crank the source rapidly from the projector fully into the source changer.

During this process, the survey meter reading should increase as the source is first exposed, fall slightly as the source is being cranked out then drop to background when the source is in the source changer.

- (e) Approach the source changer and source guide tube with the survey meter to ensure that the source is **fully within** the changer. The dose-rate should be less than 2mSv/h (200mR/h) at the surface and less than 100mSv/h (10mR/h) at 1 meter from the surface.
- (f) Lock the source in place (some models). Disconnect the drive cable from the source. Disconnect the source guide tube from the changer. If a new source is not to be transferred from the changer to the projector immediately, or if the projector is to undergo maintenance, connect the drive cable to the test connector (found inside the selector cover) and withdraw it into the projector storage position.

Secure the source in the changer and replace the cover. Wire the source identification plate to the changer.

### 7.3 Transfer: changer to projector

- (a) If a replacement source is to be installed in the projector, connect the source guide tube to the fitting above the channel containing the new source and couple the drive cable to the new source.

- (b) Return to the controls and retract the new source rapidly into the projector.

The survey meter reading should increase as the source leaves the changer and approaches the projector, then drop to background when the source is shielded in the projector.

- (c) Survey the projector to ensure that the transfer has been properly completed. Radiation should be less than  $2\text{mSv/h}$  ( $200\text{mR/h}$ ) at the surface and less than  $100\mu\text{Sv/h}$  ( $10\text{mR/h}$ ) at 1 meter.

Rotate the projector selector ring to the LOCK position.

- (d) Survey the source guide tube and source changer to confirm that the source has been correctly transferred.

- (e) Disconnect the guide tube from the changer and secure the source(s) in accordance with the instructions for the particular unit used.

- (f) Disconnect the control unit and source guide tube from the projector and replace the shield plug. Fix the new source identification plate firmly to the projector.

### 7.4 Source identification

The position and identity of each source must always be clearly defined.

Fix the new source identification plate to the projector and wire the old source identification plate to the changer over the chamber that contains the old source at the time when each transfer is made.

Attach a green "EMPTY" label to any unit which no longer contains a source.

### 7.5 Transport

- (a) Bolt the source changer cover in place and secure it with seal wire.

Survey the unit to ensure that radiation levels do not exceed  $2\text{mSv/h}$  ( $200\text{mR/h}$ ) at the surface nor  $100\mu\text{Sv/h}$  ( $10\text{mR/h}$ ) at 1 meter.

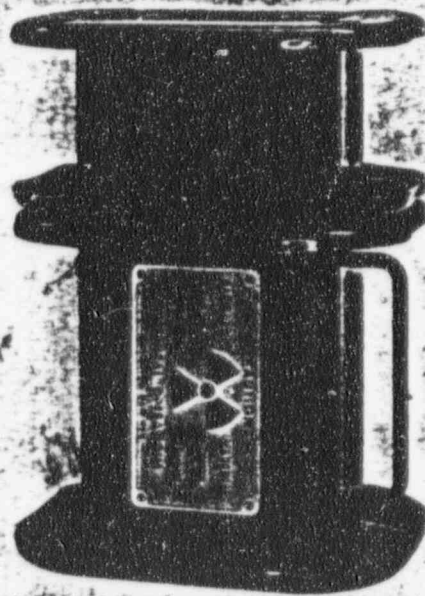
- (b) Calculate the  $T1 = \text{mR/hr}$  (or  $0.1 \times \mu\text{Sv/h}$  at 1 meter from surface and determine the correct shipping label. [see Section 4]

- (c) Return the source changer promptly to Amersham to avoid being invoiced for Demurrage charge due to delayed return.



# OPERATING INSTRUCTIONS

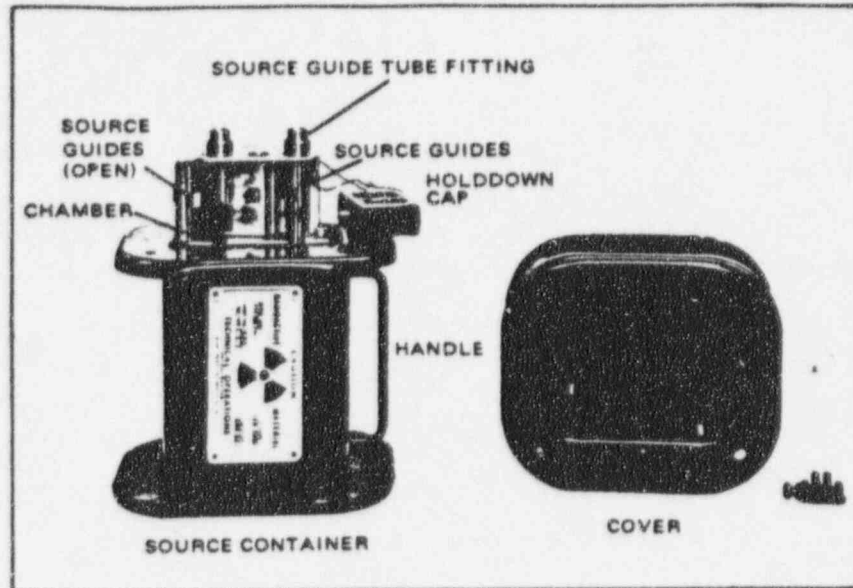
## SOURCE CHANGER Model 650



TECH/OPS, INC.  
Radiation Products Division  
Burlington, MA 01803



## ATTACHMENT 10



Model 650 Source Changer  
(Source in a chamber - Parts Identification)

### NOTICE

This container is for shipping only licensed sources of Tech/Ops, Inc. No attempt to use the equipment should be made unless the user is thoroughly familiar with the instructions in this manual.

### USER WAIVER AGREEMENT

The user agrees that Tech/Ops, Inc. is not liable for any claims alleged to be due to use of the product.

The NRC forbids the use of this equipment and the exchange of sources unless the user is specifically authorized by the terms of his license.

If user is not authorized to make source changes, contact Tech/Ops, Inc. It has licensed personnel that can perform this operation. If user wishes to be licensed to perform source changes, application should be made to the Materials Branch, Office of Nuclear Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. The application, in letter form, should specify by whom and under what conditions source exchanges are to be made. Refer to this instruction manual for detailed procedures. Additional copies may be obtained for incorporation in your operating procedures manual.

Prior to the first use of this source changer, the user, in addition, should register as such with the Transportation Branch, Office of Nuclear Safety and Security, U.S. Nuclear Regulatory Commission. The user should have in his possession a copy of Certificate of Compliance No. 9032 issued for this source changer.

## GENERAL DESCRIPTION

The Source Changer Model 650 is a portable, shielded container for transferring encapsulated radioisotope sources into radiography projectors. The changer is designed to safely contain the radiographic sources during shipment and to permit field exchange of old for new sources without exposing the operator to unsafe radiation levels. The source changer has depleted uranium for shielding.

## QUICK REFERENCE DATA

Source Types	Sealed sources (Tech/Ops sources only) Isotope: Iridium-192 Radiation: Gamma rays
Container capacity	Iridium-192: 200 Curies + 20%
Shielding	Depleted Uranium (U238), weight 35 lbs.
Housing	Steel
Design	Type B Radioactive Material Shipping Container (USNRC Certificate of Compliance No. 9032 and IAEA Certificate of Competent Authority No. USA/9032/B(U)T)
Effective radiation shielding	Well below regulatory mR/hr limits prescribed in 10CFR34.21 and 49CFR-173.393(i)
Dimensions	13¼ in. H X 10 in. L X 8¼ in. W
Shipping weight	66 lbs.

