

## MATERIALS LICENSE

Amendment No. 22

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		In accordance with application dated July 15, 1996	
1. Niles Steel Tank Company		3. License Number 21-04741-01 is amended in its entirety to read as follows:	
2. P.O. Box 728 713 Wayne Street Niles, MI 49120		4. Expiration Date July 31, 2000	
		5. Docket or Reference No. 030-04829	
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) (Amersham Model A424-9)	A. No single source to exceed 100 curies	
B. Uranium depleted in Uranium-235	B. Solid Metal	B. Not to exceed 999 kilograms total possession limit	

## 9. Authorized Use:

- A. For use in Amersham Model 660 System exposure devices for industrial radiography and in Amersham Model 650L source changers for storage and replacement of sources.
- B. For shielding in radiographic exposure devices, source changers and collimators.

CONDITIONS

10. Licensed material shall be used only at the licensee's facilities located at 713 Wayne Street, Niles, Michigan.
11. A. License material shall be used by, or under the supervision and in the physical presence of, Robert H. Wood or individuals who have been trained as specified in revised Radiography Operations Manual dated July 12, 1996, as submitted with letter dated August 15, 1996. The licensee shall maintain records of individuals designated as users.

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9609270151 960830  
PDR ADOCK 03004829  
B PDR

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**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

21-04741-01

Docket or Reference Number

030-04829

Amendment No. 22

- B. The Radiation Safety Officer for activities authorized by this license is Robert H. Wood.
12. When a radiographer or radiographer's assistant does not perform radiography for a period that exceeds 3 months, the internal inspection by the licensee to ensure that NRC regulations, license provisions and operating and emergency procedures are followed, shall be carried out the first time that person engages in radiographic operations.
13. The licensee shall use a collimator of at least 6 half value layer thickness, directed away from the roof, when performing radiography in the Radiation Cell. If a collimator as described above can not be used, the licensee shall follow the limitations described in Chart A and the explanation sheet for Chart A, contained in revised Radiography Operation Manual dated July 12, 1996, as submitted with letter dated August 15, 1996.
14. A. Notwithstanding the periodic leak test required by Section 34.25(b) of 10 CFR Part 34, such requirement does not apply to radiography sources that are stored and not being used. The sources excepted from this test shall be tested for leakage before use or transfer to another person.
- B. Sealed sources authorized for a use other than radiography shall be tested as radiography sources in accordance with Section 34.25 of 10 CFR Part 34.
15. The licensee is authorized to receive, possess, and use sealed sources of iridium-192 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% for iridium-192;
- 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 Section 34.21 of 10 CFR Part 34.
16. Sealed sources containing licensed material shall not be opened.
17. 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.

COPY

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18. 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. The U.S. 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 December 15, 1989, and July 15, 1996 (excluding Radiography Operation Manual); and
  - B. Letter dated August 15, 1996 (with enclosed revision of Radiography Operations Manual dated July 12, 1996).

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date 8/30/96

By James Mullawer  
Nuclear Materials Licensing Branch, Region III

**COPY**

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM  
AND  
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)  
INFORMATION FROM LTS

PROGRAM CODE: 03310  
STATUS CODE: 0  
FEE CATEGORY: 30  
EXP. DATE: 20000731  
FEE COMMENTS:  
DECOM FIN ASSUR-REDD: N

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED

APPLICANT/LICENSEE: NILES STEEL TANK COMPANY  
RECEIVED DATE: 960716  
DOCKET NO: 3004829  
CONTROL NO.: 301603  
LICENSE NO.: 21-04741-01  
ACTION TYPE: AMENDMENT

2. FEE ATTACHED

AMOUNT: 690  
CHECK NO.: 11307

3. COMMENTS

SIGNED  
DATE

D. Hershey  
7-18-96

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED / V)

1. FEE CATEGORY AND AMOUNT: 30 720

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:

AMENDMENT  
RENEWAL  
LICENSE

3. OTHER

SIGNED  
DATE

SC 8/5/96

AUG 09 1996

Log	Jul 13 III
Remitter	
Check No.	46307 / 46370
Amount	\$690 + \$30
Fee Category	30
Type of Fee	AMD
Date Check Rec'd	7/22/96
Date Completed	8/5/96
By:	SC

1996 JUL 22 PM 1:53



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

## APPLICATION FOR MATERIAL LICENSE

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.

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 KRYAN 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 21-04741-01

C. RENEWAL OF LICENSE NUMBER

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

Niles Steel Tank Company  
P.O. Box 728  
713 Wayne Street  
Niles, Michigan 49120

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

Niles Steel Tank Company  
713 Wayne Street  
Niles, Michigan 49120

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

Robert H. Wood, R.S.O.

TELEPHONE NUMBER  
616-683-1910

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 170.31.3-0 AMOUNT  
ENCLOSED \$ 690.00

## 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

Robert H. Wood, R.S.O.

## SIGNATURE

Robert H. Wood

## DATE

07/15/96

## FOR NRC USE ONLY

RECEIVED

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

## APPROVED BY

## DATE

JUL 16 1996

REGION III

301603  
PRINTED ON RECYCLED PAPER

**Line Item 5. "RADIOACTIVE MATERIAL."**

100 Curie <sup>192</sup>Iridium sealed sources (+20%) - Amersham (Tech/Ops) Model 424-9 for use in the Amertest Model 660 System (660A or 660B) Gamma Projector. Shipping and storage in the Amertest 650L, Tech/Ops 650L Source Changers and Amertest 660 System (660A or 660B) Gamma Projectors.

**Line Item 6. "PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED."**

Industrial Radiography of Pressure Vessels, etc. in our facility only. Calibration of Direct Reading Dosimeters and Alarming Ratemeters that we utilize, only. (We will not calibrate others' equipment.)

**Line Item 7. "INDIVIDUAL(S) RESPONSIBLE....."**

Robert H. Wood, Radiation Safety Officer / Quality Control Manager

Training: Refer to a letter dated March 4, 1988 (Subject: Education, Work Experience & Qualifications of Robert H. Wood) contained in your files. If this letter is not found, let me know and I'll fax a copy of it to you.

**Line Item 8. "TRAINING FOR INDIVIDUALS WORKING.....RESTRICTED AREAS."**

Please refer to Section 3 "TRAINING PROGRAM" of Niles Steel Tank Company's Radiography Operations Manual.

**Line Item 9. "FACILITIES AND EQUIPMENT."**

Facilities: Please refer to Section 1 "PERMANENT RADIOGRAPHY FACILITY" and Appendix A (blueprint of the Cell Area) of Niles Steel Tank Company's Radiography Operations Manual.

Equipment: 100 Curie <sup>192</sup>Iridium sealed sources (+20%) - Amersham (Tech/Ops) Model 424-9 for use in the Amertest Model 660 System (660A or 660B) Gamma Projector. Shipping and storage in the Amertest 650L, Tech/Ops 650L Source Changers and Amertest 660 System (660A or 660B) Gamma Projectors. Also please refer to Section 2 "RADIATION DETECTION INSTRUMENTS (Descriptions)" of Niles Steel Tank Company's Radiography Operations Manual.

**Line Item 10. "RADIATION SAFETY PROGRAM."**

Please refer to all sections of Niles Steel Tank Company's Radiography Operations Manual.

**Line Item 11. "WASTE MANAGEMENT."**

'Depleted' sources shall be returned to Amersham Corporation, Burlington MA. for disposal as described in Section 10 of Niles Steel Tank Company's Radiography Operations Manual.

Revision Date: 12 July 1996

# **NILES STEEL TANK COMPANY RADIOGRAPHY OPERATIONS MANUAL**

**(PROCEDURES)**

# NILES STEEL TANK COMPANY

## RADIOGRAPHY OPERATIONS MANUAL (PROCEDURES)

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## 1 PERMANENT RADIOGRAPHY FACILITY (SEE APPENDIX A)

### 1.1 Materials of Radiation Cell:

- 1.1.1 The floor of the Radiation Cell is constructed of a concrete slab, on the ground floor. (One story building.)
- 1.1.2 The Walls are constructed of concrete blocks mortared with cement. The thickness of the blocks are 12" facing the radiation. Walls "B", "C", & "D" are double blocked to give a total thickness of 24". Wall "B" has a row of exterior red brick plus a row of 16" foundation block. Though this extra shielding exists, they are not included in the calculation, because the internal properties are unknown. The only benefit that was taken in the calculations was the distance factor (Inverse Square Law). Wall "A" is a single row of 12" concrete block and which is also the exterior wall.
- 1.1.3 The ceiling (roof) is constructed galvanized corrugated metal (approx. 16 to 20 gage thick) over a wood frame support and decking.
- 1.1.4 There is an 8 ft. chain link fence plus 3 strands of barbed wire to prevent access to the roof area above and near the Cell. This fence has one locked access gate which the Radiation Safety Officer has only the key.
- 1.1.5 There are no "right of ways" nor utility (gas or electric) over or near the Cell roof.
- 1.1.6 There is an 8 ft. high chain link fence outside of Wall "A" this fence also has 3 strands of barbed wire on top. This fence is 24 ft. away from the outside wall. There existed one access gate which cannot be opened because of large tree trunks have grown across the gate. There is also a window just outside of the cell area which can be used for observing this fenced in area of Wall "A".

### 1.2 Restricted Areas around and above Cell:

- 1.2.1 The roof area above Cell shall be a Restricted Area and will be posted (on barrier fence) "CAUTION - RADIATION AREA", (With Radiation Symbols). The locked gate will be posted "CAUTION - RADIATION AREA", (With Radiation Symbols). This area will have a Radiation dose less than 100 mR in one hour and will be off limits to all personnel during exposures. If for a temporary situation the radiation level by calculation, has to exceed 100 mR in one hour, the Radiation Safety Officer will provide surveillance for the roof area to assure that no personnel will enter the "High Radiation Area" and "Restricted Area".
- 1.2.2 The area fenced in outside of Wall "A" shall be posted as a "CAUTION - RADIATION AREA" (With Radiation Symbols) with signs posted on the barrier. This area will have a radiation dose less than 100 mR in one hour.
- 1.2.3 Areas outside of the Restricted Areas will have less than 2 mR in one hour and have less than 100 mR in seven consecutive days.
- 1.2.4 If scatter radiation levels exceed 2 mR in one hour, upon survey outside of the Cell, the Radiographer will post a restricted area and monitor the area to keep unauthorized personnel out.
- 1.2.5 See Appendix A and Chart "A" for purposed radiation levels in these areas.



1.3 Security and Safeguards:

- 1.3.1 There are three different keys and locks to gain access to the source contained in the 660 Gamma Projector; the key to the Cell door which has a Master lock, the key to the projector cabinet which also has a Master lock and the key to the 660 itself.
- 1.3.2 Radioactive sources shall be stored in the Cell when not in use, in locked storage containers. Radiographic equipment shall be stored in the Cell when not in use. The Cell door shall be locked when not in use.
- 1.3.3 A Tech/Ops Model 492D "Gamma Alarm" is installed on the radiation cell. The "Gamma Alarm" emits a high intensity red light when one mR/hr is present. If the door is opened or left open, a loud audible alarm will sound. Audible alarm will discontinue when door is closed. Personnel are warned to keep out of area when red light is present. (When no radiation is present, a green light is on). The "Gamma Alarm" is checked for proper operation when the quarterly inventory of sources is taken.
- 1.3.4 If a failure occurs with the 492D Gamma Alarm which necessitates repairs or replacement of the unit. Radiographic personnel shall wear Alarming Ratemeters while performing radiographic functions in the Cell while the 492D is inoperable.
- 1.3.5 Repair or replacement of the 492D Gamma Alarm shall be dealt with expeditiously, so the downtime of the Cell radiation safeguards are minimized.
- 1.3.6 Outside of the Cell, a type "G" radiation badge (marked "Area 1") is placed 24 hours a day, 365 days a year; at the border of the restricted area, where scatter radiation is likely to occur and unmonitored personnel are likely to occupy. This badge is only to be removed (and shielded) when an 'out of Cell exposure' is being performed in that shop area, which all unauthorized personnel will be evacuated from the Restricted Area.
- 1.3.7 This film badge will be sent in for processing biweekly with the rest of the film badges and is intended to 'monitor exposure to the public'.

## 2 RADIATION DETECTION INSTRUMENTS:

2.1 The Niles Steel Tank Company utilizes survey meters, pocket dosimeters and one dosimeter charger, and alarming ratemeters for radiographic functions. They are as follows:

### 2.1.1 Victoreen Model 492 Survey Meters:

- 2.1.1.1 Survey meters shall be in accordance with 10 CFR 34.24.
- 2.1.1.2 Radiation Detected: Gamma
- 2.1.1.3 Detection Range: 1 mR/hr to 1 R/hr.
- 2.1.1.4 Intended Use: These three instruments shall be used as primary radiation detection instruments. Should one fail, there will be another meter available for back-up. (One meter may be out for calibration at any given time).
- 2.1.1.5 Calibration Method: The survey meter shall be sent every (3) months to Amersham Corporation, for calibration. The type of source they use is Cesium 137. This source is contained in the Tech/Ops Model 571 or the Amertest Model 773 Gamma Survey Meter Calibration Unit. The procedures provide for the operation of this unit are followed by Amersham Corporation.
- 2.1.1.6 The survey meter calibration due date shall be offset of the others to avoid having all meters sent out of the plant at the same time.

### 2.1.2 Victoreen Model 541R Direct Reading Pocket Dosimeters:

- 2.1.2.1 Radiation Detected: Gamma
- 2.1.2.2 Detection Range: 0-200 mR
- 2.1.2.3 Intended Use: They are used primarily as instant radiation exposure measuring devices, as described in 10 CFR 34.33 (a), (b), (c), (d).
- 2.1.2.4 Radiographers and Radiographer's Assistants shall wear on clothing (charged daily) when conducting Radiographic Operations.
- 2.1.2.5 At any time, report to the Radiation Safety Officer if a dosimeter has been completely discharged during radiography operations. (off scale)
- 2.1.2.6 Calibration will be performed yearly.

### 2.1.3 Dosimeter Corporation Model No. 1888B & Model No. 33 Alarming Ratemeters:

- 2.1.3.1 Radiation Detected: Gamma
- 2.1.3.2 Anyone performing radiography outside of the Cell shall wear an Alarming Rate Meter as described in 10 CFR 34.33 (f).
- 2.1.3.3 Alarming Ratemeters will sound and audible alarm when it encounters a radiation rate of 500 mR/hr or greater and will continue to sound until the radiation field is reduced below 500 mR/hr.
- 2.1.3.4 Ratemeters will be checked for proper operation at beginning of each shift.
- 2.1.3.5 These rate meters shall be calibrated at least yearly.

- 2.1.4      Film Badges: R.S. Landauer (N.V.L.A.P. accredited) Type "G" film and holders.
  - 2.1.4.1      Badges are replaced biweekly.
  - 2.1.4.2      R.S. Landauer performs all processing and reporting.
  - 2.1.4.3      The Radiation Safety Officer shall review reports as received in the mail from R.S. Landauer.
  - 2.1.4.4      A person's film badge will be immediately sent in if his dosimeter is found to be completely discharged after engaging in radiographic procedures.