## SHIPMENT DATA

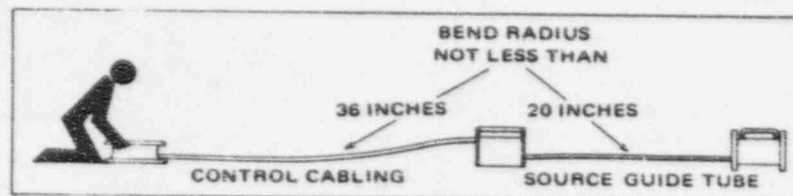
1. Source decay chart and leak test certification. Keep for user's records.
2. Source identification (ID) plate. Affix to user's projector.
3. Return shipping labels.
4. Tamperproof seals.
5. Instruction manual.

## OPERATION

**NOTE:** All the precautions used when making radiographic exposures must be followed.

**Wear personnel monitoring devices during all source changing operations. Monitor all operations with a calibrated, operable survey meter.**

1. Upon receipt of the source changer, survey the source changer to ensure that the source is in the proper storage position.
2. Locate the source changer and projector in a restricted area. Locate the devices so as to avoid sharp bends in the guide tube or control cabling.



Typical Source-exchange Arrangement

3. Set the projector as for an exposure.
4. Remove the cover from the source changer by breaking the seal wire and removing the bolts.
5. Remove the source holddown cap by breaking the seal wire and unbolting.

**CAUTION:** When the source holddown cap is removed, the source connector is exposed. Care must be taken to ensure the source is not dislodged when handling the changer.




6. Connect one end of a guide tube extension to the projector and the other end to the fitting above the empty chamber in the source changer.
7. Close and latch the source guides.
8. At the projector controls, crank the source from the projector to the source changer.
9. Approach the projector with the survey meter. Survey the projector on all sides, survey the guide tube and survey the source changer on all sides to ensure the source has been properly transferred. The maximum radiation level at the source changer should be less than 200 milliroentgens per hour at contact.

10. Open the source guides. Disconnect the drive cable from the source assembly by moving the lock pin down and sliding the drive cable connector out through the keyway.
11. Disconnect the guide tube from the source changer. Connect the guide tube to the fitting above the chamber containing the new source.
12. Couple the drive cable to the source by depressing the lock pin, sliding the drive cable connector into the keyway, and releasing the lock pin. Test for proper engagement.
13. Close and latch the source guides.
14. At the projector controls, crank the source from the source changer to its storage position in the projector.
15. Approach the projector with the survey meter. Survey the projector on all sides, survey the guide tube, and survey the source changer on all sides to ensure the source has been properly transferred.
16. Lock the projector.
17. Disconnect the source guide tube from the source changer.
18. Affix the identification plate of the new source to the projector and attach the identification plate of the old source to the source holddown cap.
19. Bolt the source holddown cap in place and seal wire.
20. Bolt the source changer cover in place and seal wire.
21. Survey all exterior surfaces of the source changer to ensure that the radiation level does not exceed 200 milliroentgens per hour at contact.



Preparing Source Changer for Shipment

22. Measure the radiation level three feet from all exterior surfaces of the source changer and ensure that the radiation level is less than 10 milliroentgens per hour. The maximum radiation level measured three feet from any exterior surface is the Transport Index. (Example: With a maximum radiation level of 2.2 milliroentgens per hour, the Transport Index is 2.2.)
23. Select the proper shipping labels (Radioactive II or Radioactive III) according to the radiation levels at the surface and at 3 feet from the container. Complete the labels listing the radioisotope contained (Iridium-192). Indicate the activity as the number of Curies. Record the Transport Index as determined above.

	MAXIMUM RADIATION LEVELS	
	Surface	3 Feet
<b>RADIOACTIVE-WHITE I</b> 	0.5mR/hr	None
<b>RADIOACTIVE-YELLOW II</b> 	50mR/hr	1.0mR/hr
<b>RADIOACTIVE-YELLOW III</b> 	200mR/hr	10mR/hr

24. If a shipping container is packaged inside a crate or other packaging, mark the outside package "Inside package complies with prescribed specifications USA/9032/B(U) Type B".
25. Apply the shipping labels, properly completed, to two opposite sides of the container.

26. Properly complete the shipping papers (see samples on following pages) indicating:

Radioactive Material, Special Form, n.o.s. NA 9182  
Iridium-192 (X) \_\_\_\_\_ curies, and  
Radioactive Device, n.o.s. UN 2911  
Uranium-238, Solid Metal, 0.005 curies  
Radioactive (X) \_\_\_\_\_ Labels  
Transport Index (X) \_\_\_\_\_  
Package Identification Number USA/9032/B(U)

All (X) marks must be completed by the shipper.

And the Shippers Certification:

"This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation."

Notes: 1. For air shipments, the following shipper's certification may be used:

"I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in proper condition for carriage by air according to applicable national governmental regulations".

2. For air shipments, the package must be labeled with a "CARGO AIRCRAFT ONLY" label and the shipping papers must state:

"THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR CARGO-ONLY AIRCRAFT"

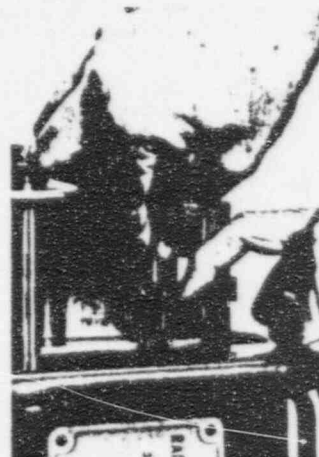
27. Return the container to Tech/Ops, Inc. according to proper procedures from transporting radioactive material as established in Title 49 Code of Federal Regulations, Parts 172-178.

28. See following page(s) for sample forms.

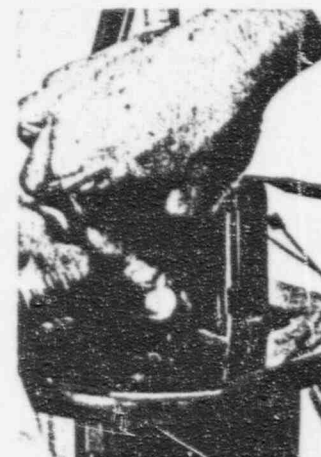
Complete the Shipping Certificate and Bill of Lading and fill in the necessary information in blocks marked (X).

#### NOTE

Please return container promptly. Rental charges will be made for containers held beyond normal transportation time.



Connecting/Disconnecting



Testing Connection

#### WARNING

Do not move source assembly more than 1/2 inch from its stored position when connecting/disconnecting or when testing for proper connection.

##### TO ENGAGE CONNECTORS

1. With fingernail move lock pin back from keyway. (Pressure on pin is downward toward stored position of source.)
2. Slide drive-cable connector into keyed sleeve and release pin.
3. Test connection by pulling between source and drive cable. (Note WARNING.)

##### TO DISENGAGE CONNECTORS

1. With fingernail move lock pin back from keyway.
2. Slide drive-cable connector out through keyway and release pin.

#### CAUTION

Move connector sideways only. Do not bend or twist.

Figure A. Procedure for engaging and disengaging the Model 550 source-assembly connector. Testing for proper connection must be performed.



# SAMPLE SHIPPERS CERTIFICATION FOR AIR CARGO SHIPMENT

## SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS

Two completed and signed copies of this certification shall be handed to the carrier.  
(Use block letters)

**WARNING:** Failure to comply in all respects with the applicable regulations of the Department of Transportation, 49 CFR, CAB 82 and, for international shipments, the IATA Restricted Articles Regulations may be a breach of the applicable law, subject to legal penalties. This certification shall in no circumstance be signed by an IATA Cargo Agent or a consolidator for international shipments.

This shipment is within the limitations prescribed for: (mark one)

☐ Passenger aircraft and contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment. ☒ Cargo aircraft only

NATURE AND QUANTITY OF CONTENT		PACKAGE			
PROPER SHIPPING NAME	RAADIOACTIVITY GROUP	FORM	ACTIVITY	CATEGORY	TRANSPORT MODE & TYPE
FOR U.S. SHIPMENTS: SEE SECTION 2, CAB 82, TABLE 2.0	MAST OR GROUP OF PRINCIPAL RADIOACTIVE GROUPS 1 TO VII	CHEMICAL FORM OR PHYSICAL STATE (e.g., LIQUID, SOLID, GASEOUS, SPECIAL FORM, SPECIAL FORM, SPECIAL FORM)	NUMBER OF CURIES	WHITE or YELLOW or YELLOW CORNERS LABEL	FOR U.S. SHIPMENTS: TYPE A, TYPE B, TYPE C, TYPE D, TYPE E, TYPE F, TYPE G, TYPE H, TYPE I, TYPE J, TYPE K, TYPE L, TYPE M, TYPE N, TYPE O, TYPE P, TYPE Q, TYPE R, TYPE S, TYPE T, TYPE U, TYPE V, TYPE W, TYPE X, TYPE Y, TYPE Z, TYPE AA, TYPE AB, TYPE AC, TYPE AD, TYPE AE, TYPE AF, TYPE AG, TYPE AH, TYPE AI, TYPE AJ, TYPE AK, TYPE AL, TYPE AM, TYPE AN, TYPE AO, TYPE AP, TYPE AQ, TYPE AR, TYPE AS, TYPE AT, TYPE AU, TYPE AV, TYPE AW, TYPE AX, TYPE AY, TYPE AZ, TYPE BA, TYPE BB, TYPE BC, TYPE BD, TYPE BE, TYPE BF, TYPE BG, TYPE BH, TYPE BI, TYPE BJ, TYPE BK, TYPE BL, TYPE BM, TYPE BN, TYPE BO, TYPE BP, TYPE BQ, TYPE BR, TYPE BS, TYPE BT, TYPE BU, TYPE BV, TYPE BW, TYPE BX, TYPE BY, TYPE BZ, TYPE CA, TYPE CB, TYPE CC, TYPE CD, TYPE CE, TYPE CF, TYPE CG, TYPE CH, TYPE CI, TYPE CJ, TYPE CK, TYPE CL, TYPE CM, TYPE CN, TYPE CO, TYPE CP, TYPE CQ, TYPE CR, TYPE CS, TYPE CT, TYPE CU, TYPE CV, TYPE CW, TYPE CX, TYPE CY, TYPE CZ, TYPE DA, TYPE DB, TYPE DC, TYPE DD, TYPE DE, TYPE DF, TYPE DG, TYPE DH, TYPE DI, TYPE DJ, TYPE DK, TYPE DL, TYPE DM, TYPE DN, TYPE DO, TYPE DP, TYPE DQ, TYPE DR, TYPE DS, TYPE DT, TYPE DU, TYPE DV, TYPE DW, TYPE DX, TYPE DY, TYPE DZ, TYPE EA, TYPE EB, TYPE EC, TYPE ED, TYPE EE, TYPE EF, TYPE EG, TYPE EH, TYPE EI, TYPE EJ, TYPE EK, TYPE EL, TYPE EM, TYPE EN, TYPE EO, TYPE EP, TYPE EQ, TYPE ER, TYPE ES, TYPE ET, TYPE EU, TYPE EV, TYPE EW, TYPE EX, TYPE EY, TYPE EZ, TYPE FA, TYPE FB, TYPE FC, TYPE FD, TYPE FE, TYPE FF, TYPE FG, TYPE FH, TYPE FI, TYPE FJ, TYPE FK, TYPE FL, TYPE FM, TYPE FN, TYPE FO, TYPE FP, TYPE FQ, TYPE FR, TYPE FS, TYPE FT, TYPE FU, TYPE FV, TYPE FW, TYPE FX, TYPE FY, TYPE FZ, TYPE GA, TYPE GB, TYPE GC, TYPE GD, TYPE GE, TYPE GF, TYPE GH, TYPE GI, TYPE GJ, TYPE GK, TYPE GL, TYPE GM, TYPE GN, TYPE GO, TYPE GP, TYPE GQ, TYPE GR, TYPE GS, TYPE GT, TYPE GU, TYPE GV, TYPE GW, TYPE GX, TYPE GY, TYPE GZ, TYPE HA, TYPE HB, TYPE HC, TYPE HD, TYPE HE, TYPE HF, TYPE HG, TYPE HH, TYPE HI, TYPE HJ, TYPE HK, TYPE HL, TYPE HM, TYPE HN, TYPE HO, TYPE HP, TYPE HQ, TYPE HR, TYPE HS, TYPE HT, TYPE HU, TYPE HV, TYPE HW, TYPE HX, TYPE HY, TYPE HZ, TYPE IA, TYPE IB, TYPE IC, TYPE ID, TYPE IE, TYPE IF, TYPE IG, TYPE IH, TYPE II, TYPE IJ, TYPE IK, TYPE IL, TYPE IM, TYPE IN, TYPE IO, TYPE IP, TYPE IQ, TYPE IR, TYPE IS, TYPE IT, TYPE IU, TYPE IV, TYPE IW, TYPE IX, TYPE IY, TYPE IZ, TYPE JA, TYPE JB, TYPE JC, TYPE JD, TYPE JE, TYPE JF, TYPE JG, TYPE JH, TYPE JI, TYPE JJ, TYPE JK, TYPE JL, TYPE JM, TYPE JN, TYPE JO, TYPE JP, TYPE JQ, TYPE JR, TYPE JS, TYPE JT, TYPE JU, TYPE JV, TYPE JW, TYPE JX, TYPE JY, TYPE JZ, TYPE KA, TYPE KB, TYPE KC, TYPE KD, TYPE KE, TYPE KF, TYPE KG, TYPE KH, TYPE KI, TYPE KJ, TYPE KK, TYPE KL, TYPE KM, TYPE KN, TYPE KO, TYPE KP, TYPE KQ, TYPE KR, TYPE KS, TYPE KT, TYPE KU, TYPE KV, TYPE KW, TYPE KX, TYPE KY, TYPE KZ, TYPE LA, TYPE LB, TYPE LC, TYPE LD, TYPE LE, TYPE LF, TYPE LG, TYPE LH, TYPE LI, TYPE LJ, TYPE LK, TYPE LL, TYPE LM, TYPE LN, TYPE LO, TYPE LP, TYPE LQ, TYPE LR, TYPE LS, TYPE LT, TYPE LU, TYPE LV, TYPE LW, TYPE LX, TYPE LY, TYPE LZ, TYPE MA, TYPE MB, TYPE MC, TYPE MD, TYPE ME, TYPE MF, TYPE MG, TYPE MH, TYPE MI, TYPE MJ, TYPE MK, TYPE ML, TYPE MM, TYPE MN, TYPE MO, TYPE MP, TYPE MQ, TYPE MR, TYPE MS, TYPE MT, TYPE MU, TYPE MV, TYPE MW, TYPE MX, TYPE MY, TYPE MZ, TYPE NA, TYPE NB, TYPE NC, TYPE ND, TYPE NE, TYPE NF, TYPE NG, TYPE NH, TYPE NI, TYPE NJ, TYPE NK, TYPE NL, TYPE NM, TYPE NN, TYPE NO, TYPE NP, TYPE NQ, TYPE NR, TYPE NS, TYPE NT, TYPE NU, TYPE NV, TYPE NW, TYPE NX, TYPE NY, TYPE NZ, TYPE OA, TYPE OB, TYPE OC, TYPE OD, TYPE OE, TYPE OF, TYPE OG, TYPE OH, TYPE OI, TYPE OJ, TYPE OK, TYPE OL, TYPE OM, TYPE ON, TYPE OO, TYPE OP, TYPE OQ, TYPE OR, TYPE OS, TYPE OT, TYPE OU, TYPE OV, TYPE OW, TYPE OX, TYPE OY, TYPE OZ, TYPE PA, TYPE PB, TYPE PC, TYPE PD, TYPE PE, TYPE PF, TYPE PG, TYPE PH, TYPE PI, TYPE PJ, TYPE PK, TYPE PL, TYPE PM, TYPE PN, TYPE PO, TYPE PP, TYPE PQ, TYPE PR, TYPE PS, TYPE PT, TYPE PU, TYPE PV, TYPE PW, TYPE PX, TYPE PY, TYPE PZ, TYPE QA, TYPE QB, TYPE QC, TYPE QD, TYPE QE, TYPE QF, TYPE QG, TYPE QH, TYPE QI, TYPE QJ, TYPE QK, TYPE QL, TYPE QM, TYPE QN, TYPE QO, TYPE QP, TYPE QQ, TYPE QR, TYPE QS, TYPE QT, TYPE QU, TYPE QV, TYPE QW, TYPE QX, TYPE QY, TYPE QZ, TYPE RA, TYPE RB, TYPE RC, TYPE RD, TYPE RE, TYPE RF, TYPE RG, TYPE RH, TYPE RI, TYPE RJ, TYPE RK, TYPE RL, TYPE RM, TYPE RN, TYPE RO, TYPE RP, TYPE RQ, TYPE RR, TYPE RS, TYPE RT, TYPE RU, TYPE RV, TYPE RW, TYPE RX, TYPE RY, TYPE RZ, TYPE SA, TYPE SB, TYPE SC, TYPE SD, TYPE SE, TYPE SF, TYPE SG, TYPE SH, TYPE SI, TYPE SJ, TYPE SK, TYPE SL, TYPE SM, TYPE SN, TYPE SO, TYPE SP, TYPE SQ, TYPE SR, TYPE SS, TYPE ST, TYPE SU, TYPE SV, TYPE SW, TYPE SX, TYPE SY, TYPE SZ, TYPE TA, TYPE TB, TYPE TC, TYPE TD, TYPE TE, TYPE TF, TYPE TG, TYPE TH, TYPE TI, TYPE TJ, TYPE TK, TYPE TL, TYPE TM, TYPE TN, TYPE TO, TYPE TP, TYPE TQ, TYPE TR, TYPE TS, TYPE TT, TYPE TU, TYPE TV, TYPE TV, TYPE TW, TYPE TX, TYPE TY, TYPE TZ, TYPE UA, TYPE UB, TYPE UC, TYPE UD, TYPE UE, TYPE UF, TYPE UG, TYPE UH, TYPE UI, TYPE UJ, TYPE UK, TYPE UL, TYPE UM, TYPE UN, TYPE UO, TYPE UP, TYPE UQ, TYPE UR, TYPE US, TYPE UT, TYPE UY, TYPE UZ, TYPE VA, TYPE VB, TYPE VC, TYPE VD, TYPE VE, TYPE VF, TYPE VG, TYPE VH, TYPE VI, TYPE VJ, TYPE VK, TYPE VL, TYPE VM, TYPE VN, TYPE VO, TYPE VP, TYPE VQ, TYPE VR, TYPE VS, TYPE VT, TYPE VU, TYPE VV, TYPE VW, TYPE VX, TYPE VY, TYPE VZ, TYPE WA, TYPE WB, TYPE WC, TYPE WD, TYPE WE, TYPE WF, TYPE WG, TYPE WH, TYPE WI, TYPE WJ, TYPE WK, TYPE WL, TYPE WM, TYPE WN, TYPE WO, TYPE WP, TYPE WQ, TYPE WR, TYPE WS, TYPE WT, TYPE WY, TYPE WZ, TYPE XA, TYPE XB, TYPE XC, TYPE XD, TYPE XE, TYPE XF, TYPE XG, TYPE XH, TYPE XI, TYPE XJ, TYPE XK, TYPE XL, TYPE XM, TYPE XN, TYPE XO, TYPE XP, TYPE XQ, TYPE XR, TYPE XS, TYPE XT, TYPE XU, TYPE XV, TYPE XW, TYPE XX, TYPE XY, TYPE XZ, TYPE YA, TYPE YB, TYPE YC, TYPE YD, TYPE YE, TYPE YF, TYPE YG, TYPE YH, TYPE YI, TYPE YJ, TYPE YK, TYPE YL, TYPE YM, TYPE YN, TYPE YO, TYPE YP, TYPE YQ, TYPE YR, TYPE YS, TYPE YT, TYPE YU, TYPE YV, TYPE YW, TYPE YX, TYPE YY, TYPE YZ, TYPE ZA, TYPE ZB, TYPE ZC, TYPE ZD, TYPE ZE, TYPE ZF, TYPE ZG, TYPE ZH, TYPE ZI, TYPE ZJ, TYPE ZK, TYPE ZL, TYPE ZM, TYPE ZN, TYPE ZO, TYPE ZP, TYPE ZQ, TYPE ZR, TYPE ZS, TYPE ZT, TYPE ZU, TYPE ZV, TYPE ZW, TYPE ZX, TYPE ZY, TYPE ZZ