### 3 TRAINING PROGRAM

#### 3.1 Radiographer's Assistant Trainee:

- 3.1.1 A Trainee will work with a Radiographer or the Radiation Safety Officer for a period not less than one month to familiarize himself with Niles Steel Tank Company's Radiography Operations, equipment operating manuals and Emergency Procedures. During this time the Trainee is only an observer and shall not make radiographic exposures.
- 3.1.2 Specific instruction on Niles Steel Tank Company's Radiography Operating Procedures and Emergency Procedures will be minimum of 6 hours and 4 hours minimum on the proper use of Niles Steel Tank Company's radiographic equipment.
- 3.1.3 There will be approximately 30 minutes to 1 hour of instruction on each of the following subjects: (He will receive personal copies of 10 CFR Parts 19, 20, and this Manual.)
  - 3.1.3.1 The handling and use of licensed sealed sources and radiographic exposure devices to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in 10 CFR Part 20, Subpart C.
  - 3.1.3.2 Methods and occasions for conducting radiation surveys.
  - 3.1.3.3 Methods for controlling access to radiographic areas.
  - 3.1.3.4 Methods and occasions for locking and securing radiographic exposure devices, storage containers and sealed sources.
  - 3.1.3.5 Personnel monitoring and the use of personnel monitoring equipment.
  - 3.1.3.6 Minimizing exposure of persons in the event of an accident.
  - 3.1.3.7 The procedure for notifying proper persons in the event of an accident.
  - 3.1.3.8 Maintenance of records.
  - 3.1.3.9 The inspection and maintenance of radiographic exposure devices and storage containers.
  - 3.1.3.10 Steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale.
  - 3.1.3.11 The procedure(s) for identifying and reporting defects and noncompliance, as required by 10 CFR Part 21.
- 3.1.4 At the end of the required training period the Radiation Safety Officer will administer a written multiple choice exam to the Trainee. This exam will be a minimum of 25 questions and will be specific to Niles Steel Tank Company's Radiography Operating and Emergency Procedures and the use of Niles Steel Tank Company's radiographic equipment. The Trainee must achieve a minimum 70% score on this exam before he may advance to Radiographer's Assistance.
- 3.1.5 The Radiation Safety Officer shall re-instruct the Trainee on all questions missed on the exam. For failed exams, the Radiation Safety Officer will provide ample re-instruction so the Trainee can retake the exam. There is no minimum or maximum time allotment for this re-instruction and is to the discretion of the Radiation Safety Officer. Then the Radiographer's Assistant will take the Practical

Exam under supervision of the Radiation Safety Officer. (The Practical Exam is described later in this part under paragraph. 3.3.6 Radiographer's "Practical Exam.")

3.2 Radiographer's Assistant (RT Assistant or Level 1):

- 3.2.1 The Radiographer's Assistant will work with the Radiographers with a "hands on" capacity, only under direct visual supervision of the Radiographer (or the Radiation Safety Officer) when working with the radiographic exposure devices.

3.3 Radiographer (RT Level 11):

- 3.3.1 The Radiographer Assistant must work a minimum of nine more months as on the job training before he may be considered a "candidate" for promotion to Radiographer.
- 3.3.2 The candidate shall attend an Isotope Radiation Safety course (outside of Niles Steel Tank Company.) This course must consist of the following:
  - 3.3.2.1 A Minimum of 40 hours classroom instruction addressing Isotope Radiography, Radiation Safety and the subject matter addressed in 10 CFR Part 34 - Appendix A.
  - 3.3.2.2 A final exam consisting of not less than 50 questions pertaining to the subject matter addressed in 10 CFR Part 34 - Appendix A.
  - 3.3.2.3 After April 1, 1990 these exams must return with the candidate for the Radiation Safety Officer's approval and record retention.
- 3.3.3 Niles Steel Tank Company requires a minimum of 75% correct answers on these exams. The Radiation Safety Officer will re-instruct the candidate on missed questions to assure a good understanding of the subject matter.
- 3.3.4 Failed exams will result in a retraining period of not less than one month, then the candidate will retake a 50 question exam, rewritten from the first exam. The Radiation Safety Officer is responsible for the rewriting of this exam.
- 3.3.5 Previously Niles Steel Tank Company used Technical Operations in Burlington, Massachusetts for the administration of the courses. We will use Amersham Corporation's Radiation Safety Course to fulfill the above requirements.
- 3.3.6 Upon completion of the course and passing grade (75%). That candidate will take a practical examination administered by the Radiation Safety Officer. The Radiation Safety Officer will have the candidate setup and shoot a radiographic exposure (under supervision of the Radiation Safety Officer). The following is the list of Check Points:
  - 3.3.6.1 Proper Use of Film Badge, Alarming Rateometer and Dosimeter.
    - 3.3.6.1.1 Placement on clothing.
    - 3.3.6.1.2 Recharged dosimeter correctly.
  - 3.3.6.2 Proper Use of Survey Meter.
    - 3.3.6.2.1 Verify if meter is working.
    - 3.3.6.2.2 Battery check, calibrated.
    - 3.3.6.2.3 Proper surveys before, during and after exposure.



- 3.3.6.2.4 Survey's during exposure, check for increasing the Restricted Area.
- 3.3.6.2.5 Did he bring survey meter out of cell with him after locking cell door.
- 3.3.6.3 Proper Placement of the source in the Cell.
  - 3.3.6.3.1 No increase in restricted areas, proper use of Chart "A", using radiation protection formulas and understanding ALARA.
- 3.3.6.4 Proper check of radiographic equipment for damage and proper operation. (Daily inspection requirements.)
- 3.3.6.5 [Radiographic Artistry.]
- 3.3.6.6 During the exposure, ask Candidate question about the Emergency Procedures. ("What if" questions.)
- 3.3.6.7 Securing the source after exposure; proper surveys of the Projector and Cell.
  - 3.3.6.7.1 Is the radiographic source in it's properly shielded position? (Survey of tubes, collimator, etc.)
  - 3.3.6.7.2 Is the Projector locked.
  - 3.3.6.7.3 Base readings.
  - 3.3.6.7.4 Is the Cell door locked.
- 3.3.6.8 [Film Development]
- 3.3.6.9 [Film Interpretations]
- 3.3.6.10 Utilization Log Book filled out properly.
  - 3.3.6.10.1 Dosimeter reading.
  - 3.3.6.10.2 Base readings.
  - 3.3.6.10.3 Exposure logged properly.
  - 3.3.6.10.4 Maintenance check list, OK.
  - 3.3.6.10.5 Survey's recorded.
- 3.3.7 The Practical Exams will be pass/fail on the discretion of the Radiation Safety Officer and errors will be discussed with the Candidate to insure his proficiency. Failed exams will cause the Candidate to retrain under the Radiation Safety Officer's supervision until the Radiation Safety Officer feels that the Candidate has become proficient in Niles Steel Tank Company's radiography activities. The Candidate will be reexamined.
- 3.3.8 Passing grade on the Practical Exam, passing grade on the previously mentioned written exams and have at least one year working experience in Isotope Radiography, he will be promoted to Radiographer.
- 3.3.9 As an option to the above, Niles Steel Tank Company may use the ASNT-IRRSP to qualify it's radiography personnel.
- 3.4 Hiring an employee with previous experience as a Radiographer to qualify for Niles Steel Tank Company Radiographer:
  - 3.4.1 Prove at least one year experience in Isotope Radiography.
  - 3.4.2 Evidence of completion of an approved Radiation Safety Course, as mentioned above.
  - 3.4.3 A copy of the necessary written exams with grades from his previous employer. These exams shall be similar to Niles Steel Tank

Company's exams (one exam shall have a minimum of 50 questions relating to Radiation Safety in regards to 10 CFR Part 34 - Appendix A).

- 3.4.4 Pass a 25 question written exam on Niles Steel Tank Company's Radiography Operations and Emergency Procedures (75%).
- 3.4.5 Pass Niles Steel Tank Company's Practical Exam (mentioned above).
- 3.4.6 If possible, a letter of recommendation from the previous Radiation Safety Officer.
- 3.4.7 As an option to the above, Niles Steel Tank Company may use the ASNT-IRRSP to qualify it's radiography personnel.
- 3.4.8 Failed Examinations:
  - 3.4.8.1 When a candidate fails an exam he will be given ample time to study and/or gain experience to enable him to attempt to pass the exam.
  - 3.4.8.2 The Radiation Safety Officer or Radiographer will spend more time with the candidate to help them with deficient areas.
- 3.5 All exams will be kept as records, for inspection during the duration of a person's employment. Exams will be kept for at least 3 years after an employment has been terminated, for inspection.
- 3.6 Instructors will be Radiographers and/or the Radiation Safety Officer and shall have at least one year working experience in Isotope Radiography and be a certified Radiographer by Niles Steel Tank Company.
  - 3.6.1 The following personnel presently employed shall serve as instructor and supervisory capacity over the Radiographer's Assistant:
    - 3.6.1.1 Name: Robert H. Wood (616-683-9182), Radiation Safety Officer.
- 3.7 Training personnel for auditing the Radiation Safety Officer:
  - 3.7.1 The Auditor will be provided with documents; 10 CFR Part 19, Part 20, Part 34, Part 71, Niles Steel Tank Company's Quality Assurance Program (per 10 CFR Part 71, Subpart H), this Manual and the Audit Checklist for his review.
  - 3.7.2 The Auditor will receive all revisions to the above documents as available.
  - 3.7.3 Questions that may arise as to the interpretation and/or procedural matters will be discussed between the Auditor and the Radiation Safety Officer before auditing is to be performed, as the Auditor does not engage in any other functions of radiographic procedures than auditing the performance and duties of the Radiation Safety Officer.
  - 3.7.4 The Auditor will be issued his film badge, charged dosimeter and an Alarming Ratemeter (if necessary), while performing the audits.

#### 4 RADIOGRAPHY PROCEDURE WITH THE AMERTEST 660 PROJECTOR:

##### 4.1 Exposures inside the Radiation Cell:

- 4.1.1 Carry an operable and calibrated survey meter and be sure meter is on.
- 4.1.2 Wear your film badge and charged pocket dosimeter on clothing that won't be removed during the course of radiographic functions. Note the pocket dosimeter reading after charging.
- 4.1.3 Secure keys to the Cell and the Projector from the Radiation Safety Officer.
- 4.1.4 Approach the Cell door with your survey meter on. If survey the reading is zero mR/hr and the Gamma Alarm light is green. Unlock the Cell door and approach the Projector storage cabinet, noticing survey readings. [Do not enter the Cell if the Gamma Alarm horn sounds and the red light is on. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.1.5 Unlock the Projector storage cabinet and remove the Projector. Survey all sides of the Projector and record surface Base Reading. [No reading shall exceed 200 mR/hr. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.1.6 Inspect the Projector and associated equipment per 5.3 (Daily Inspection) of this manual.
- 4.1.7 Setup the exposure, connect source stop or collimator and guide tubes to the Projector. Inspect the guide tubes for kinks, sharp bends or crushed areas. Inspect the setup and setup area to assure that nothing could cause damage to the equipment during the source exposure.
- 4.1.8 Drive cable connection: Connection of the drive cable assembly as described per the operating manual for the Amertest 660 Operation Manual, as follows:
  - 4.1.8.1 Cable layout: Lay out the control cables with no bend radii less than about one (1) meter.
  - 4.1.8.2 Avoid any risk of crushing by falling objects, moving vehicles or closing doors, etc.
  - 4.1.8.3 The drive cable control unit should be placed as far away from the source focal position as possible (preferably behind shielding).
  - 4.1.8.4 Connect the drive cable to the source Projector as shown in fig. 5.7 (pictorial illustration) of the Amertest 660 Operations Manual.
  - 4.1.8.5 Unlock with the key and turn the selector ring from LOCK to CONNECT. The storage cover will disengage from the Projector.
  - 4.1.8.6 Slide the control cable collar back and open the jaws to expose the male portion of the swivel coupling (ie., the ball-end on the drive cable).
  - 4.1.8.7 Press back the spring-loaded locking pin with a thumb nail and engage the male and female portions of the swivel coupling.

- 4.1.8.8 Release the locking pin and check that the connection is secure.
- 4.1.8.9 Close the jaws of the control cable connector over the swivel coupling.
- 4.1.8.10 Slide the control collar over the connector jaws.
- 4.1.8.11 NOTE: The drive cable connector, when properly installed with the selector ring in the CONNECT position, displaces anti-rotation lugs which allows the selector ring to be rotated to the LOCK position and when required, through to the OPERATE position.
- 4.1.8.12 Push and hold the control cable collar flush against the Projector connector and rotate the selector ring from CONNECT to LOCK.
- 4.1.8.13 Do not rotate past LOCK.
- 4.1.8.14 The drive cable connector is now locked into the Projector.
- 4.1.8.15 Keep the Projector in the LOCK position until ready to start the exposure.
- 4.1.9 Radiographic exposure:
  - 4.1.9.1 Guide tubes: Remove the shipping plug from the Projector and connect the source guide tube(s). DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 4.1.9.2 Projector survey: Check the operation of the survey meter by reading the radiation level at the surface of the Projector. It should read no more than 2 Sv/h (200 mR/h) except for the area just in front of the exit port when the shipping plug is removed.
  - 4.1.9.3 Note that the readings for verification of the source return after exposure. (Base Reading)
  - 4.1.9.4 Verify that the guide tube and drive cable are correctly connected.
  - 4.1.9.5 Ensure that no unauthorized personnel are inside the Restricted Area or the Cell, and that signs are posted and warnings are in operation.
  - 4.1.9.6 CAUTION: Do not apply excess force to the control handle in the exposed direction as this could cause the source assembly to move forward out of the stored position when the lock slide is released.
  - 4.1.9.7 Unlock: Use the key to unlock the Projector lock and rotate the selector ring to the OPERATE position. Ensure there is no tension force in either direction on the drive cable. Push the slide bar (green marking) laterally from left to right (as seen behind the Projector) until the slide bar (red marking) fully appears on the right side of the selector ring and you feel or hear the sleeve snap into slide. When the green marking is visible the source assembly is locked into the safely stored position within the Projector; when the red marking is visible the source assembly is free to be projected from/to the Projector. The source is now free to move.
  - 4.1.9.8 Close and lock the Cell door.



- 4.1.9.9 Return to the drive control unit.
- 4.1.9.10 Project: Rapidly rotate the crank in the 'EXPOSE' direction (counterclockwise) to move the source out of the Projector to the radiographic focal position.
- 4.1.9.11 The hand crank will stop turning when the source reaches its stop. Do not use excessive force.
- 4.1.9.12 Set the brake to ON to prevent movement of the source during exposure.
- 4.1.9.13 Calculate the exposure time from the moment when the source reaches its stop.
- 4.1.9.14 Survey: Survey meter readings observed during the projection operation should increase rapidly from background to a high level as the source emerges from the Projector. Then readings should fall sharply as the source enters a collimator (if used) and remain steady throughout the exposure.
- 4.1.9.15 Actual survey meter readings will depend on the source activity, distance, collimators and shielding.
- 4.1.9.16 The sequence of changes should be observed and the readings noted.
- 4.1.9.17 During source retractions the sequence will reverse.
- 4.1.9.18 During the exposure, use the survey meter to check the perimeter of the Cell to assure that the source exposure site is correct.
- 4.1.9.19 Retract: At the end of the required exposure time, set the brake to OFF and rapidly turn the crank in 'RETRACT' (clockwise) direction until the crank no longer moves. You should hear the slide bar "click" back into it's original position and observe the green marking on the slide bar.
- 4.1.9.20 Apply a slight amount of forward pressure on the crank handle as if to expose the source to insure that the positive locking mechanism has actuated. Allow the crank handle to return to a neutral position, thereby relieving any tension (force) on drive cable which would cause source movement when unlocking the camera. At this point the source cannot be moved out of the stored position.
- 4.1.9.21 In the unlikely event of the locking slide moves toward the lock position before the source is fully stored in the Projector, turn the hand crank in the "RETRACT" (clockwise) direction until the crank stops turning. (The lock slide is designed to lock on the stop ball, not the drive cable.) Do not use excessive force. The source will be in the Projector but not in the fully shielded position. Approach the Projector, from the rear, with a survey meter. The meter will read approximately 40 mR/hr at the rear plate of the Projector when a 100 Ci source is in use.
- 4.1.9.22 CAUTION: Remain clear of the front of the Projector to minimize personal exposure. Reset the lock slide to the open position. Return to the control and turn the hand crank in the retract (clockwise) direction and store the source in the normal manner.