### ADDITIONAL INFORMATION REQUIRED FOR FISSILE MATERIALS ONLY

EXEMPTED FROM THE ADDITIONAL REQUIREMENTS FOR FISSILE MATERIALS SPECIFIED IN 49 CFR, PART 172 OF THE IATA RESTRICTED ARTICLES REGULATIONS ☐ MAINTAIN FISSILE MATERIALS IN CONTAINERS OR EQUIPMENT IN 172.25

NOT EXEMPTED FISSILE CLASS I ☐ FISSILE CLASS II ☐ FISSILE CLASS III ☐

Additional certificates obtained by the Shipper when necessary:

☒ Special Form Documentation Certificate ☐ Certificate by Large Radioactive Source ☐

☒ Type "B" Packaging Certificate ☐ Government Approval Permit ☐

Certificate by F-1414 Material ☐

Special Handling Information

ARTICLE #2641 RADIOACTIVE LABEL FOR CARGO AIRCRAFT ONLY

I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, labeled and in proper condition for carriage by air according to applicable national governmental regulations, and for international shipments the current IATA Restricted Articles Regulations.

Name and full address of Shipper (your own company name) ☒ Name and title of person signing Certification (your technicians name) ☐

TECHNOLOGY, INC. (your address) ☒

40 NORTH AVE. (your location) ☒

BURLINGTON, MA 01803 (your location) ☒

Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

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Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

## STRAIGHT BILL OF LADING - SHORT FORM

Two completed and signed copies of this bill of lading shall be handed to the carrier.  
(Use block letters)

**WARNING:** Failure to comply in all respects with the applicable regulations of the Department of Transportation, 49 CFR, CAB 82 and, for international shipments, the IATA Restricted Articles Regulations may be a breach of the applicable law, subject to legal penalties. This bill of lading shall in no circumstance be signed by an IATA Cargo Agent or a consolidator for international shipments.

This shipment is within the limitations prescribed for: (mark one)

☐ Passenger aircraft and contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment. ☒ Cargo aircraft only

NATURE AND QUANTITY OF CONTENT		PACKAGE			
PROPER SHIPPING NAME	RAADIOACTIVITY GROUP	FORM	ACTIVITY	CATEGORY	TRANSPORT MODE & TYPE
FOR U.S. SHIPMENTS: SEE SECTION 2, CAB 82, TABLE 2.0	MAST OR GROUP OF PRINCIPAL RADIOACTIVE GROUPS 1 TO VII	CHEMICAL FORM OR PHYSICAL STATE (e.g., LIQUID, SOLID, GASEOUS, SPECIAL FORM, SPECIAL FORM, SPECIAL FORM)	NUMBER OF CURIES	WHITE or YELLOW or YELLOW CORNERS LABEL	FOR U.S. SHIPMENTS: TYPE A, TYPE B, TYPE C, TYPE D, TYPE E, TYPE F, TYPE G, TYPE H, TYPE I, TYPE J, TYPE K, TYPE L, TYPE M, TYPE N, TYPE O, TYPE P, TYPE Q, TYPE R, TYPE S, TYPE T, TYPE U, TYPE V, TYPE W, TYPE X, TYPE Y, TYPE Z, TYPE AA, TYPE AB, TYPE AC, TYPE AD, TYPE AE, TYPE AF, TYPE AG, TYPE AH, TYPE AI, TYPE AJ, TYPE AK, TYPE AL, TYPE AM, TYPE AN, TYPE AO, TYPE AP, TYPE AQ, TYPE AR, TYPE AS, TYPE AT, TYPE AU, TYPE AV, TYPE AW, TYPE AX, TYPE AY, TYPE AZ, TYPE BA, TYPE BB, TYPE BC, TYPE BD, TYPE BE, TYPE BF, TYPE BG, TYPE BH, TYPE BI, TYPE BJ, TYPE BK, TYPE BL, TYPE BM, TYPE BN, TYPE BO, TYPE BP, TYPE BQ, TYPE BR, TYPE BS, TYPE BT, TYPE BU, TYPE BV, TYPE BW, TYPE BX, TYPE BY, TYPE BZ, TYPE CA, TYPE CB, TYPE CC, TYPE CD, TYPE CE, TYPE CF, TYPE CG, TYPE CH, TYPE CI, TYPE CJ, TYPE CK, TYPE CL, TYPE CM, TYPE CN, TYPE CO, TYPE CP, TYPE CQ, TYPE CR, TYPE CS, TYPE CT, TYPE CU, TYPE CV, TYPE CW, TYPE CX, TYPE CY, TYPE CZ, TYPE DA, TYPE DB, TYPE DC, TYPE DD, TYPE DE, TYPE DF, TYPE DG, TYPE DH, TYPE DI, TYPE DJ, TYPE DK, TYPE DL, TYPE DM, TYPE DN, TYPE DO, TYPE DP, TYPE DQ, TYPE DR, TYPE DS, TYPE DT, TYPE DU, TYPE DV, TYPE DW, TYPE DX, TYPE DY, TYPE DZ, TYPE EA, TYPE EB, TYPE EC, TYPE ED, TYPE EE, TYPE EF, TYPE EG, TYPE EH, TYPE EI, TYPE EJ, TYPE EK, TYPE EL, TYPE EM, TYPE EN, TYPE EO, TYPE EP, TYPE EQ, TYPE ER, TYPE ES, TYPE ET, TYPE EU, TYPE EV, TYPE EW, TYPE EX, TYPE EY, TYPE EZ, TYPE FA, TYPE FB, TYPE FC, TYPE FD, TYPE FE, TYPE FF, TYPE FG, TYPE FH, TYPE FI, TYPE FJ, TYPE FK, TYPE FL, TYPE FM, TYPE FN, TYPE FO, TYPE FP, TYPE FQ, TYPE FR, TYPE FS, TYPE FT, TYPE FU, TYPE FV, TYPE FW, TYPE FX, TYPE FY, TYPE FZ, TYPE GA, TYPE GB, TYPE GC, TYPE GD, TYPE GE, TYPE GF, TYPE GH, TYPE GI, TYPE GJ, TYPE GK, TYPE GL, TYPE GM, TYPE GN, TYPE GO, TYPE GP, TYPE GQ, TYPE GR, TYPE GS, TYPE GT, TYPE GU, TYPE GV, TYPE GW, TYPE GX, TYPE GY, TYPE GZ, TYPE HA, TYPE HB, TYPE HC, TYPE HD, TYPE HE, TYPE HF, TYPE HG, TYPE HH, TYPE HI, TYPE HJ, TYPE HK, TYPE HL, TYPE HM, TYPE HN, TYPE HO, TYPE HP, TYPE HQ, TYPE HR, TYPE HS, TYPE HT, TYPE HU, TYPE HV, TYPE HW, TYPE HX, TYPE HY, TYPE HZ, TYPE IA, TYPE IB, TYPE IC, TYPE ID, TYPE IE, TYPE IF, TYPE IG, TYPE IH, TYPE II, TYPE IJ, TYPE IK, TYPE IL, TYPE IM, TYPE IN, TYPE IO, TYPE IP, TYPE IQ, TYPE IR, TYPE IS, TYPE IT, TYPE IU, TYPE IV, TYPE IW, TYPE IX, TYPE IY, TYPE IZ, TYPE JA, TYPE JB, TYPE JC, TYPE JD, TYPE JE, TYPE JF, TYPE JG, TYPE JH, TYPE JI, TYPE JJ, TYPE JK, TYPE JL, TYPE JM, TYPE JN, TYPE JO, TYPE JP, TYPE JQ, TYPE JR, TYPE JS, TYPE JT, TYPE JU, TYPE JV, TYPE JW, TYPE JX, TYPE JY, TYPE JZ, TYPE KA, TYPE KB, TYPE KC, TYPE KD, TYPE KE, TYPE KF, TYPE KG, TYPE KH, TYPE KI, TYPE KJ, TYPE KK, TYPE KL, TYPE KM, TYPE KN, TYPE KO, TYPE KP, TYPE KQ, TYPE KR, TYPE KS, TYPE KT, TYPE KU, TYPE KV, TYPE KW, TYPE KX, TYPE KY, TYPE KZ, TYPE LA, TYPE LB, TYPE LC, TYPE LD, TYPE LE, TYPE LF, TYPE LG, TYPE LH, TYPE LI, TYPE LJ, TYPE LK, TYPE LM, TYPE LN, TYPE LO, TYPE LP, TYPE LQ, TYPE LR, TYPE LS, TYPE LT, TYPE LU, TYPE LV, TYPE LW, TYPE LX, TYPE LY, TYPE LZ, TYPE MA, TYPE MB, TYPE MC, TYPE MD, TYPE ME, TYPE MF, TYPE MG, TYPE MH, TYPE MI, TYPE MJ, TYPE MK, TYPE ML, TYPE MM, TYPE MN, TYPE MO, TYPE MP, TYPE MQ, TYPE MR, TYPE MS, TYPE MT, TYPE MU, TYPE MV, TYPE MW, TYPE MX, TYPE MY, TYPE MZ, TYPE NA, TYPE NB, TYPE NC, TYPE ND, TYPE NE, TYPE NF, TYPE NG, TYPE NH, TYPE NI, TYPE NJ, TYPE NK, TYPE NL, TYPE NM, TYPE NN, TYPE NO, TYPE NP, TYPE NQ, TYPE NR, TYPE NS, TYPE NT, TYPE NU, TYPE NV, TYPE NW, TYPE NX, TYPE NY, TYPE NZ, TYPE OA, TYPE OB, TYPE OC, TYPE OD, TYPE OE, TYPE OF, TYPE OG, TYPE OH, TYPE OI, TYPE OJ, TYPE OK, TYPE OL, TYPE OM, TYPE ON, TYPE OO, TYPE OP, TYPE OQ, TYPE OR, TYPE OS, TYPE OT, TYPE OU, TYPE OV, TYPE OW, TYPE OX, TYPE OY, TYPE OZ, TYPE PA, TYPE PB, TYPE PC, TYPE PD, TYPE PE, TYPE PF, TYPE PG, TYPE PH, TYPE PI, TYPE PJ, TYPE PK, TYPE PL, TYPE PM, TYPE PN, TYPE PO, TYPE PP, TYPE PQ, TYPE PR, TYPE PS, TYPE PT, TYPE PU, TYPE PV, TYPE PW, TYPE PX, TYPE PY, TYPE PZ, TYPE QA, TYPE QB, TYPE QC, TYPE QD, TYPE QE, TYPE QF, TYPE QG, TYPE QH, TYPE QI, TYPE QJ, TYPE QK, TYPE QL, TYPE QM, TYPE QN, TYPE QO, TYPE QP, TYPE QQ, TYPE QR, TYPE QS, TYPE QT, TYPE QU, TYPE QV, TYPE QW, TYPE QX, TYPE QY, TYPE QZ, TYPE RA, TYPE RB, TYPE RC, TYPE RD, TYPE RE, TYPE RF, TYPE RG, TYPE RH, TYPE RI, TYPE RJ, TYPE RK, TYPE RL, TYPE RM, TYPE RN, TYPE RO, TYPE RP, TYPE RQ, TYPE RR, TYPE RS, TYPE RT, TYPE RU, TYPE RV, TYPE RW, TYPE RX, TYPE RY, TYPE RZ, TYPE SA, TYPE SB, TYPE SC, TYPE SD, TYPE SE, TYPE SF, TYPE SG, TYPE SH, TYPE SI, TYPE SJ, TYPE SK, TYPE SL, TYPE SM, TYPE SN, TYPE SO, TYPE SP, TYPE SQ, TYPE SR, TYPE SS, TYPE ST, TYPE SU, TYPE SV, TYPE SW, TYPE SX, TYPE SY, TYPE SZ, TYPE TA, TYPE TB, TYPE TC, TYPE TD, TYPE TE, TYPE TF, TYPE TG, TYPE TH, TYPE TI, TYPE TJ, TYPE TK, TYPE TL, TYPE TM, TYPE TN, TYPE TO, TYPE TP, TYPE TQ, TYPE TR, TYPE TS, TYPE TU, TYPE TV, TYPE TV, TYPE TW, TYPE TX, TYPE TY, TYPE TZ, TYPE UA, TYPE UB, TYPE UC, TYPE UD, TYPE UE, TYPE UF, TYPE UG, TYPE UH, TYPE UI, TYPE UJ, TYPE UK, TYPE UL, TYPE UM, TYPE UN, TYPE UO, TYPE UP, TYPE UQ, TYPE UR, TYPE US, TYPE UT, TYPE UY, TYPE UZ, TYPE VA, TYPE VB, TYPE VC, TYPE VD, TYPE VE, TYPE VF, TYPE VG, TYPE VH, TYPE VI, TYPE VJ, TYPE VK, TYPE VL, TYPE VM, TYPE VN, TYPE VO, TYPE VP, TYPE VQ, TYPE VR, TYPE VS, TYPE VT, TYPE VU, TYPE VV, TYPE VW, TYPE VX, TYPE VY, TYPE VZ, TYPE WA, TYPE WB, TYPE WC, TYPE WD, TYPE WE, TYPE WF, TYPE WG, TYPE WH, TYPE WI, TYPE WJ, TYPE WK, TYPE WL, TYPE WM, TYPE WN, TYPE WO, TYPE WP, TYPE WQ, TYPE WR, TYPE WS, TYPE WT, TYPE WY, TYPE WZ, TYPE XA, TYPE XB, TYPE XC, TYPE XD, TYPE XE, TYPE XF, TYPE XG, TYPE XH, TYPE XI, TYPE XJ, TYPE XK, TYPE XL, TYPE XM, TYPE XN, TYPE XO, TYPE XP, TYPE XQ, TYPE XR, TYPE XS, TYPE XT, TYPE XU, TYPE XV, TYPE XW, TYPE XX, TYPE XY, TYPE XZ, TYPE YA, TYPE YB, TYPE YC, TYPE YD, TYPE YE, TYPE YF, TYPE YG, TYPE YH, TYPE YI, TYPE YJ, TYPE YK, TYPE YL, TYPE YM, TYPE YN, TYPE YO, TYPE YP, TYPE YQ, TYPE YR, TYPE YS, TYPE YT, TYPE YU, TYPE YV, TYPE YW, TYPE YX, TYPE YY, TYPE YZ, TYPE ZA, TYPE ZB, TYPE ZC, TYPE ZD, TYPE ZE, TYPE ZF, TYPE ZG, TYPE ZH, TYPE ZI, TYPE ZJ, TYPE ZK, TYPE ZL, TYPE ZM, TYPE ZN, TYPE ZO, TYPE ZP, TYPE ZQ, TYPE ZR, TYPE ZS, TYPE ZT, TYPE ZU, TYPE ZV, TYPE ZW, TYPE ZX, TYPE ZY, TYPE ZZ