- 4.1.9.23 The survey meter should indicate a continually increasing radiation level as the source retracts, then drop to background when the source is stored in the Projector.
- 4.1.9.24 Check survey: Approach the Projector with the survey meter, observe the green marking on the slide bar and survey it on all sides. The meter should indicate the same radiation level as observed before the exposure. Note particularly the exit port reading.
- 4.1.9.25 Survey the entire source guide tube with the survey meter. If the meter shows a sharp increase, the source is exposed or incompletely shielded.
- 4.1.9.26 If the source is still exposed, attempt to store it properly by cranking the source a short distance toward the source stop and retracting it, repeating if necessary.
- 4.1.9.27 If the source cannot be fully retracted after several attempts, treat the situation as an EMERGENCY.
- 4.1.9.28 If there are more exposures to be taken, rotate selector ring to the LOCK position. Setup the new exposure and proceed from 4.1.9.7 above. If your exposures are complete or you have to leave the direct supervision of the Cell area, proceed below.
- 4.1.9.29 Lock Projector: When the source is properly stored in the Projector, rotate the selector ring from the OPERATE position to the LOCK position.
- 4.1.9.30 WARNING: If after several attempts to return the source, the selector ring cannot be rotated to the lock position (do not use excessive force) or the lock slide is not actuated, one must suspect an accident in which the source could have become disconnected or stuck outside the Projector, giving rise to a very high radiation field. Treat the situation as an EMERGENCY!
- 4.1.10 Dismantling equipment:
  - 4.1.10.1 Guide tubes: Unscrew the source guide tube sections. Screw the shipping plug into the Projector guide tube connector.
  - 4.1.10.2 Drive control unit: Unlock the Projector and then rotate the selector ring from LOCK to CONNECT. The safety control connector will partially disengage.
  - 4.1.10.3 Disengage the drive control unit from the Projector by reversing the sequence of actions described in section 4.1.8.
  - 4.1.10.4 Replace and hold the storage cover on the Projector connector and rotate the selector ring to the LOCK position.
  - 4.1.10.5 Remove the key and push in the lock to secure the Projector.
  - 4.1.10.6 Check the entire circumference of the Projector with the survey meter to ensure the source is properly secured. Record final Base Reading.
- 4.1.11 Put things back in their proper place. Lock Projector in it's storage cabinet. Survey the Cell. Lock the Cell. Secure keys with the Radiation Safety Officer. Record all required information on the Daily Utilization Log.

#### 4.2 Radiographic Exposures Outside of the Cell:

- 4.2.1 Carry an operable and calibrated survey meter and be sure meter is on.
- 4.2.2 Wear your film badge, charged pocket dosimeter and calibrated Alarming Ratemeter on clothing that won't be removed during the course of radiographic functions. Note the pocket dosimeter reading after charging.
- 4.2.3 Secure keys to the Cell and the Projector from the Radiation Safety Officer.
- 4.2.4 Approach the Radiation Cell door with your survey meter on. If the survey reading is zero mR/hr and the Gamma Alarm light is green. Unlock Cell door and approach the Projector storage cabinet, noticing survey readings. [Do not enter Cell if the Gamma Alarm horn sounds and the red light is on. **THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!**]
- 4.2.5 Unlock the cabinet and remove the Projector. Survey all sides of the Projector and record surface Base Reading. [No reading shall exceed 200 mR/hr. **THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!**]
- 4.2.6 Inspect the Projector and associated equipment per 5.3 (Daily Inspection) of this manual.
- 4.2.7 Load the radiographic equipment onto a "two wheel cart". [Radiation Safety Officer's personal suggestion: It is advised that you do not carry the 660 by hand to the exposure area because radiation levels at the surface of the 660 are high. By carrying this unit like a "suitcase" and by its sheer weight, you cannot eliminate the close body contact; which defeats the principal of ALARA. Use "two wheel carts" for transporting the 660, except for very short distances.]
- 4.2.8 Visually survey the area and where the source placements are to be.
- 4.2.9 Calculate and post the High Radiation (100 mR/hr) areas and rope off and post the Restricted Area (2 mR/hr) with "CAUTION - RADIATION AREA". Be slightly excessive in regards to your distances as an additional safety factor.
- 4.2.10 Use a collimator when ever possible. When shooting panoramic exposures, cover (shield) openings in vessels with at least the thickness of the material to be exposed. This will eliminate "hot areas" which makes it hard to calculate your restricted areas.
- 4.2.11 Setup the exposure, connect source stop or collimator and guide tubes to the Projector. Inspect the guide tubes for kinks, sharp bends or crushed areas. Inspect the setup and setup area to assure that nothing could cause damage to the equipment during source exposure.
- 4.2.12 Drive cable connection: Connection of the drive cable assembly as described per the operating manual for the Amertest 660 Operation Manual, as follows:
  - 4.2.12.1 Cable layout: Lay out the control cables with no bend radii less than about 1m.
  - 4.2.12.2 Avoid any risk of crushing by falling objects, moving vehicles or closing doors, etc.

- 4.2.12.3 The drive cable control unit should be placed as far away from the source focal position as possible (preferably behind shielding).
- 4.2.12.4 Connect the drive cable to the source Projector as shown in fig. 5.7 (pictorial illustration) of the Amertest 660 Operations Manual.
- 4.2.12.5 Unlock with the key and turn the selector ring from LOCK to CONNECT. The storage cover will disengage from the Projector.
- 4.2.12.6 Slide the control cable collar back and open the jaws to expose the male portion of the swivel coupling (ie. the ball-end on the drive cable).
- 4.2.12.7 Press back the spring-loaded locking pin with a thumb nail and engage the male and female portions of the swivel coupling.
- 4.2.12.8 Release the locking pin and check that the connection is secure.
- 4.2.12.9 Close the jaws of the control cable connector over the swivel coupling.
- 4.2.12.10 Slide the control collar over the connector jaws.
- 4.2.12.11 NOTE: The drive cable connector, when properly installed with the selector ring in the CONNECT position, displaces anti-rotation lugs which allows the selector ring to be rotated to the LOCK position and when required, through to the OPERATE position.
- 4.2.12.12 Push and hold the control cable collar flush against the Projector connector and rotate the selector ring from CONNECT to LOCK.
- 4.2.12.13 Do not rotate past LOCK.
- 4.2.12.14 The drive cable connector is now locked into the Projector.
- 4.2.12.15 Keep the Projector in the LOCK position until ready to start the exposure.
- 4.2.13 Radiographic exposure:
  - 4.2.13.1 Guide tubes: Remove the shipping plug from the Projector and connect the source guide tube(s). DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 4.2.13.2 Projector survey: Check the operation of the survey meter by reading the radiation level at the surface of the Projector. It should read no more than 2 Sv/h (200 mR/h) except for the area just in front of the exit port when the shipping plug is removed.
  - 4.2.13.3 Note that the readings for verification of the source return after exposure. (Base Reading)
  - 4.2.13.4 Verify that the guide tube and drive cable are correctly connected.
  - 4.2.13.5 Ensure that no unauthorized personnel are inside the Restricted Area and that signs are posted and warnings are in operation.

- 4.2.13.6 CAUTION: Do not apply excess force to the control handle in the exposed direction as this could cause the source assembly to move forward out of the stored position when the lock slide is released.
- 4.2.13.7 Unlock: Use the key to unlock the Projector lock and rotate the selector ring to the OPERATE position. Ensure there is no tension force in either direction on the drive cable. Push the slide bar (green marking) laterally from left to right (as seen behind the Projector) until the slide bar (red marking) fully appears on the right side of the selector ring and you feel or hear the sleeve snap into slide. When the green marking is visible the source assembly is locked into the safely stored position within the Projector; when the red marking is visible the source assembly is free to be projected from/to the Projector. The source is now free to move.
- 4.2.13.8 Return to the drive control unit.
- 4.2.13.9 If an odometer is fitted, adjust the reset knob to read zero.
- 4.2.13.10 Project: Rapidly rotate the crank in the 'EXPOSE' direction (counterclockwise) to move the source out of the Projector to the radiographic focal position.
- 4.2.13.11 The hand crank will stop turning when the source reaches its stop. Do not use excessive force.
- 4.2.13.12 The odometer (if fitted) will indicate the approximate total distance traveled. (about 2.1m (7 ft) for each guide tube section).
- 4.2.13.13 Set the brake to ON to prevent movement of the source during exposure.
- 4.2.13.14 Calculate the exposure time from the moment when the source reaches its stop.
- 4.2.13.15 Survey: Survey meter readings observed during the projection operation should increase rapidly from background to a high level as the source emerges from the Projector. Then readings should fall sharply as the source enters a collimator (if used) and remain steady throughout the exposure.
- 4.2.13.16 The sequence of changes should be observed and the readings noted.
- 4.2.13.17 During source retractions the sequence will reverse.
- 4.2.13.18 Actual survey meter readings will depend on the source activity, distance, collimators and shielding. If necessary, extend the Restricted Area perimeter. Make notes of surveys and distances for the Daily Utilization Log.
- 4.2.13.19 The Radiographer shall have full observation or access control of the Restricted Area while the source is exposed.
- 4.2.13.20 At anytime that an unauthorized (unmonitored) person should enter the Restricted Area, the source will be immediately retracted and secured.
- 4.2.13.21 Retract: At the end of the required exposure time, set the brake to OFF and rapidly turn the crank in 'RETRACT' (clockwise) direction until the crank no longer moves. You



- should hear the slide bar "click" back into it's original position and observe the green marking on the slide bar.
- 4.2.13.22 Apply a slight amount of forward pressure on the crank handle as if to expose the source to insure that the positive locking mechanism has actuated. Allow the crank handle to return to a neutral position, thereby relieving any tension (force) on drive cable which would cause source movement when unlocking the camera. At this point the source cannot be moved out of the stored position.
- 4.2.13.23 In the unlikely event of the locking slide moves toward the lock position before the source is fully stored in the Projector, turn the hand crank in the "RETRACT" (clockwise) direction until the crank stops turning. (The lock slide is designed to lock on the stop ball, not the drive cable.) Do not use excessive force. The source will be in the Projector but not in the fully shielded position. Approach the Projector, from the rear, with a survey meter. The meter will read approximately 40 mR/hr at the rear plate of the Projector when a 100 Ci source is in use.
- 4.2.13.24 CAUTION: Remain clear of the front of the Projector to minimize personal exposure. Reset the lock slide to the open position. Return to the control and turn the hand crank in the retract (clockwise) direction and store the source in the normal manner.
- 4.2.13.25 The odometer (if supplied) should read approximately zero when the source assembly has returned to the Projector.
- 4.2.13.26 The survey meter should indicate a continually increasing radiation level as the source retracts, then drop to background when the source is stored in the Projector.
- 4.2.13.27 Check survey: Approach the Projector with the survey meter, observe the green marking on the slide bar and survey it on all sides. The meter should indicate the same radiation level as observed before the exposure. Note particularly the exit port reading.
- 4.2.13.28 Survey the entire source guide tube with the survey meter. If the meter shows a sharp increase, the source is exposed or incompletely shielded.
- 4.2.13.29 If the source is still exposed, attempt to store it properly by cranking the source a short distance toward the source stop and retracting it, repeating if necessary.
- 4.2.13.30 If the source cannot be fully retracted after several attempts, treat the situation as an EMERGENCY.
- 4.2.13.31 If there are more exposures to be taken, rotate selector ring to the LOCK position. Setup the new exposure and proceed from 4.2.8 above. If your exposures are complete or you have to leave the direct supervision of the restricted area, proceed below.
- 4.2.13.32 Lock Projector: When the source is properly stored in the Projector, rotate the selector ring from the OPERATE position to the LOCK position.
- 4.2.13.33 WARNING: If after several attempts to return the source, the selector ring cannot be rotated to the lock position (do



not use excessive force) or the lock slide is not actuated, one must suspect an accident in which the source could have become disconnected or stuck outside the Projector, giving rise to a very high radiation field. Treat the situation as an EMERGENCY!

4.2.14 Dismantling equipment:

- 4.2.14.1 Guide tubes: Unscrew the source guide tube sections. Screw the shipping plug into the Projector guide tube connector.
  - 4.2.14.2 Drive control unit: Unlock the Projector and then rotate the selector ring from LOCK to CONNECT. The safety control connector will partially disengage.
  - 4.2.14.3 Disengage the drive control unit from the Projector by reversing the sequence of actions described in section 4.2.12.
  - 4.2.14.4 Replace and hold the storage cover on the Projector connector and rotate the selector ring to the LOCK position.
  - 4.2.14.5 Remove the key and push in the lock to secure the Projector.
  - 4.2.14.6 Check the entire circumference of the Projector with the survey meter to ensure the source is properly secured.
- 4.2.15 Load everything back up on to the two wheel cart and take it back to the Cell. Put thing in their proper place. Lock Projector in it's storage cabinet. Survey the Cell. Lock the Cell. Secure keys with the Radiation Safety Officer.
- 4.2.16 Record all information on the Daily Utilization Log.

## 5 INSPECTION AND MAINTENANCE REQUIREMENTS:

- 5.1 Projectors and associated equipment must be maintained regularly to ensure consistent and safe operation.
- 5.2 Equipment should be completely serviced after it has been subjected to severe conditions (eg. Immersed in water or mud, in a sand storm, dropped, etc.).
- 5.3 Daily Inspection:
  - 5.3.1 Survey all sides of the Projector for excessive radiation readings. [No reading shall exceed 200 mR/hr. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
  - 5.3.2 Inspect Projector for visible damage.
  - 5.3.3 Inspect drive cable housing for cuts, dents and broken or worn fittings. Ensure that the 'available length of drive cable is greater than the total length of the guide tubes (plus source stop) to be used. DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 5.3.4 Inspect the source guide tubes for obstructions, cuts, dents (or signs of crushing) and heat damage. Inspect fittings for same, but inspect female 'swivel' coupling for freedom of movement.
  - 5.3.5 During the course of radiographic activities, check the general operation of the Projector. Check that the selector ring, slide bar, lock mechanism and crank assembly moves freely and the characterizations of their movements have not changed significantly.
  - 5.3.6 If when cranking out the source and you encounter excessive resistance, return the source to it's stored/shielded position. Survey and check that the slide bar is set on green to assure proper source shield position. Investigate the reason for the resistance, ie., too tight of bend radius in drive cable housings and/or source guide tubes, and correct situation.
  - 5.3.7 If excessive resistance is still encountered, do not force the exposure. Store source properly in its stored/shielded position (survey) and perform maintenance on all components as outlined below. [5.4 Quarterly Maintenance.] Take unit out of service until such maintenance is conducted and is check for proper operation. Contact the Radiation Safety Officer about the situation and inform him of the cause of the failure.
  - 5.3.8 Record all information on the Daily Utilization Log.
- 5.4 Quarterly maintenance:
  - 5.4.1 Clean (if necessary), inspect and maintain the drive cable assembly.
  - 5.4.2 Clean (if necessary) and inspect the source guide tubes.
  - 5.4.3 Clean (if necessary) and inspect the Projector for wear or obvious damage. Report to the Radiation Safety Officer any defect which might effect safe operation and withdraw it from service until repairs can be effected.
  - 5.4.4 See that the radioisotope warning labels are secure and legible. Do not cover with any other labels.
  - 5.4.5 Check that the source outlet shipping plug is in place and that the screw and nut turn freely, but are not loose.