### ADDITIONAL INFORMATION REQUIRED FOR FISSILE MATERIALS ONLY

EXEMPTED FROM THE ADDITIONAL REQUIREMENTS FOR FISSILE MATERIALS SPECIFIED IN 49 CFR, PART 172 OF THE IATA RESTRICTED ARTICLES REGULATIONS ☐ MAINTAIN FISSILE MATERIALS IN CONTAINERS OR EQUIPMENT IN 172.25

NOT EXEMPTED FISSILE CLASS I ☐ FISSILE CLASS II ☐ FISSILE CLASS III ☐

Additional certificates obtained by the Shipper when necessary:

☒ Special Form Documentation Certificate ☐ Certificate by Large Radioactive Source ☐

☒ Type "B" Packaging Certificate ☐ Government Approval Permit ☐

Certificate by F-1414 Material ☐

Special Handling Information

ARTICLE #2641 RADIOACTIVE LABEL FOR CARGO AIRCRAFT ONLY

I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, labeled and in proper condition for carriage by air according to applicable national governmental regulations, and for international shipments the current IATA Restricted Articles Regulations.

Name and full address of Shipper (your own company name) ☒ Name and title of person signing Certification (your technicians name) ☐

TECHNOLOGY, INC. (your address) ☒

40 NORTH AVE. (your location) ☒

BURLINGTON, MA 01803 (your location) ☒

Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

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Signature of the Shipper (see WARNING above) ☒

Signature of the Shipper (see WARNING above) ☒

ATTACHMENT 11

All sources will be returned to Amersham, Inc. for disposal.



OCT 15 1996

Dennis Frazier  
Radiation Safety Officer  
Nooter Corporation  
P.O. box 451  
1400 South Third Street  
St. Louis, MO 63166

Dear Mr. Frazier:

Enclosed is Amendment No. 25 renewing your NRC Material License No. 24-03783-01 in accordance with your request.

Please review the enclosed document carefully and be sure that you understand all conditions. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region III office at (630) 829-9887 so that we can provide appropriate corrections and answers.

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Unless your license has been terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.
2. Notify NRC, in writing, within 30 days:
  - a. When the Radiation Safety Officer permanently discontinues performance of duties under the license or has a name change; or
  - b. When the licensee's mailing address changes (no fee is required if the location of byproduct material remains the same).
3. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license when you decide to terminate all activities involving materials authorized under the license.