- 5.4.6 Check for wear in the cable connector using the NO GO gauge. There are four NO GO tests -- ball diameter; ball shank; slot width; and connector gap width.
- 5.4.7 Any component that fail any of these tests, must be replaced before it can be used. Withdraw unit from service and contact the Radiation Safety Officer.
- 5.4.8 Check that the selector ring and lock mechanism operate freely. If operation is faulty, withdraw unit from service and notify Radiation Safety Officer.
- 5.4.9 If for any reason that you feel that a Projector or it's components are not or will not operate properly or safely; withdraw it from service, label it "DO NOT USE" and report it to the Radiation Safety Officer promptly.
- 5.4.10 Record on the Daily Utilization Log in the "comments" section that this maintenance procedure was performed on that date.
- 5.4.11 Other maintenance and/or repairs to the 660 Projector (or components) will not be performed by Niles Steel Tank Company personnel, except that in the case that the Radiation Safety Officer determines that in the unlikely event that the locking assembly needs additional lubrication. This can only be done if there is an empty source changer on hand (during source changes) and is only to be performed by the Radiation Safety Officer.
- 5.4.12 All other repairs will be completed by the Manufacturer, or his representative, by qualified personnel.

## 6 INTERNAL INSPECTION AND MANAGEMENT CONTROL

### 6.1 Audits of radiographic personnel:

6.1.1 There shall be quarterly audits of the Radiographic Operations, Radiographer's Assistant and Radiographers.

6.1.1.1 Radiography Operations will be reviewed by the Radiation Safety Officer to insure that the Operating and Emergency Procedures, proper safety techniques and ALARA, etc. are being performed. The Radiation Safety Officer will use a checklist to document these audits.

6.1.2 If a Radiographer or an Assistant has not performed radiography in a period of three (3) months, he shall be reexamined before he may perform radiography.

### 6.1.3 Audits of the Radiation Safety Officer:

6.1.3.1 Audit of the Radiation Safety Officer will be performed by management personnel trained in the auditing procedure described in 3.7 of this Manual.

6.1.3.2 The audit will be performed from a checklist of the Radiation Officer's responsibilities. A comprehensive review of documents required by this Manual and 10 CFR will also be included on this checklist. [see Exhibits; Radiation Safety Officer Audit Checklist]

6.1.3.3 The Auditor will not actually be engaged in the radiographic functions performed, but only as an observer.

6.1.3.4 Audits will be performed annually.

6.1.3.5 The person responsible for auditing the Radiation Safety Officer is: James A. Coleman, President/Owner of Niles Steel Tank Company.

### 6.2 Deficiencies and Corrective Action:

#### 6.2.1 Deficiencies found during a Quarterly Audits:

6.2.1.1 If a person is found deficient in their duties during an audit, he will be instructed about his deficiencies.

6.2.1.2 The Radiation Safety Officer may require a more comprehensive examination or more closely monitor this person while performing their duties.

### 6.3 Intentional Violations:

6.3.1 Intentional violations of this Radiography Operating Manual, Emergency Procedures, NRC requirements by radiography personnel will undergo disciplinary action.

6.3.2 Severity of the violations will be a judgment of the Radiation Safety Officer and his employer.

6.3.3 Violations and disciplinary action will be recorded and will be maintained a minimum of 5 years.

6.4 Violations that require NRC notification will be performed as prescribed in 10 CFR Part 21.

6.5 Internal inspection and management control shall be the responsibility of the Radiation Safety Officer.

6.6 Radiation Safety Officer: Robert H. Wood

6.7 Duties of the Radiation Safety Officer are as follows:

- 6.7.1 Conduct the Training Program.
- 6.7.2 Quarterly audits of Radiographers' and Radiographer Assistants' performances to assure they are performing their duties in the prescribed manner.
- 6.7.3 Review radiographic operations to determine that all persons involved are performing their duties as prescribed by this manual and current 10 CFR Regulations.
- 6.7.4 Review personal monitoring records. Assuring that the occupational dose limits are within the limits described in 10 CFR Part 20, Subpart C.
- 6.7.5 Review Daily Utilization Logs.
- 6.7.6 Quarterly Inventory of sealed sources.
- 6.7.7 Review of Calibration Records for Pocket Dosimeters, Survey Meters and Alarming Ratemeters and to make sure that the instruments are current and documented as to their required calibration intervals.
- 6.7.8 Supervise receipt and return of Radioactive Packages and the records of such.
- 6.7.9 Review of Quarterly Maintenance Records and to make sure that equipment is current as to the frequency of such.
- 6.7.10 On an annual basis; review the NRC License, current CFR, Niles Steel Tank Company's Radiographic Operations Manual, etc. to make sure that Niles Steel Tank Company radiography program is current.
- 6.7.11 On periodic basis review radiographic operations to determine that all personnel are performing their duties as prescribed.
- 6.7.12 At anytime: Halt the duties of any person when his pocket dosimeter has been discharged off-scale. This person's film badge will be immediately be sent (overnight) for processing. This person will not perform any radiographic "hot" (not to be allowed in a Restricted Area) functions until the result of his film badge is returned.
- 6.7.13 At anytime: Halt the duties of radiography personnel if he is not performing in accordance to this manual, defeating safety and security systems, or knowingly making misrepresentations.

6.8 Personal Monitoring:

- 6.8.0.1 The Radiographer is responsible for changing of film badges and presenting the dosimeter reports to the Radiation Safety Officer for his review.
- 6.8.0.2 Film badges are the type "G" as supplied by R.S. Landauer Company, N.V.L.A.P. accredited.
- 6.8.0.3 Film badges are replaced and processed biweekly.
- 6.8.0.4 It is the responsibility of each monitored individual to be using the current film badge. It is the responsibility of the Radiation Safety Officer (or his delegate) to collect the film badges at expiration, and send them in for processing.
- 6.8.0.5 The reports of the film badge dosages shall be reviewed by the Radiation Safety Officer.



6.8.0.6 The Radiation Safety Officer shall halt any "hot" activities of any personnel that accumulated dosages that reach or exceed the dosage parameters set forth by 10 CFR Part, Subpart C. The Radiation Safety Officer will make required notifications and reports as provided in 10 CFR 20.2202 and 20.2203.

6.8.0.7 Film badge reports will be filed until which time the NRC authorizes their disposal.

6.9 Utilization Log:

6.9.1 A log (NST/R1) of radiographic functions shall be kept by radiographic personnel.

6.9.2 Radiography personnel are instructed to fill in the spaces as follows:

6.9.2.1 Date of exposures(s) that were taken.

6.9.2.2 Mark if either the exposures were taken inside the Cell or outside, in the plant area.

6.9.2.3 Source strength.

6.9.2.4 Survey meter readings before entering Cell.

6.9.2.5 Number of exposures taken - time of each exposure - serial number or identification of article radiographed.

6.9.2.6 Surveys performed during exposure.

6.9.2.7 Pocket dosimeter readings at start of shift and end of shift.

6.9.2.8 Fill out the daily inspection report questions (bottom half of form NST/R1); YES?/NO?

6.9.2.9 Indicate that all equipment is has been locked and secured.

6.9.2.10 Cell survey reading before Cell door is locked.

6.9.2.11 Signatures of radiographic personnel attesting to the above.

6.10 Quarterly Inventory:

6.10.1 Each quarter of the year, the Radiation Safety Officer shall list the following information, which will be kept on record for review:

6.10.1.1 Isotope of the sealed source.

6.10.1.2 Source activity at the time of the inventory.

6.10.1.3 Serial number of the source.

6.10.1.4 Location of the source.

6.10.1.5 Date of inventory.

6.11 Instrument Calibration:

6.11.1 The Radiographer is responsible for sending out the survey meters for calibration to Amersham Corporation, upon reaching their calibration due date. He will also assure that proper documentation accompanies the meter when it has returned from Amersham.

6.11.2 The Radiation Safety Officer will verify that a file of this documentation is properly completed.

6.12 Training Program:

6.12.1 It is the duty of the Radiation Safety Officer to initiate and/or conduct the training. He may designate responsibility to the radiographer as required. The Radiation Safety Officer will conduct all personnel qualification examinations.

## 7 LEAK TESTING:

- 7.1 Under normal circumstances source are not retained at Niles Steel Tank Company for more than six months, by which leak testing is not required.
- 7.2 If a source is retained for six months or more, a leak test will be performed per 10 CFR 34.25. Under such conditions the Radiographer shall use a Amersham 518 Leak Test Kit and perform the test in accordance with instruction provided with the test kit.
  - 7.2.1 Remove the shipping plug from the Projector and survey the source exit port. This is the nearest accessible point to the source. You will want to swab this port, but this is where the highest amount of radiation is exiting the Projector. Keep exposure time to a minimum at this port.
  - 7.2.2 After thoroughly wiping the source exit port with the swab, as described in the kit instructions. Place the swab and the applicator stick in the plastic bag without touching any part of your body or clothing because of possibility of radioactive contamination on the swab.
  - 7.2.3 Replace shipping plug into Projector.
  - 7.2.4 Take bagged swab out of the Cell and to an area where there is no radioactive source emissions. Make sure (operable) survey meter is reading zero and slowly bring swab close to the front right corner of the survey meter. If the survey meter remains reading zero, seal bag with staples or tape. Fill out the leak test form with the required information and send the complete leak test kit to Amersham for radioassay.
  - 7.2.5 If the survey meter reading rises off of zero, take the bagged swab back into the Cell and secure. Take Projector and all other components that were used with this Projector out of service, and tag them "DO NOT USE". Contact the Radiation Safety Officer promptly.
  - 7.2.6 The Radiation Safety Officer will then evaluate the situation and contact Amersham (source manufacturer) as to the next course of action to be taken. If radioassay readings exceed 0.005 uCi the requirements of 10 CFR 34.25(d) will be imposed.
  - 7.2.7 The contaminated equipment shall not be put back into service until which time the radioassay of the swab reveals that the amount of contamination is acceptable or the Projector and effected components were decontaminated by Amersham or their representative.
  - 7.2.8 Records of leak test results shall be maintained three years.
  - 7.2.9 All of the above operations shall be verified by the Radiation Safety Officer.

## 8 EMERGENCY OPERATING PROCEDURES:

8.1 An emergency shall be constituted in the event of the following:

- 8.1.1 The disconnection of a source outside of the stored/shielded position in the Projector.
- 8.1.2 The loss or theft of a source, Projector or source changer.
- 8.1.3 If the source will not completely return to its stored/shielded position in the Projector, after several attempts. [Notify Radiation Safety Officer if there are any problems regarding the return of a source to its stored/shielded position on the first attempt.]
- 8.1.4 A Projector or source changer emitting excessive radiation, ie., 200 mR/hr at any surface or 10 mR/hr at one meter.
- 8.1.5 Any signs of external contamination on a source changer or Projector after receipt from the carrier.

8.2 The Emergency Operating Procedures are as follows:

- 8.2.1 Immediately, but calmly evacuate surrounding personnel until the Restricted Area perimeters can be established. Keep your own exposure as low as possible!
- 8.2.2 Establish Restricted Area and rope off boundaries. If necessary, post guards at the boundaries (entrust them only after explaining the full 'gravity' of the situation) if you have to leave full control of the emergency area; when contacting the Radiation Safety Officer or proceeding with other safety related activities concerning the Emergency.
- 8.2.3 Notify the Radiation Safety Officer promptly (if not at work, his home address and phone number are as follows):

Robert H. Wood      683-9182  
1505 Valley View Drive  
Niles, Mi.

- 8.2.4 At no time shall the Radiographer try to retrieve or attempt to place a disconnected source in its shielded position. Qualified personnel will conduct this operation.
- 8.2.5 Maintain direct surveillance and control over the area. If a emergency occurs in the Cell, lock Cell door and post a warning "Emergency - Do Not Enter" over the lock.
- 8.2.6 If possible (and as soon as possible), write down the events that caused the emergency. This information could be quite beneficial for the location and retrieval procedure.
- 8.2.7 In the case of a Projector or source changer that is emitting excessive radiation or has indications of contamination, or has damage that would give indications that the unit could not operate properly, or that the integrity of the shield or the safety mechanisms are disabled:
  - 8.2.7.1 Immediately move this unit into the Cell and place within the Exposure Area, survey to make sure that the Restricted Area does not have to be increased; if so, do so. Lock door

and post notice over the Cell door lock "Emergency - Do Not Enter".

8.2.7.2 Contact the Radiation Safety Officer so he can make the proper responses and reports to the NRC.

8.2.7.3 Required reports will be filed per 10 CFR Part 21, 10 CFR 30.50, 10 CFR 34.30 and over exposures will be reported in pursuant to 10 CFR 20.2202 and 20.2203.

## 9 SURVEY METERS, POCKET DOSIMETERS, FILM BADGES AND ALARMING RATEMETERS: (PROCEDURES)

### 9.1 Survey meters

- 9.1.1 Survey meters shall be operable and calibrated before they may be used.
- 9.1.2 If a survey meter is not operating properly, no radiographic operations may be performed. Report this situation to the Radiation Safety Officer.
- 9.1.3 Survey meters are to be sent out every three months from the last calibration date for calibration (used or not) as described in 2.0 of this manual.
- 9.1.4 Victoreen Model 492:
  - 9.1.4.1 Turn switch to the battery check position.
  - 9.1.4.2 Meter should move on scale to area marked as 'battery Check'.
  - 9.1.4.3 If battery strength is adequate, as indicated by the meter, move the switch to the desired range.
  - 9.1.4.4 If battery is inadequate:
    - 9.1.4.4.1 Turn off meter.
    - 9.1.4.4.2 Remove cover.
    - 9.1.4.4.3 Remove old batteries.
    - 9.1.4.4.4 Replace with fresh batteries.
    - 9.1.4.4.5 Reassemble meter.
    - 9.1.4.4.6 (Return to 9.1.4.1)
  - 9.1.4.5 Check to see if the survey is operating in reaction to radiation; approach the Projector and survey surface. If the survey meter does not respond, do not use. [Even an empty 660 Projector emits about 2.5 mR/hr at the surface.] If you feel that you aren't getting a proper response from the survey meter, check the previous Daily Utilization Logs in regards to Projector base readings and verify your readings. If another survey meter is available you can verify reading between the two of them.
  - 9.1.4.6 If you find a survey meter to be unresponsive to radiation or responding incorrectly, tag and take the unit out of service. Contact Radiation Safety Officer so he can evaluate the situation and arrange for the unit to be replaced, repaired and/or calibrated.

### 9.2 Victoreen Model 541 (0-200 mR range) direct reading Pocket Dosimeters:

- 9.2.1 Place dosimeter on charger and reset as close to zero as possible and the beginning of the day or before conducting radiographic functions.
- 9.2.2 Log your charged dosimeter reading, recharge if reading is 10 mR or above.
- 9.2.3 Wear your dosimeter on clothing that will not be removed during radiographic procedures.



- 9.2.4 It is advised to check dosimeter readings at various intervals while performing radiographic activities.
  - 9.2.5 Remove and log your dosimeter readings after all radiographic procedures are completed for the day.
  - 9.2.6 If your dosimeter has gone off scale, while performing radiographic activities. Immediately stop radiographic functions, except securing and storing the source, Projector, etc. Report directly to the Radiation Safety Officer, so that your film badge can be immediately sent for processing.
- 9.3 Alarming Ratemeters:
- 9.3.1 Ratemeters shall be used while conducting radiographic operations outside of the Cell.
  - 9.3.2 Dosimeter Corporation Model No. 1888B:
    - 9.3.2.1 Turn on Ratemeter. After a few second the Ratemeter will emit a short "beep" indicating that it is operational
    - 9.3.2.2 Place Ratemeter on clothing that will not be removed during the course of radiographic functions.
    - 9.3.2.3 A solid tone from the rate meter signifies that you are in a very high radiation field. You may here this sometimes when you are cranking in or out the source to the focal point.
  - 9.3.3 Dosimeter Corporation Model No. 33
    - 9.3.3.1 Turn on Ratemeter. Push the "Test" button. If a tone sounds the Ratemeter is operational.
    - 9.3.3.2 Place Ratemeter on clothing that will not be removed during the course of radiographic functions.
    - 9.3.3.3 A solid tone from the rate meter signifies that you are in a very high radiation field. You may here this sometimes when you are cranking in or out the source to the focal point.
  - 9.3.4 The main purpose of the Ratemeter is for a secondary warning device in case that a survey meter has become inoperable during an exposure and the source is not completely in its safe/shielded position. It is also a measure to warn a Radiographer that there is an exposed source, because he or his assistant did not survey properly.
  - 9.3.5 Alarming Ratemeters shall be calibrated annually.
- 9.4 Film Badges:
- 9.4.1 R.S. Landaure type "G" film badges will be worn on clothing that will not be removed during radiographic procedures.
  - 9.4.2 Film Badges will be returned to Landaure (N.V.L.A.P. accredited) biweekly for processing.
  - 9.4.3 The Radiation Safety Officer will review the reports when they are received.
  - 9.4.4 At anytime that a pocket dosimeter is totally discharged while performing radiographic functions, this person's film badge will be immediately sent for processing.

**10 RECEIPT, CHANGING AND SHIPPING OF SOURCES IN SHIPPING PACKAGES:  
(T/O 650L, AMERTEST 650L SOURCE CHANGER & AMERTEST 660 PROJECTOR)**

**10.1 Receipt of shipping package:**

- 10.1.1 Upon receipt of the Shipping Package, before removal from the possession of the final delivering carrier, a survey reading shall be taken of all external sides to assure that the source is properly stored in it's shield. Readings should be below 200 mR/hr and less than 10 mR/hr at one meter at an surface. If radiation levels exceed 200 mR/hr at any surface or 10 mR/hr at one meter from any surface, the shipping package shall be immediately removed from the carrier by the Radiation Safety Officer (preferably) or the Radiographer, if the Radiation Safety Officer is not immediately available. [THIS CONSTITUTES AN EMERGENCY.] Quickly and safely put the Shipping package into the Cell, post and secure, and extend the Restricted Areas if necessary. The appropriate regional office of the NRC is to be immediately contacted by telephone, along with the final delivering carrier and Amersham Corporation (source vendor).
- 10.1.2 At any time there is a discrepancy in the Shipping Package, such as severe damage, radioactive contamination, abnormally high survey readings, violations of shipping seals and locks, or mismarking; the Radiation Safety Officer shall be notified immediately. The shipping package shall be secured in the Cell, monitored and not moved until the discrepancies are resolved by the Radiation Safety Officer.
- 10.1.3 The Radiation Safety Officer will file the necessary reports and notifications as required by 10 CFR 20.1906, 20.2202, 20.2203, 10 CFR Part 21, 10 CFR 30.50, 10 CFR 34.30; respectively.

**10.2 Removal of old source from Projector: (The instructions herein do not supersede the instructions provided with the T/O 650L - Amertest 650L source changer. Follow the instructions provided with the source changer; if there are any discrepancies, consult the Radiation Safety Officer.)**

- 10.2.1 Changing of source shall be performed in the Cell. An operable, calibrated survey meter should always be at the Radiographer's side. Entrances, surveys, safety procedures, etc. are still enforced as previously stated.
- 10.2.2 Locate the source changer so that one (1) section of guide tube reaches between the fittings on the Projector and the source changer. Remove the source changer cover. Fasten the guide tube to the EMPTY chamber of the source changer. The EMPTY chamber of the source changer is now your source stop.
- 10.2.3 Crank (expose) the source from the Projector until it stops in the empty chamber of the source changer.
- 10.2.4 Unlock and reenter Cell with survey meter, surveying the Projector first, then the source guide tube then the source changer. Assure that the sources are stored/shielded properly in the source changer. Open source guide clamps to see that only the connector portion of the pigtail is exposed.
- 10.2.5 Disconnect the old source from the drive cable, being careful not to accidentally extract the source from it's stored/shielded position in the source changer. After disconnection, push the connector downward to make sure the source is in the full stored/shielded position (as far as it will go).

- 10.2.6 Survey to make sure that the source changer is not emitting excessive radiation, no more than 200 mR/hr at any surface.
- 10.2.7 [This is a good time to do your Quarterly Maintenance on the Projector.]
- 10.3 Installation of a new source:
  - 10.3.1 Remove shipping cap and hold down from the channel holding the new source. Open source channel guides. Connect the source guide tube to this channel and connect the drive cable to the new source pigtail
  - 10.3.2 Close the source guides. Exit the Cell, lock and control as usual. Crank the control cable to retract the new source into the Projector.
  - 10.3.3 Survey the Projector to assure that the source is in it's properly stored/shielded position. [No reading shall exceed 200 mR/hr from any surface. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!] Check that the slide bar reads green.
  - 10.3.4 Remove old source identification plate from the Projector and install it to the "old source" channel of the changer. Affix new source identification plate to the Projector.
  - 10.3.5 Replace the source changer covers. Tighten bolts, lock and seal with the tamperproof seals provided.
  - 10.3.6 If shipping the 660 (with or without a source) attach a tamperproof seal through the shipping plug and secure the Projector in a rigid enclosed skid/crate to minimize damage that could be incurred during shipping. This action will minimize having to repair or replace warning signs, identification labels, etc.
  - 10.3.7 Survey all sides of the source changer. [No reading shall exceed 200 mR/hr or 10 mR/hr at one meter; THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 10.4 Return of old source:
  - 10.4.1 Appropriate D.O.T. Radioactive Yellow shipping labels will be affixed to the shipping container (T/O 650L, Amertest 650L) or "Contents Contains" (and appropriate) Radioactive Yellow labels on the outermost package (660 Projector).
  - 10.4.2 D.O.T. shipping labels inform of the following:
    - 10.4.2.1 Isotope
    - 10.4.2.2 Strength of source contained
    - 10.4.2.3 Transport Index - mR/hr reading @ one meter. [No reading shall exceed 200 mR/hr or 10 mR/hr at one meter.]
  - 10.4.3 When shipping the Amertest 660 with a source in it. You must mark the outer crate with the following:
    - 10.4.3.1 "Inside Package Complies With Prescribed Specifications USA/9033/B(U) Type B - Which contains Special Form, n.o.s., UN2974 Iridium 192 (activity & Transport Index)."
    - 10.4.3.2 The appropriate D.O.T. Radioactive Yellow Labels which will note the isotope, activity and T.I., and will be applied on at least two sides of the outer crate.

- 10.4.3.3 In addition to the above, the 660 (inside the crate) will have the D.O.T. Radioactive Yellow labels on it describing the source contents, activity and T.I.
- 10.4.4 When shipping a Shipping Package (T/O 650L, Amertest 650L or Amertest 660) that does not contain a source you must attach an "EMPTY" labels on the shipping containers. You will still have to classify the 650L or 660 as "Radioactive II" because of the D-Uranium shielding materials inside of the units.
  - 10.4.4.1 The crate containing the 660 shall be marked "Radioactive Materials, D-Uranium Shielding Material Only, LSA, n.o.s., UN2912" and "Inside Package Complies With Prescribed Specification, USA/9033/B(U), Type B (EMPTY)".
  - 10.4.4.2 The Bill Of Lading will contain the required information per CFR 49. (Including the Emergency Phone Number.)
- 10.4.5 The transportation of the shipping package will be scheduled with a qualified commercial trucking company. Niles Steel Tank Company will visibly assure that the pickup driver (by reviewing his C.D.L.) is qualified to receive hazardous materials.
- 10.4.6 Loading of the shipping package shall be observed by radiographic personnel.
- 10.4.7 All receiving and shipments shall be in strict accordance with 10 CFR Part 71 (for Special Form sources and Type B(U) Shipping Containers).
- 10.4.8 When the shipping container (and old source) is returned to Amersham Corporation. A copy of the original Bill Of Lading will be mailed to the Consignee (Amersham Corporation) to alert them that a radioactive package is on route to them. Amersham will then, after receipt of the shipping package, acknowledge the receipt of the shipping package and contents within.
- 10.4.9 Record all functions of receipt, source changes and shipments of Radioactive Packages on the (special) Form NST/R1 "Source Change" and attach all documentation with this form for review of the NRC Inspector.



APPENDIX B

## INSTRUCTIONS FOR POSITIONING SOURCE IN CELL

*The walls of the Cell are described as follows:*

Wall "A" = North wall is constructed of 12" concrete block (.0125 attenuation factor)  
Wall "B" = East wall is constructed of 24" concrete block (.00016 attenuation factor)  
Wall "C" = South wall is constructed of 24" concrete block (.00016 attenuation factor)  
Wall "D" = West wall is constructed of 24" concrete block, including split section (.00016 attenuation factor)

- The collimator shall be used whenever possible. The port side ( $30^{\circ} \times 60^{\circ}$ ) shall not be pointed at Walls "C" and "D" unless the collimator is at least four feet away, three feet away from Wall "B".
- The collimator port should not be pointed at the ceiling whenever possible. If this case should arise, consult Chart "A". For maximum source exposure times.
- Unless otherwise instructed by Radiation Safety Officer, unshielded (uncollimated) source exposures and panoramic vessel exposures must stay within the orange lines painted on the floor and below the orange diagonal lines painted on the walls. This is the "Exposure Area". Use Chart "A" to find the maximum time allowable that the source can be exposed in a hour's time. {This is to limit the roof from being a High Radiation Area}
- If for any reason the above cannot be adhered to, contact the Radiation Safety Officer for further instructions and calculations.
- See Appendix A for dimensions of the boundaries of the exposure area.
- In all cases, in panoramic exposures (uncollimated) exposures, with the strict adherence to Chart "A" and the correct minimum distances to the walls, the radiation levels through the walls will be quite minimal.



## ROOF RADIATION PROTECTION

### CHART "A" EXPLANATION

- Chart "A" is a spread sheet showing the intensity rates at a minimum of 12 feet, from the roof at given curie strengths, from the source. Also shown, are shielding effects of different thickness of steel (tanks) which are commonly produced at Niles Steel Tank Company. Shown with these intensity rates (mR/min) are the maximum allowable source exposure times (single or multiple) in one hour's time.
- If the Radiographer cannot use the collimator (to protect the roof area) or has a "panoramic" exposure, he shall use this chart to determine his maximum allowed exposure time per hour.
- In the case that film exposure time calculations exceed the maximum allowable times as shown on Chart "A", the Radiographer shall contact the Radiation Safety Officer. The Radiation Safety Officer will then recalculate the planned exposure to the roof area using more precise values. These calculation may appear on the backs of the pages of the Daily Utilization Log.
- Note: Chart "A" does not take in account of the shielding factor of the metal roof or use the allowable extra distance of 30 cm. from the surface of the roof. Also Chart "A" uses the old R/hr of 5.9 R/hr @ one foot per curie of Iridium 192. The new accepted value is actually 5.2 R/hr @ one foot per curie of Iridium 192.
- If the Radiation Safety Officer cannot attain a <100 mR/hr dose for the roof (30 cm from the surface), it will become a High Radiation Area. The area will be posted and the area will be provided with constant surveillance, so that no person shall enter this area while these exposures are being performed.

Curies  
Max.