398590

4. Request and obtain a license amendment before you:
  - a. Change Radiation Safety Officers;
  - b. Order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;
  - c. Add or change the areas of use or address or addresses of use identified in the license application or on the license; or
  - d. Change ownership of your organization.
5. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or certifying official rather than a consultant.

You will be periodically inspected by NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the General Policy and Procedures for NRC Enforcement Actions. Since serious consequences to employees and the public can result from failure to comply with NRC requirements, prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Sincerely,  
Original Signed By  
Deborah A. Piskura  
Nuclear Materials Licensing Branch

License No.: 24-03783-01  
Docket No.: 030-05088  
Enclosure: Amendment No. 25

DOCUMENT NAME: M:\03005088.CL6

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	DNMS/Rili								
NAME	DPISKURA:jaw								
DATE	10/ /96								

OFFICIAL RECORD COPY

# NOOTER CORPORATION



1400 South Third Street  
Saint Louis, Missouri U.S.A. 63104  
Mailing Address: P.O. Box 451  
Saint Louis, MO U.S.A.  
63166

Telephone: (314) 621-6000  
Fax: (314) 421-7580

September 16, 1996

Materials Licensing Section  
USNRC, Region III  
801 Warrenville Road  
Lisle, IL 60532-4351  
Attn: Deborah A. Piskura

RE: Control 398590

Dear Ms. Piskura:

Following is our response to your review of our license renewal application. The items are as enumerated in your review.

1. a) We have, in our original application, submitted an outline with the amount of training time shown by each item. This is in your possession.
- b) Individuals will receive a minimum of 520 hours of on-the-job training in isotope radiography before being qualified as radiographer.
- c) 1,2,3. Our original application contains on page 5, paragraph 9, the information you desire.
- d) The minimum acceptable score on the written and field exam is 75%.
2. a) The 520 source has been transferred to Amersham for disposal. Attached is a copy of the receiving report from Amersham.

The Amersham 520 camera and its controls have been dismantled and are in our possession. This is a lead camera. We will, at some future date, dispose of it through a scrap dealer.

RECEIVED

SEP 18 1996

REGION III



Steel and Alloy Plate Fabricators and Erectors . . . "Boilermakers"

- b) The storage area for our radiography cameras is our exposure cell (building 302). This is stated in our application. We also clearly state that there are two locked doors, with different locks, between the outside of building 302 and the storage area. We also clearly state that both doors are kept locked and access to keys are limited to radiographers and radiographers' assistants.

Survey meter calibration is performed within the confines of building 302.

- c) The Gammalarm is checked by either energizing an x-ray machine or placing a locked 660 projector next to the Gammalarm. Radiation levels at the exterior of the 660 are sufficient to activate the Gammalarm when placed in close proximity.
- 3.
- a) Film badges and pocket dosimeters are stored in the NDT office when not in use. This is a low radiation area.
  - b) We will continue to exchange film badges at two week intervals.
  - c) Should a dosimeter reading be off scale the following is our procedure:
    - 1) The individual will immediately retract any exposed sources and place in the locked storage position.
    - 2) The RSO will be notified.
    - 3) The film badge will be sent in for processing.
    - 4) The individual involved will not work with any radiography equipment until the film badge exposure has been determined.
  - d) Dosimeters are checked by the RSO or a qualified radiographer at periods not to exceed one year for response to the  $\pm 30\%$  of the true exposure. A DCA Model 3060 is used with the following procedure:
    - 1) Zero the dosimeter.
    - 2) Place the dosimeter in the outer ring (50 mr) of the DCA 3060.
    - 3) After 24 hours check to the dosimeter reading. The reading should be in the range of 35-65 mr.
    - 4) Record the reading of acceptable dosimeters.
    - 5) Scrap any dosimeters not reading with the required range.

- e) All radiographers and assistants are provided with alarming rate meters.

The daily operability check is as follows:

- 1) Turn meter on.
- 2) Press test button.
- 3) If alarm sounds, meter is acceptable.
- 4) If alarm doesn't sound, turn in to maintenance for repair and obtain operable meter.

Annual check is performed using T0773 calibration unit as follows:

- 1) Calculate the 400mr/hr and the 500 mr/hr distance of the T0773 unit.
- 2) Turn alarm rate meter on.
- 3) Place meter at 400 mr/hr range.
- 4) Expose source for one minute.
- 5) Meter should not alarm. If rate meter alarms, send to maintenance for repair. If not, proceed with calibration.
- 6) Place meter at 500 mr/hr range.
- 7) If meter alarms, record calibration data. Meter is acceptable.
- 8) If meter does not alarm, send to maintenance for repair.
- 9) All meters that are repaired are re-calibrated before use.

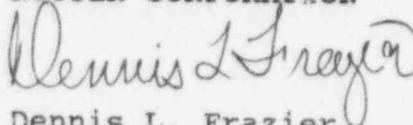
4. If a radiographer or a radiographer's assistant has not performed radiography within a three month or greater period, then he will be audited the next time he performs radiography.

Any individuals whose performance is deficient at any time is advised of the deficiency and is also cautioned that continued deficient performance will subject them to possible disciplinary action up to and including termination.

5.   a)   We will not perform a survey to determine the high radiation area, but rather will calculate the boundary using the inverse square law.  
      b)   Our procedures state that during each radiographic operation direct surveillance is maintained. Should an individual enter the restricted area during a radiographic exposure, the source will be immediately retracted to the safe position. The RSO will be notified and the potential for exposure to that individual will be assessed.
6.   a)   No assistant radiographer will perform a source recovery operation.  
      b)   Dennis Frazier and Richard Horton have received extensive training in radiation safety and have actual practice training in source retrieval using dummy sources.
7.   This is so stated in our license application.
8.   We have submitted our step by step procedural check list, which lists each device, with our application.
- 9    This is so stated in our license application.

Very truly yours,

**NOOTER CORPORATION**



Dennis L. Frazier  
R.S.O.

DF:sk



AMERSHAM CORPORATION  
SENTINEL DIVISION  
40 NORTH AVE  
BURLINGTON, MA 01803  
FAX: (617) 273-2216

PAGE 1

RECEIVING REPORT

R-008650

Whs: 1

RMA NUMBER:  
DATE RECEIVED: 5/22/91

Mail To

Received From

NOOTER CORPORATION  
PO BOX 451, 125 RUTGER  
ATTN: DENNIS FRAZIER  
ST. LOUIS

AMERSHAM CORP  
C/O NOOTER CORP  
125 RUTGER  
ST. LOUIS

MO 63104

MO 63166

CARRIER: ABF

FREIGHT BILL #: 002975963

PREPAID

MODEL: SC-770

770 DU SOURCE CHANGER

SERIAL: 1

SALES ORDER: C056561  
CUSTOMER: 1591100

OVER PACK SN:

ISOTOPE: COBALT-60

Model#

Serial#

Activity

4:4-7

2357

84.3 CURIES

SURFACE RADIATION: 26 mr/hr

TRANSPORT INDEX: 1.0 mr/hr

REMOVABLE CONTAMINATION LEVEL IS < .001 uCi

COMMENTS

SOURCE CHANGER LABELED AS:  
LOW SPECIFIC ACTIVITY

This form is to acknowledge that the materials listed above were received by  
AMERSHAM CORPORATION. Please save this for your files.