Attenuation Factor 1.00

.90

.77

.66

.54

.43

.3

.26

.21

.16

.08

	Minimum Source to Roof Nominal Vessel Thickness	(@ 12 Ft.) No Shield	(@ 12 Ft.) 10 Ga.	(@ 12 Ft.) 1/4"	(@ 12 Ft.) 3/8"	(@ 12 Ft.) 1/2"	(@ 12 Ft.) 3/4"	(@ 12 Ft.) 1"	(@ 12 Ft.) 1 1/8"	(@ 12 Ft.) 1 1/4"	(@ 12 Ft.) 1 1/2"	(@ 12 Ft.) 2"
120	4916.67 mR/hr. Total Exposure Time allowed per hour...	81.94 mR/min. 1 min.	73.75 mR/min. 1 min. 20 sec.	63.09 mR/min. 1 min. 30 sec.	54.08 mR/min. 1 min. 50 sec.	44.25 mR/min. 2 min. 15 sec.	35.24 mR/min. 2 min. 50 sec.	24.58 mR/min. 4 min.	21.30 mR/min. 4 min. 40 sec.	17.21 mR/min. 5 min. 50 sec.	13.11 mR/min. 7 min. 40 Sec.	6.56 mR/min. 16 min.
110	4506.94 mR/hr. Total Exposure Time allowed per hour...	75.27 mR/min. 1 min. 20 sec.	67.74 mR/min. 1 min. 20 sec.	57.95 mR/min. 1 min. 40 sec.	49.68 mR/min. 2 min.	40.64 mR/min. 2 min. 30 sec.	32.36 mR/min. 3 min.	22.58 mR/min. 4 min. 20 sec.	19.57 mR/min. 5 min. 15 sec.	15.81 mR/min. 6 min. 20 sec.	12.04 mR/min. 8 min. 20 sec.	6.02 mR/min. 16 min.
100	4097.22 mR/hr. Total Exposure Time allowed per hour...	68.42 mR/min. 1 min. 20 sec.	61.58 mR/min. 1 min. 30 sec.	52.69 mR/min. 1 min. 45 sec.	45.16 mR/min. 2 min.	36.95 mR/min. 2 min. 45 sec.	29.42 mR/min. 3 min. 20 sec.	20.53 mR/min. 4 min. 50 sec.	17.79 mR/min. 5 min. 30 sec.	14.37 mR/min. 7 min. 08 sec.	10.95 mR/min. 9 min.	5.47 mR/min. 18 min.
90	3687.50 mR/hr. Total Exposure Time allowed per hour...	61.58 mR/min. 1 min. 30 sec.	55.42 mR/min. 1 min. 40 sec.	47.42 mR/min. 2 min.	40.64 mR/min. 2 min. 30 sec.	33.25 mR/min. 3 min.	26.48 mR/min. 3 min. 50 sec.	18.47 mR/min. 5 min. 30 sec.	16.01 mR/min. 6 min. 15 sec.	12.93 mR/min. 7 min. 45 sec.	9.85 mR/min. 10 min.	4.93 mR/min. 20 min.
80	3277.78 mR/hr. Total Exposure Time allowed per hour...	54.74 mR/min. 1 min. 50 sec.	49.27 mR/min. 2 min.	42.15 mR/min. 2 min. 20 sec.	36.13 mR/min. 2 min. 45 sec.	29.56 mR/min. 3 min. 25 sec.	23.54 mR/min. 4 min. 20 sec.	16.42 mR/min. 6 min. 15 sec.	14.23 mR/min. 7 min. 8 sec.	11.50 mR/min. 9 min.	8.76 mR/min. 12 min. 30 sec.	4.38 mR/min. 25 min.
70	2868.06 mR/hr. Total Exposure Time allowed per hour...	47.90 mR/min. 2 min.	43.11 mR/min. 2 min. 15 sec.	36.88 mR/min. 2 min. 45 sec.	31.61 mR/min. 3 min. 10 sec.	25.86 mR/min. 3 min. 50 sec.	20.60 mR/min. 4 min. 50 sec.	14.37 mR/min. 7 min.	12.45 mR/min. 8 min.	10.06 mR/min. 10 min.	7.66 mR/min. 13 min.	3.83 mR/min. 25 min.
60	2458.33 mR/hr. Total Exposure Time allowed per hour...	41.05 mR/min. 2 min. 25 sec.	36.95 mR/min. 2 min. 45 sec.	31.61 mR/min. 3 min.	27.10 mR/min. 3 min. 40 sec.	22.17 mR/min. 4 min. 30 sec.	17.65 mR/min. 5 min. 30 sec.	12.32 mR/min. 8 min.	10.67 mR/min. 9 min.	8.62 mR/min. 11.5 min.	6.57 mR/min. 15 min.	3.28 mR/min. 30 min.
50	2048.61 mR/hr. Total Exposure Time allowed per hour...	34.21 mR/min. 2 min. 50 sec.	30.79 mR/min. 3 min. 15 sec.	26.34 mR/min. 3 min. 50 sec.	22.58 mR/min. 4 min. 25 sec.	18.47 mR/min. 5 min. 20 sec.	14.71 mR/min. 6 min. 45 sec.	10.26 mR/min. 9 min. 45 sec.	8.89 mR/min. 11 min.	7.18 mR/min. 14 min.	5.47 mR/min. 18 min.	2.74 mR/min. 36 min.
40	1638.89 mR/hr. Total Exposure Time allowed per hour...	27.37 mR/min. 3 min. 30 sec.	24.63 mR/min. 4 min.	21.07 mR/min. 4 min. 45 sec.	18.06 mR/min. 5 min. 30 sec.	14.78 mR/min. 6 min. 45 sec.	11.77 mR/min. 8 min. 30 sec.	8.21 mR/min. 12 min.	7.12 mR/min. 14 min.	5.75 mR/min. 17 min.	4.38 mR/min. 22 min.	2.19 mR/min. 45 min.
30	1229.17 mR/hr. Total Exposure Time allowed per hour...	20.53 mR/min. 4 min. 45 sec.	18.47 mR/min. 5 min. 30 sec.	15.81 mR/min. 6 min. 30 sec.	13.55 mR/min. 7 min. 30 sec.	11.08 mR/min. 9 min.	8.83 mR/min. 11 min.	6.16 mR/min. 16 min.	5.34 mR/min. 18 min.	4.31 mR/min. 23 min.	3.28 mR/min. 30 min.	1.64 mR/min. Unlimited
20	819.44 mR/hr. Total Exposure Time allowed per hour...	13.68 mR/min. 7 min. 15 sec.	12.32 mR/min. 8 min.	10.54 mR/min. 9 min. 30 sec.	9.03 mR/min. 11 min.	7.39 mR/min. 13 min. 30 sec.	5.88 mR/min. 17 min.	4.11 mR/min. 24 min.	3.56 mR/min. 28 min.	2.87 mR/min. 34 min.	2.19 mR/min. 45 min.	1.09 mR/min. Unlimited
10	409.72 mR/hr. Total Exposure Time allowed per hour...	6.84 mR/min. 14 min.	6.16 mR/min. 16 min.	5.27 mR/min. 19 min.	4.52 mR/min. 22 min.	3.69 mR/min. 27 min.	2.94 mR/min. 34 min.	2.05 mR/min. 48 min.	1.78 mR/min. 56 min.	1.44 mR/min. Unlimited	1.09 mR/min. Unlimited	.55 mR/min. Unlimited
5	204.86 mR/hr. Total Exposure Time allowed per hour...	3.42 mR/min. 29 min.	3.08 mR/min. 32 min.	2.63 mR/min. 38 min.	2.26 mR/min. 44 min.	1.85 mR/min. 54 min.	1.47 mR/min. Unlimited	1.03 mR/min. Unlimited	.89 mR/min. Unlimited	.72 mR/min. Unlimited	.55 mR/min. Unlimited	.27 mR/min. Unlimited

## INSTRUCTIONS:

- 1) Find Curie amount of your source, using this value as a maximum (ie., if you have a 51 Curie source you will use 60 Curies on the chart).
- 2) Find thickness of vessel that source will be shielded by.
- 3) Where these points intersect read time in minutes and second. This is the maximum allowed time for source exposure in one hour. This may be a single or multiple exposure but may not exceed the total time given on chart.
- 4) Any questions or problems, see R.S.O. for further instruction.

## **RADIOGRAPHER & RADIOGRAPHER'S ASSISTANT QUARTERLY AUDIT**

NAME \_\_\_\_\_ DATE \_\_\_\_ / \_\_\_\_ / 19 \_\_\_\_

An "OK" will be marked if the function being audited is acceptable. A "XX" will be marked if the function was not audited. A "NO" will be marked if the function being audited is unsatisfactory. Comments or notes can be written in the spaces between the categories or in the "Other Comments" section.

Proper Use of Film Badge, Alarming Ratemeter and Dosimeter. \_\_\_\_\_

Placement on clothing. \_\_\_\_\_ Recharged dosimeter correctly. \_\_\_\_\_

Verify if Ratemeter is operational. \_\_\_\_\_ Battery check, calibrated? \_\_\_\_\_

Proper Use of Survey Meter. \_\_\_\_\_

Battery check, calibrated? \_\_\_\_\_ Verify if survey meter is operational \_\_\_\_\_

Proper surveys before, during and after exposure. \_\_\_\_\_

Survey's during exposure, check for increasing the restricted area. \_\_\_\_\_

Did he bring survey meter out of cell with him after locking cell door? \_\_\_\_\_

Proper Check of Radiographic Device for Damage and Proper Operation. (Daily inspection requirements.) \_\_\_\_\_

Proper Placement of Source in Cell. \_\_\_\_\_

No increase in restricted areas, proper use of Chart "A", using radiation protection formulas. \_\_\_\_\_

Proper Restricted Area boundaries and postings. (If audit is performed during out of Cell exposures.) \_\_\_\_\_

Understanding and implementing ALARA. \_\_\_\_\_

**RADIOGRAPHER & RADIOGRAPHER'S ASSISTANT QUARTERLY AUDIT, *Continued***

Name \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / 19 \_\_\_\_

Securing source after exposure; proper surveys of projector and Cell. Survey of tubes, collimator, etc. \_\_\_\_\_

Is projector locked & stored properly? \_\_\_\_\_

Is Cell door locked? \_\_\_\_\_

Utilization Log Book filled out properly. \_\_\_\_\_

Base readings. \_\_\_\_\_

Dosimeter reading. \_\_\_\_\_

Exposure logged properly. \_\_\_\_\_

Maintenance check list, OK? \_\_\_\_\_

Survey's recorded. \_\_\_\_\_

Other Comments

Auditor \_\_\_\_\_ Date \_\_\_\_\_



# Radiation Safety Officer Audit

## Duties of the Radiation Safety Officer Checklist

1. Conduct the Training Program.
2. Quarterly audits of Radiographers' and Radiographer Assistants' performances to assure they are performing their duties in the prescribed manner.
3. Review radiographic operations to determine that all persons involved are performing their duties as prescribed by this manual and current 10 CFR Regulations.
4. Review Personal monitoring records. Assuring that the occupational dose limits are within the limits described in 10 CFR Part 20, Subpart C.
5. Review Daily Utilization Logs.
6. Quarterly Inventory of sealed sources.
7. Review of Calibration Records for Pocket Dosimeters, Survey Meters and Alarming Ratemeters and to make sure that the instruments are current and documented as to their required calibration intervals.
8. Supervise receipt and return of Radioactive Packages and the records of such.
9. Review of Quarterly Maintenance Records and to make sure that equipment is current as to the frequency of such.
10. On an annual basis; review the NRC License, current CFR, NST Co.'s Radiographic Operations Manual, etc. to make sure that NST Co. radiography program is current.
11. On periodic basis review radiographic operations to determine that all personnel are performing their duties as prescribed.
12. At anytime: Halt the duties of any personal when his pocket dosimeter has been discharged off-scale. This persons film badge will be immediately be sent (overnight) for processing. This person will not perform any radiographic "hot" (not to be allowed in a Restricted Area) functions until the result of his film badge is returned.
13. At anytime: Halt the duties of radiography personnel if he is not performing in accordance to this manual, defeating safety and security systems, or knowingly making misrepresentations.
14. The Radiation Safety Officer shall halt any "hot" activities of any personnel that accumulated dosages that reach or exceed the dosage parameters set forth by 10 CFR Part, Subpart C. The Radiation Safety Officer will make required notifications and reports as provided in 10 CFR 20.2202 and 20.2203.

### Reports and Notifications

1. Reports to workers - 10 CFR 19.13.
2. Report of loss or theft of licensed material - 10 CFR 20.2201 and NST Co's. Radiography Operation Manual.
3. Notification of incidents - 10 CFR 20.2202.
4. Reports of over exposures - 10 CFR 20.2202 & 20.2203.
5. Reports of individual monitoring - 10 CFR 20.2206 .
6. Reports per 10 CFR 30.50.
7. Reports per 10 CFR 34.30 and NST Co's. Radiography Operation Manual.
8. Leak test results.
9. Reports per 10 CFR 34.25 (d) and NST Co's. Radiography Operation Manual.
10. Source receipt documents per 49 CFR 172.201, 172.202, 172.203 and NST Co's. Radiography Operation Manual.
11. Source shipping documents per 49 CFR 172.201, 172.202, 172.203 and NST Co's. Radiography Operation Manual.
12. Internal records not required for NRC reporting.

Name \_\_\_\_\_ Date \_\_\_\_\_

## WRITTEN EXAM FOR THE QUALIFICATION OF RADIOGRAPHER'S ASSISTANTS

FULL NAME \_\_\_\_\_ DATE \_\_\_\_ / \_\_\_\_ / 199\_\_

SOCIAL SECURITY # \_\_\_\_ - \_\_\_\_ - \_\_\_\_

DATE OF BIRTH \_\_\_\_ / \_\_\_\_ / 19\_\_

---

PART A: Selected Questions from text materials.

1. Name three (3) items of Personal Monitoring Devices:

2. Define the "Inverse Square Law":

$$\text{(clue)} \quad \frac{I_a}{I_b} = \frac{D_b^2}{D_a^2}$$

3. List the advantages and disadvantages of the film badge:

4. What should you do if you find that your Pocket Dosimeter has been completely discharged (off scale) during radiographic operations?

Name \_\_\_\_\_ Date \_\_\_\_\_

5. How can you determine that your Survey Meter is operational and is reacting to the presents of radiation?

6. Define ALARA (or A.L.A.R.A.)

7. Where can you find you permissible Occupational Dose Limits?

8. Briefly explain the Operating Procedures, from acquiring the keys and before using the projector to make exposures (in order): [There should be at least 7 basic items.]

9. What action should be taken if a source fails to return to it's stored/shielded position after many attempts?



10. What do you do if a source is unintentionally disconnected outside of its stored/shielded position in the projector?

11. What is your maximum whole body exposure in one (1) calendar year as permitted by 10 CFR, Subpart C?

PART B: True or False and Multiple Choice (Circle answers)

1. You may unlock and enter the Cell as long as you are wearing a film badge.

True

False

2. You may operate the 660B Gamma Projector without the supervision of a Radiographer.

True

False

3. To operate the 660B inside the Cell you must have your film badge, a charged pocket dosimeter and a survey meter.

True

False

4. When exposing the source in the Cell and you have a lengthy exposure time, you can lock the Cell door and leave the area.

True

False

Name \_\_\_\_\_ Date \_\_\_\_\_

5. After entering the Cell, all sides of the Projector Cabinet must be surveyed.

True

False

6. After taking the 660B from the cabinet you must remove the shipping plug and survey all surfaces of the projector.

True

False

7. Surface survey readings of the 660B or a 650 source changer shall not exceed:

[1.] 200 mR/hr

[2.] 300 mR/hr

[3.] 500 mR/hr

8. When cranking out the source and if undue resistance is encountered, you immediately reverse the direction of cranking until the source is back into it's stored/sheilded position.

True

False

9. When the source is exposed in the Cell, radiation doses at 30 cm from the exterior of the Cell shall not exceed:

[1.] 5 mR in one hour

[2.] 2 mR in one hour

[3.] 10 mR in one hour

10. When all exposures are complete, lock the Cell door and survey the area.

True

False

11. Signs shall be posted stating, "CAUTION - HIGH RADIATION AREA" at the perimeter where the radiation level is calculated to be 100 mR/hr.

True

False

12. Out of Cell exposure, you rope off and post a Restricted Area with signs stating, "Caution - Radiation Area". At what dose level do you establish the boundary of the Restricted Area?

[1.] 5 mR in one hour

[2.] 2 mR in one hour

[3.] 10 mR in one hour

13. When an exposure is complete, confirm the Base Reading by surveying a surfaces of the projector and check to see if the Slide Bar has actuated to the green position.

True

False

14. It is necessary to keep a daily utilization log in which describes each exposure made and all safety precautions used.

True

False

15. It is not necessary for everyone to wear film badges and dosimeters in a Restricted Area.

True

False

16. A Radiographer's Assistant:

[1.] Must have outside "formal" training in Radiation Safety per 10 CFR - Appendix A.

[2.] Must have on-the-job training.

[3.] Must understand and comply with operating and emergency procedures.

[4.] Must stand guard.

17. You must record your dosimeter reading before performing radiographic functions and after all radiographic functions are completed.

True

False

18. Leak testing of sealed sources must be performed:

[1.] Every three months

[2.] Every six months

[3.] Annually

19. Survey meters must be calibrated:

[1.] Every three months

[2.] Every six months

[3.] Annually

20. Which of the following illustrates the most means of protection from external radiation sources:

[1.] Wearing film badges, pocket dosimeters and alarming ratemeters.

[2.] Lead, concrete and steel.

[3.] Time, distance and shielding.

21. Using Chart "A", what is the total allowable exposure time per hour of panoramic shots on 24" dia. x 1 1/2 inch thick pipe tanks. Your source activity is 26 Curies.

[1.] 10 minutes

[2.] 13 minutes

[3.] 45 minutes

[4.] 90 minutes

[5.] None of the above

Name \_\_\_\_\_ Date \_\_\_\_\_

22. What happens when your pocket dosimeter goes off scale during radiographic functions?

- [1.] Go to the hospital and get a blood test.
- [2.] Send film badge in immediately for processing. Cease all radiographic functions.
- [3.] Recharge dosimeter and continue with radiographic functions.
- [4.] Ignore it, a dosimeter can discharge accidentally bumping it or dropping it.

23. Dosimeters shall be charged:

- [1.] Daily
- [2.] Weekly
- [3.] Monthly
- [4.] Daily, only if you plan to make radiographic exposures for that day.
- [5.] When completely discharged or off scale.

24. Dosimeters shall be calibrated:

- [1.] Daily
- [2.] Weekly
- [3.] Monthly
- [4.] Quarterly
- [5.] Yearly



# WRITTEN EXAM FOR THE QUALIFICATION OF RADIOGRAPHER'S ASSISTANTS

## Master

---

PART A: Selected Questions from text materials.

1. Name three (3) items of Personal Monitoring Devices:

Film badge, pocket dosimeter & Alarming Ratemeter.

2. Define the "Inverse Square Law":

The intensity is inversely proportional to the square of the distance.

Double the distance, divide the intensity by four.

(clue) 
$$\frac{I_a}{I_b} = \frac{D_b^2}{D_a^2}$$

3. List the advantages and disadvantages of the film badge:

Advantages: Permanent record of doses and more accurate.

Disadvantage: Not direct reading of doses, has to be sent in for processing.

4. What should you do if you find that your Pocket Dosimeter has been completely discharged (off scale) during radiographic operations?

Halt all radiographic functions, except for properly securing radiographic equipment per the procedures, and report to the Radiation Safety Officer, immediately.

5. How can you determine that your Survey Meter is operational and is reacting to the presents of radiation?

Check the survey of the projector. An empty 660B emits 2.5 mR/hr. If you feel that you are getting an improper response look at previous logged Base Readings or get another meter to verify the readings in question

6. Define ALARA (or A.L.A.R.A.)

Dosages or exposure "As Low As Reasonably Achievable."

7. Where can you find you permissible Occupational Dose Limits?

10 CFR Part 20 - Subpart C or 10 CFR Part 20.1201 or 10 CFR Part 20

8. Briefly explain the Operating Procedures, from acquiring the keys and before using the projector to make exposures (in order): [There should be at least 7 basic items.]

Film badge and charged dosimeter (and ratemeter if needed).

Survey meter on & currently calibrated.

Survey Cell door area and check the Gamma Alarm that it is not activated.

Unlock Cell door and approach Projector storage cabinet, surveying all sides for excessive radiation.

Unlock storage cabinet, remove the projector and survey all side at the surface for excessive radiation. Make note of the highest surface reading for future reference and log entrees.

Inspect projector for damage that could impair it's proper and safe operation.

Inspect guide tubes, source stops and control cable assembly for damage or obstructions.

9. What action should be taken if a source fails to return to it's stored/shielded position after many attempts?

Help the Radiographer post Restricted Area, remove unauthorized personnel from the Restricted Area, secure and monitor the area. Contact the Radiation Safety Officer after you are confident that the area involved is secure, but promptly. (Try to limit your own exposures as much as possible.)

10. What do you do if a source is unintentionally disconnected outside of its stored/shielded position in the projector?

Help Radiographer evacuate surrounding personnel until the Restricted Area perimeters can be established. Establish Restricted Area and rope off boundaries. Keep your own exposure as low as possible! Help maintain surveillance over the Restricted Area, assuring that no unauthorized persons enter the Restricted Area.

11. What is your maximum whole body exposure in one (1) calendar year as permitted by 10 CFR, Subpart C?

5 REM

PART B: True or False and Multiple Choice (Circle answers)

1. You may unlock and enter the Cell as long as you are wearing a film badge.

False

2. You may operate the 660B Gamma Projector without the supervision of a Radiographer.

False

3. To operate the 660B inside the Cell you must have your film badge, a charged pocket dosimeter and a survey meter.

True

4. When exposing the source in the Cell and you have a lengthy exposure time, you can lock the Cell door and leave the area.

False

5. After entering the Cell, all sides of the Projector Cabinet must be surveyed.

True

6. After taking the 660B from the cabinet you must remove the shipping plug and survey all surfaces of the projector.

False

7. Surface survey readings of the 660B or a 650 source changer shall not exceed:

[1.] 200 mR/hr

8. When cranking out the source and if undue resistance is encountered, you immediately reverse the direction of cranking until the source is back into it's stored/sheilded position.

True

9. When the source is exposed in the Cell, radiation doses at 30 cm from the exterior of the Cell shall not exceed:

[2.] 2 mR in one hour

10. When all exposures are complete, lock the Cell door and survey the area.

False

11. Signs shall be posted stating, "CAUTION - HIGH RADIATION AREA" at the perimeter where the radiation level is calculated to be 100 mR/hr.

True

12. Out of Cell exposure, you rope off and post a Restricted Area with signs stating, "Caution - Radiation Area". At what dose level do you establish the boundary of the Restricted Area?

[2.] 2 mR in one hour

13. When an exposure is complete, confirm the Base Reading by surveying a surfaces of the projector and check to see if the Slide Bar has actuated to the green position. Survey guide tubes and collimator (if used.)

True

14. It is necessary to keep a daily utilization log in which describes each exposure made and all safety precautions used.

True



15. It is not necessary for everyone to wear film badges and dosimeters in a Restricted Area.

False

16. A Radiographer's Assistant:

[1.] Must have outside "formal" training in Radiation Safety per 10 CFR - Appendix A.

[2.] Must have on-the-job training.

[3.] Must understand and comply with operating and emergency procedures.

[4.] Must stand guard.

17. You must record your dosimeter reading before performing radiographic functions and after all radiographic functions are completed.

True

18. Leak testing of sealed sources must be performed:

[2.] Every six months

19. Survey meters must be calibrated:

[1.] Every three months

20. Which of the following illustrates the most means of protection from external radiation sources:

[3.] Time, distance and shielding.

21. Using Chart "A", what is the total allowable exposure time per hour of panoramic shots on 24" dia. x 1 1/2 inch thick pipe tanks. Your source activity is 26 Curies.

[5.] None of the above

22. What happens when your pocket dosimeter goes off scale during radiographic functions?

[2.] Send film badge in immediately for processing. Cease all radiographic functions.

23. Dosimeters shall be charged:

[4.] Daily, only if you plan to make radiographic exposures for that day.

24. Dosimeters shall be calibrated:

[5.] Yearly

UTILIZATION, INSPECTION & MAINTENANCE REPORT: Sht \_\_\_\_ of \_\_\_\_ Date \_\_\_\_

T/O Model \_\_\_\_ Gamma Ray Projector using IR<sup>192</sup> Assigned to: Mr. R.H. Wood  
Projector Used Inside/Outside Radiation Cell Radiological Safety Officer

Number of Curies \_\_\_\_ Reading of \_\_\_\_ MR/HR Before Entering Cell  
BASE READING @ START \_\_\_\_ MR/HR BASE READING @ FINISH \_\_\_\_ MR/HR

Exposure(s):

Number

Time

Serial No.

Survey Readings During Exp.

Pocket Dosimeter Reading Before Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

Pocket Dosimeter Reading After Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

All Equipment Locked

AT \_\_\_\_ FT \_\_\_\_ MR/HR

Comments: \_\_\_\_

Survey Reading After all Exps. \_\_\_\_ MR/HR

Changes in Operating Characteristics  
of Unit \_\_\_\_

Rust, Dirt, or Sludge Build-Up in  
the Source Tube \_\_\_\_

Proper Operation of Source Position  
Indicator Mechanism \_\_\_\_

Proper Positioning of Source Inside  
the Shield \_\_\_\_

Proper Operation of the Crank  
Mechanism \_\_\_\_

Shifting of the Shield Inside the  
Projecting Housing \_\_\_\_

Proper Operation of Locking  
Mechanism \_\_\_\_

Proper Connection of all Mating  
Components \_\_\_\_

Source and Drive - Cable Wear  
or Damage \_\_\_\_

Damage to the Device, Which May  
Impair its Operation \_\_\_\_

Damaged or Worn Source and Drive Cable  
Tube and Connector Wear and Damage \_\_\_\_

Cable Drive Gear-Box Damage and  
Wear \_\_\_\_

Proper Labeling \_\_\_\_

REMARKS: \_\_\_\_

Radiographer

Radiographer's Assist.

NST/R1

UTILIZATION, INSPECTION & MAINTENANCE REPORT: Sht \_\_\_\_ of \_\_\_\_ Date \_\_\_\_

T/O Model \_\_\_\_ Gamma Ray Projector using IR<sup>192</sup> Assigned to: Mr. J.C. Wood  
Radiological Safety Officer

Projector Used Inside/Outside Radiation Cell

SOURCE CHANGE

NEW SOURCE S/N \_\_\_\_

Shipping Package No. \_\_\_\_ (Model) Serial No. \_\_\_\_

1. survey @ 1 meter \_\_\_\_ MR/HR
2. surface survey \_\_\_\_ MR/HR
3. wipe test \_\_\_\_
4. sealed properly \_\_\_\_

Projector Base Reading  
Old Source In \_\_\_\_ MR/HR  
Projector Base Reading  
Old Source Out \_\_\_\_ MR/HR  
Projector Base Reading  
New Source In \_\_\_\_ MR/HR

OLD SOURCE S/N \_\_\_\_

1. survey @ 1 meter \_\_\_\_ MR/HR
2. surface survey \_\_\_\_ MR/HR
3. sealed properly \_\_\_\_

COMMENTS

Survey Readings During Exp. \_\_\_\_

Pocket Dosimeter Reading Before Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

Pocket Dosimeter Reading After Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

All Equipment Locked \_\_\_\_

Comments: \_\_\_\_

Survey Reading After all Exps. \_\_\_\_ MR/HR

Changes in Operating Characteristics  
of Unit \_\_\_\_

Rust, Dirt, or Sludge Build-Up in  
the Source Tube \_\_\_\_

Proper Operation of Source Position  
Indicator Mechanism \_\_\_\_

Proper Positioning of Source Inside  
the Shield \_\_\_\_

Proper Operation of the Crank  
Mechanism \_\_\_\_

Shifting of the Shield Inside the  
Projecting Housing \_\_\_\_

Proper Operation of Locking  
Mechanism \_\_\_\_

Proper Connection of all Mating  
Components \_\_\_\_

Source and Drive - Cable Wear  
or Damage \_\_\_\_

Damage to the Device, Which May  
Impair its Operation \_\_\_\_

Damaged or Worn Source and Drive Cable  
Tube and Connector Wear and Damage \_\_\_\_

Cable Drive Gear-Box Damage and  
Wear \_\_\_\_

Proper Labeling \_\_\_\_

REMARKS: \_\_\_\_

Radiographer

Radiographer's Assist.

NST/R2



NILES STEEL TANK COMPANY  
713 WAYNE STREET  
P.O. BOX 728  
NILES, MICHIGAN 49120  
TELEPHONE (616) 683-1910

March 4, 1988

Subject: Education, Work Experience & Qualifications of Robert H. Wood.

To Whom It May Concern:

Below listed are my Educational Background, Work Experience and Qualifications pertaining to Radiography work I perform at Niles Steel Tank Company.:

Graduated Howe Military School in June of 1974.

Attended Michigan Technological University in September of 1974, to May of 1975.

Hired at Niles Steel Tank Company, February 16, 1976, as Q.C. Inspector and Radiography Trainee. My duties were mainly Q.C. Inspection but I was to observe some Radiographic functions in spare time.

Successfully completed "Radiation Safety" at Technical Operation in September of 1980.

Passed RT Level I (Radiographer's Assistant) Exam at Niles Steel Tank Company with a composite score of 89%, on September 20, 1980.

Passed re-exam for RT Level I on February 26, 1982.

May 21, 1982, I attended RT Level II (40-hr Radiographer) course at Nondestructive Test Engineering Section of Hartford Steam Boiler Inspection & Insurance Company. My exam scores were as follows: General 84%, Specific 90%, and Practical 99%. Composite Score was 92.7%. My duties after this were RT Level II (Radiographer) at Niles Steel Tank Company.

Attended A.S.N.T.'s Level III Refresher Course in August of 1986.

March 1987, I took A.S.N.T.'s Level III Radiography Exam and passed. (It is A.S.N.T.'s policy not to publish exam scores, only pass/fail).

In addition to the above, our current R.S.O. has deligated many of his functions (for his review) for me to perform as part of my training. Also, I have been Niles Steel Tank Company's representative during the last three of our Audits that the N.R.C. conducts routinely.

I am currently "Acting R.S.O.", while our current R.S.O., J. C. Wood is preparing for retirement and have been appointed R.S.O. upon N.R.C. approval.

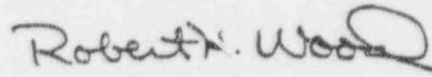


PAGE 2

All of the above mentioned documentation is a permanent record at Niles Steel Tank Company and may be examined per your request.

Very truly yours,

NILES STEEL TANK COMPANY



Robert H. Wood.  
Q.C. Manager &  
Acting R.S.O.

RHW/sh

Enc.

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## LICENSE FEE REQUIREMENTS

COA  
LICENSE FEE AND DEBT COLLECTION BRANCH  
DIVISION OF ACCOUNTING AND FINANCE  
OFFICE OF THE CONTROLLER  
U.S. NUCLEAR REGULATORY COMMISSION  
WASHINGTON, DC 20555-0001NILES STEEL TANK COMPANY  
ATTN: ROBERT H. WOOD  
RADIATION SAFETY OFFICER  
P. O. BOX 728  
713 WAYNE STREET  
NILES, MICHIGAN 49120

## TYPE OF ACTION

- ☐
- NEW LICENSE
- 
- ☐
- RENEWAL OF LICENSE
- 
- ☒
- AMENDMENT TO LICENSE

REQUESTED DATE

7-15-96

LICENSE NUMBER

21-04741-01

CONTROL NUMBER

301603

## I. APPLICATION FEE DUE

Your request for a licensing action is subject to the fee(s) in the category(ies) noted below in accordance with Section 170.31 of the enclosed Federal Register notice. Payment of the fee is required prior to the issuance of the license, renewal, or amendment.

FEE CATEGORY	APPLICATION	RENEWAL	AMENDMENT
30	\$	\$	\$ 720.00
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$
	\$	\$	\$

FEE(s) DUE	\$	720.00
PAYMENT RECEIVED	\$	690.00
AMOUNT DUE	\$	30.00

☐ Your request was received without the prescribed application fee.☒ We received your Check No. 46307 in the amount of \$ 990.00. Payment of the additional fee noted above is required.☐ Your request will increase the scope of your license program. Therefore, your request is subject to the application fee(s) noted above. Refer to Section 170.31 and Footnote 1(d)(2).☐ Your license expired prior to the receipt of your application for renewal. Therefore, your request is subject to the application fee(s) noted above. Refer to Section 170.31 and Footnote 1(a).

MAKE PAYMENT OF THE FEE(S) TO THE U.S. NUCLEAR REGULATORY COMMISSION AND MAIL THE PAYMENT TO THE ADDRESS LISTED AT THE TOP OF THIS FORM. IF WE DO NOT RECEIVE A REPLY FROM YOU WITHIN 30 CALENDAR DAYS FROM THE DATE LISTED BELOW, WE SHALL ASSUME THAT YOU DO NOT WISH TO PURSUE YOUR APPLICATION AND WILL VOID THIS ACTION.