RECEIVED BY:

RADIOLOGICAL TECHNICIAN

AUG 28 1996

Dennis L. Frazier  
Radiation Safety Officer  
Nooter Corporation  
P.O. Box 451  
1400 South Third Street  
St. Louis, MO 63166

Dear Mr. Frazier:

We have reviewed your application dated May 17, 1995, requesting renewal of your NRC license number 24-03783-01 and find that we need additional information as follows:

1. Training Program

Please modify your training program to include the following:

- a. An individual qualifying as a radiographer's assistant should receive instruction in your operating and emergency procedures and the use of your radiographic equipment. You should provide an outline of the training to be provided to individuals qualifying to become radiographer's assistants and indicate the amount of time spent on each item in the outline. The duration of this training is typically be 4-6 hours. The on-the-job training for individuals qualifying to become radiographer's assistants should be limited to demonstration of the use of radiographic equipment. Individuals cannot actually operate radiographic equipment (containing "live sources") even under the direct supervision of a qualified radiographer until they have qualified as radiographers' assistants.
- ✓ b. Individuals qualifying as radiographers should receive a minimum of three months (or 520 hours) on-the-job training (no credit can be given for training and experience with x-ray devices) in isotope radiography.
- c. You should revise your training program for experienced radiographers and radiographers' assistants to include the following:
  - (1) For those individuals who were previously employed as a radiographer or assistant radiographer, please make a commitment that you will obtain written documentation from their previous employer which illustrates their qualifications as a radiographer or an assistant.

- (2) Commit to providing these individuals with a minimum of 4-6 hours instruction in your operating and emergency procedures.
- (3) Commit to administering the same field exam to these individuals as you give to newly trained radiographers.
- ✓ d. Please indicate your acceptable passing scores on each of your exams (including the field exam on equipment).

2. Facilities and Equipment

- ✓ a. Your application indicated that you wish to delete the Automation Industries Model 520 radiography camera from the license. In order to delete the Model 520 exposure device and the sealed sources and changers associated with the camera from your license, we need information on the disposition of these items. Provide information which describes how you transferred or disposed of this equipment and sealed source(s).
- b. It is not clear from your submitted diagrams the location of the storage area for the radiography cameras when not in use. We assume it is inside the exposure cell. Please clarify. Describe your security measures to insure against unauthorized removal or use. Also inform us of the location where you will perform survey meter calibrations. *Keys to assistants?*
- ✓ c. In Attachment 9, "Radiographic Facilities," of your application you described the Gammalarn system installed in the exposure cell. Please describe how you test this system and record the results in order to comply with the requirements in Section 34.29(c). *note*

3. Personnel Monitoring Equipment

- ✓ a. Please designate your low background radiation area where film badges and pocket dosimeters are to be stored when not in use.
- ✓ b. In your application, you stated that the frequency of whole body film badge exchange would be a two week intervals. The NRC considers a monthly exchange frequency for film badges acceptable. You may want to reconsider your exchange frequency for whole body film badges.
- ✓ c. Paragraph 34.33(d) of 10 CFR Part 34 requires that an individual's film badge or TLD be immediately sent for processing if the self-reading pocket dosimeter is found off-scale. Please describe your procedures to handle an

off-scale dosimeter reading. The procedures should include: (1) stop work immediately and place the source in the safe storage position within the exposure device; (2) notify the RSO; and (3) immediately send the badge in for processing. The involved individual(s) should also be instructed to halt work with radiography equipment until the film badge exposure has been determined. There should be no exercise in judgement by radiography personnel.

- ✓d. 10 CFR Part 34.33(c) requires that pocket dosimeters be checked at periods not to exceed one year for correct response within  $\pm 30$  percent of the true radiation exposure. Please submit your step-by-step procedures for performing these checks and include the names and qualifications of the individuals performing the procedure.
- ✓e. Please note that Section 34.33(a) requires radiography personnel to wear in addition to pocket dosimeters and whole body badges, an alarming ratemeter (at temporary job sites or field locations). The alarm ratemeter must have an audible alarm at a preset dose rate of 500 milliroentgens per hour. It must be checked for operability each day, prior to start of radiography operations. Section 34.33 (f) (4) requires that ratemeters be calibrated annually for proper response ( $\pm 20\%$ ). Please confirm that you will provide your radiographers and their assistants with alarming rate meters and submit your procedures for their daily operability check and annual calibration.

✓4. Internal Inspection Program

Your internal inspection program should cover each radiographer and radiographer's assistant at intervals not to exceed 3 months. If a radiographer or assistant has not performed radiography within a period of 3 months or greater, then he must be audited the next time he performs radiography. Please include this in your internal inspection procedure. Also describe management action to correct any deficiencies found during an audit.

5. Operating Procedures

- ✓a. In Item 9, you stated that radiographers will perform a radiation survey of the perimeter of the restricted area at each temporary job site to confirm that radiation levels do not exceed 2 mR/hr. Please also verify that you will not perform a survey to determine where the high radiation area should be posted but rather you will use the inverse square law and calculate this location.

- ✓ b. Please modify your operating procedures to include continuous surveillance of the restricted area during an exposure. Also include provisions if an individual should enter the restricted area during an exposure. This should include immediate.

6. Emergency Procedures

In your emergency procedures you stated that the RSO may perform source retrieval operations under certain circumstances. Please include the following commitments or additional information to support your source recovery procedures:

- ✓ a. Confirmation that at no time an assistant radiographer be allowed to perform source recovery operations.
- (b) Submit a description of the training and experience for Mr. Frazier or other individuals in performing source recoveries operations. Radiography personnel must not attempt to perform source recovery or retrieval operations unless they have received specific training and actual practice in these operations using a "dummy" source.

✓ 7. Daily Inspection of Equipment

ATTN: During the daily inspection of equipment, radiographers and their assistants, must be instructed to remove the defective equipment from use and report defects to management. Your instructions to personnel must reflect the regulatory requirement that the daily inspection be performed each day before the equipment is used.

8. Quarterly Maintenance of Equipment

Please submit your procedures for performing quarterly inspection and maintenance of equipment. This should include procedures for each device you wish to possess and use (as included in Item 5. of your renewal application. If radiography personnel are assigned the task of performing the quarterly inspection and maintenance, your instructions your provide step-by-step procedures for each manufacturer's devices.

9. Reporting Defects and Noncompliance

Please verify that you will instruct all radiography personnel to immediately notify management of any malfunctions or defects found in radiography equipment.

D. Frazier

-5-

We will continue our review of your application upon receipt of this information. Please reply, in duplicate, within 30 days, and refer to Control Number 398590.

If you have any questions or require clarification on any of the information stated above, you may contact us at (708) 829-9887.

Sincerely,

Original Signed by  
Deborah A. Piskura, Health Physicist  
Nuclear Materials Licensing Branch

License No. 24-03783-01

Docket No. 030-05088

Enclosures: 1. 10 CFR Parts 20, 21,  
34, and 71  
2. Regulatory Guide 10.6

DOCUMENT NAME: M:\03005088.DF6

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OFFICE	DNMS/RIII								
NAME	DPISKURA:jaw								
DATE	08/27/96								

OFFICIAL RECORD COPY



May 24, 1995

Nooter Corporation  
ATTN: Dennis L. Frazier  
Radiation Safety Officer  
P. O. Box 451  
1400 South Third Street  
St. Louis, MO 63166

SUBJECT: LICENSE RENEWAL APPLICATION

Dear Mr. Frazier:

This is to acknowledge receipt of your application for renewal of the material(s) license identified above. Your application is deemed timely filed, and accordingly, the license will not expire until final action has been taken by this office.

Any correspondence regarding the renewal application should reference the control number specified and your license number.

Sincerely,

Original Signed By  
Marianne Meenan, Chief  
Nuclear Materials Support Section

License No. 24-03783-01  
Control No. 398590

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