SIGNATURE - LICENSE FEE ANALYST

LFDCB

LFDCB

SHIRLEY CRUTCHFIELD

7/25/96

## II. FEE NOT REQUIRED

☐ Enclosed is Check No. \_\_\_\_\_ which accompanied your request. The fee is not required because:☐ We received your Check No. \_\_\_\_\_ in payment of the fee.☐ The Licensing staff has informed us that your request is to be considered as a continuation of your request dated \_\_\_\_\_, Control No. \_\_\_\_\_.☐ Your request was combined, prior to review, with your \_\_\_\_\_ request, Control No. \_\_\_\_\_.

## III. CHECK RETURNED

☐ Enclosed is Check No. \_\_\_\_\_ which was returned to us by the bank for:

- ☐
- INSUFFICIENT FUNDS
- 
- ☐
- ACCOUNT CLOSED
- 
- ☐
- OTHER

MAIL THE REPLACEMENT CHECK TO THE ADDRESS LISTED AT THE TOP OF THIS FORM AND REFERENCE THE ABOVE CONTROL NUMBER.

## IV. LICENSE ISSUED WITHOUT THE REQUIRED FEE

☐ License No. \_\_\_\_\_, Amendment No. \_\_\_\_\_, issued on \_\_\_\_\_ was issued without the required fee being collected. The fee required is noted in Section I of this form.☐ The scope of your licensed program was increased. Therefore, your request is subject to the application fee(s) noted in Section I of this form. Refer to Section 170.31 and Footnote 1(d)(2).☐ Because of the urgency of your request, the license was issued without remittance of the prescribed fee noted in Section I of this form.

Distribution:

Pending Fee File  
LFARB R/F (2)

OC/DAF/RF

OC/DAF/SF(LF-3.2.7)

Region 3

DATE

July 25, 1996

Frene,

8/2/96

Rec'd w/ Fee Shirts. Should  
we control.

Thanks,  
Shirley

*Delma Holdmeyer*  
*Tax & Accounting Service*

*1345 N. Union Avenue*

*Union, Mo. 63084*

*583-2214*

JULY 16, 1996

TO WHOM IT MAY CONCERN:

I GIVE MY PERMISSION FOR SCI SOIL CONSULTANTS INC TO  
STORE NUCLEAR DENSITY GAUGES IN THE SHED ON MY PROPERTY  
AT 1345 N. UNION AVENUE, UNION, MO 63084. THIS PERMISSION  
IS GRANTED SO LONG AS SCI REMAINS A TENANT ON THE PROPERTY  
AND ALL REQUIREMENTS OF THE NUCLEAR REGULATORY COMMISSION  
ARE ADHERED TO.

*Delma Holdmeyer*  
DELMA HOLDMEYER

1996 AUG - 2 AM 11:26



AUG 30 1996

Robert H. Wood  
Radiation Safety Officer  
Niles Steel Tank Company  
P.O. Box 728  
713 Wayne Street  
Niles, MI 49120

Dear Mr. Wood:

Enclosed is Amendment No. 22 to your NRC Material License No. 21-04741-01 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 note the following changes to your NRC license: (1) the expiration date was increased 5 years in accordance with 10 CFR 30.36(2) and now reads July 31, 2000; (2) the Technical Operations Model 402 and Model 650 and 414 source changers were removed from your NRC license; (3) license condition now references your new operations manual; (4) License Condition No. 12 was removed since your training program now specifies where training will take place; (5) License Condition No. 14 was removed since you no longer use T/O Model 402 exposure devices; (6) License Condition No. 18 was removed and is now a line item in your NRC license; (7) License Condition No. 20 was removed since you do not transport radioactive material; (8) License Condition No. 21 was removed since these records are now required to be maintained by regulation; and (9) new License Condition No. 17 was added to assure you do not exceed the quantity of radioactive material that would require you to provide a financial assurance program in accordance with 10 CFR 30.35(d).

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.

301603

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.
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

R. Wood

-3-

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  
James R. Mullauer, M.H.S.  
Health Physicist  
Nuclear Materials Licensing Branch

License No.: 21-04741-01

Docket No.: 030-04829

Enclosure: Amendment No. 22

DOCUMENT NAME: M:\03004829.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/RUI								
NAME	JRMULLAUER:jaw								
DATE	08/18/96								

OFFICIAL RECORD COPY

## CONVERSATION RECORD

TIME | DATE  
10 a.m. 7/23/96☐ VISIT ☐ CONFERENCE ☒ TELEPHONE☐ INCOMING  
☒ OUTGOING

NAME OF PERSON(S) CONTACTED OR IN CONTACT

Robert Woods, RSO  
Niles Tank  
616-683-1910

ORGANIZATION (OFFICE, DEPT. ETC.)

TELEPHONE NO.

## SUBJECT

Application dated 7/15/96

## SUMMARY

I spoke to Rob to inform him that NRC is currently not doing renewals and that he should not provide his entire program in a license amendment. Therefore, I requested Rob to resubmit the application with only those areas that have changed to be highlighted. Also consider giving him any iridium-192 sealed source under 32.210.

This action is certified by \_\_\_\_\_

## ACTION REQUIRED

Due in 30 days

NAME OF PERSON DOCUMENTING CONVERSATION

James R. Mullauer

SIGNATURE

DATE

## ACTION TAKEN

SIGNATURE

TITLE

DATE



SINCE 1898

NILES STEEL TANK COMPANY  
713 WAYNE STREET  
P.O. BOX 728  
NILES, MICHIGAN 49120  
TELEPHONE (616) 683-1910  
FAX (616) 683-1953

August 15, 1996

U.S. Nuclear Regulator Commission  
Region III  
801 Warrenville Road  
Lisle, Illinois 60532-4351

Attention: James Mullaur(Mail Control #301-603)

Subject: Amendments to our Radiography Operations Manual

Dear Mr. Mullaur:

Per our telephone conversation please find enclosed an updated version of our Radiography Operations Manual. The amendments from the "Old Manual" to the "New Manual" are highlighted in yellow.

I have also included a brief synopsis of these amendments for your review. I hope this will be helpful in finding the amendments. There may be subtle changes that I did not find, but I am sure that they are insignificant to our program.

As explained to you over the phone, the reason our Operations Manual was "re-vamped" was because we thought we were applying for Renewal, but by NRC rule making our license was extended for five more years. This rule making was done after we had submitted our license for renewal.

I feel that the "New Manual" is better organized and is more thorough than the "old", I hope you agree.

If you have any questions feel free to call me at (616)683-1910 (8:00 - 3:00 EDT)

Very truly yours,

NILES STEEL TANK COMPANY

Robert H. Wood  
R.S.O.

RHW/pk

RECEIVED  
AUG 21 1996  
REGION III

AUG 21 1996



## SYNOPSIS OF AMENDMENTS TO OUR RADIOGRAPHY OPERATIONS MANUAL

Table of contents to adjust for the reformatting of the New Manual

Para 1.2.1: Old Manual was incorrect per NRC requirements

Para 1.2.1: Old Manual the "Note" was deleted

Para 1.2.2: Old Manual was incorrect per NRC requirements

Para 1.3.1: Was added to New Manual

Para 1.3.2: Was added to New Manual

Para 1.3.4. thru 1.3.7: Was added to New Manual

Para 2.1.2.3: Amended for clarification (New Manual)

Para 2.1.3 (etc): Amended for clarification (New Manual)

Para 3.2: Part of this paragraph was deleted (3.2.1 in New Manual)

Para 3.3.9: Was added to the New Manual

Para 3.4.7: Was added to the New Manual

Para 3.7 (etc): From the Old Manual has been moved to paragraph 6.1 in the New Manual

Para 3.7 (etc): In the New Manual has been added.

Para 3.8: In the Old Manual has been moved to 6.2 of the New Manual

Chapter 4 of the Old Manual has been changed in its entirety. The T/O 402 is not compliant to Part 34 and is no longer in use. Chapter 4 of the New Manual reflect the changes necessary for the use of the 660 system projector (Part 34 compliant).

Chapter 5 of the Old Manual is deleted and replaced with Chapter 5 "Inspection and Maintenance Requirements" which has changed in its entirety to accomodate the 660 projector.

Chapter 6 has been completely reorganized, consider it changed completely in the New Manual.

Para 6.1.3 (etc): Was added to the New Manual

"Leak Testing" appear in Chapter 7 of the New Manual

"Emergency Operating Procedures" appears in Chapter 8 of the New Manual and has been amended completely.

Chapter 8 of the Old Manual has been moved to Chapter 9 of the New Manual. Verbage has been added for clarity.

Para 9.3 (etc): In the New Manual has been added

Chapter 9 of the Old Manual has been deleted in its entirety. The instruction for Inspection and Maintenance are in Chapter 5 of the New Manual.

Chapter 10 has been edited in its entirety.

Appendix C has an addition.

Exhibit A changed in its entirety.

Exhibit B has been added to the New Manual.

Exhibit C has been added to the New Manual.

# **NILES STEEL TANK COMPANY RADIOGRAPHY OPERATIONS MANUAL**

**(PROCEDURES)**

# **NILES STEEL TANK COMPANY**

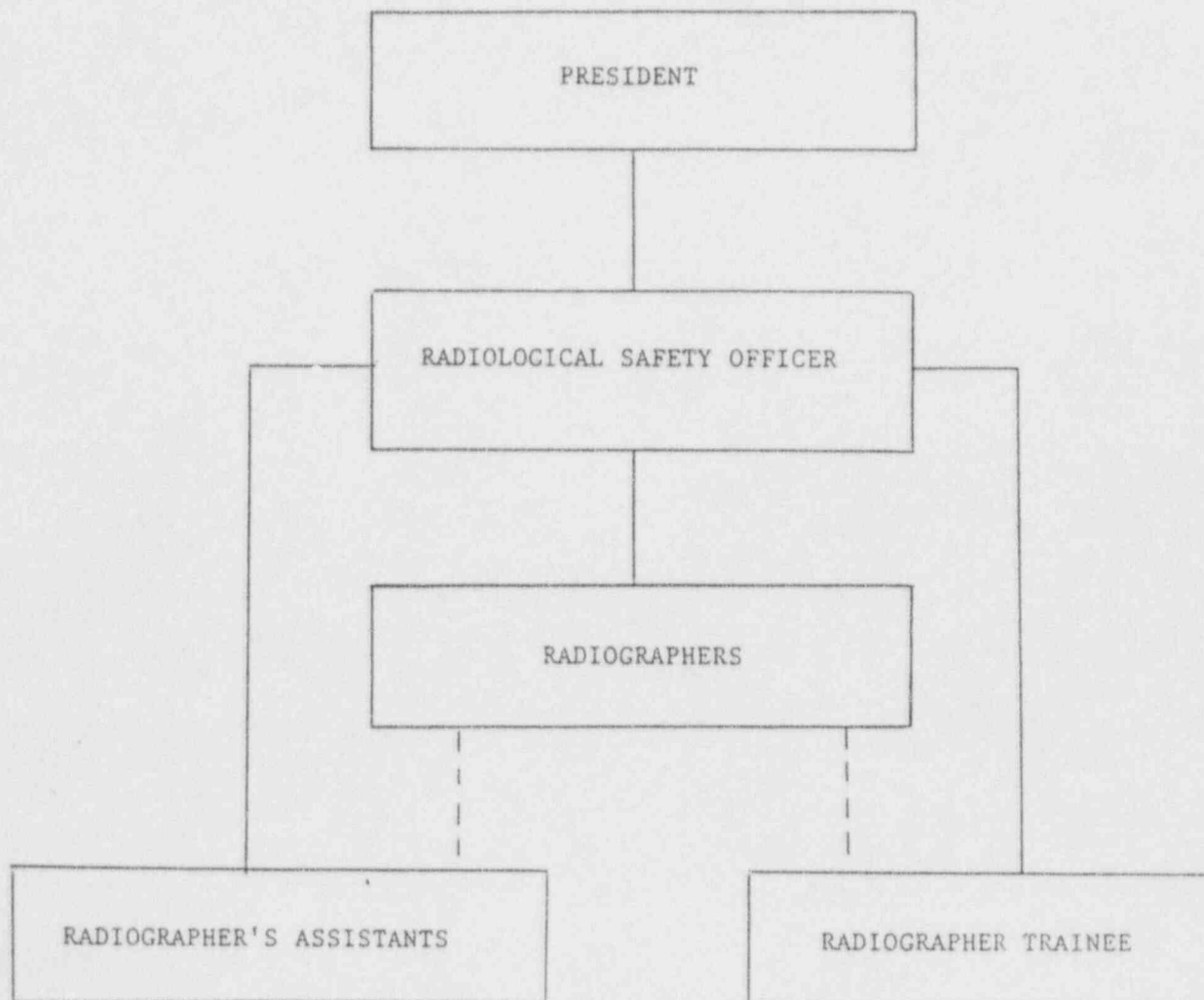
## **RADIOGRAPHY OPERATIONS MANUAL (PROCEDURES)**

### **TABLE OF CONTENTS**

<u>SECTION</u>	<u>DESCRIPTION</u>
1.	ORGANIZATIONAL STRUCTURE
1.	PERMANENT RADIOGRAPHY FACILITY
2.	RADIATION DETECTION INSTRUMENTS (Descriptions)
3.	TRAINING PROGRAM
4.	RADIOGRAPHIC OPERATING PROCEDURES FOR THE AMERTEST 660 PROJECTOR
5.	INSPECTION AND MAINTENANCE REQUIREMENTS
6.	INTERNAL INSPECTION AND MANAGEMENT CONTROL SYSTEM
7.	LEAK TESTING
8.	EMERGENCY OPERATING PROCEDURES
9.	SURVEY METERS, POCKET DOSIMETERS, FILM BADGES AND ALARMING RATEMETERS (PROCEDURES)
10.	RECEIPT, CHANGING AND SHIPPING OF SOURCES IN SHIPPING PACKAGES: (T/O 650L SOURCE CHANGER & AMERTEST 660 PROJECTOR.
APPENDIX:	
A.	BLUE PRINT OF THE CELL AREA (folded and not in correct order of this table of contents.)
B.	INSTRUCTIONS FOR POSITIONING SOURCE IN CELL
C.	ROOF RADIATION PROTECTION; CHART "A" EXPLANATION
D.	CHART "A"
EXHIBITS:	
A.	RADIOGRAPHER & RADIOGRAPHER'S ASSISTANT QUARTERLY CHECKLIST
B.	RADIATION SAFETY OFFICER AUDIT CHECKLIST
C.	RADIOGRAPHER'S ASSISTANT EXAMINATION & ANSWERS (NRC copy of the Manual only!)

ORGANIZATIONAL STRUCTURE

RADIOGRAPHIC DEPARTMENT





## 1 PERMANENT RADIOGRAPHY FACILITY (SEE APPENDIX A)

### 1.1 Materials of Radiation Cell:

- 1.1.1 The floor of the Radiation Cell is constructed of a concrete slab, on the ground floor. (One story building.)
- 1.1.2 The Walls are constructed of concrete blocks mortared with cement. The thickness of the blocks are 12" facing the radiation. Walls "B", "C", & "D" are double blocked to give a total thickness of 24". Wall "B" has a row of exterior red brick plus a row of 16" foundation block. Though this extra shielding exists, they are not included in the calculation, because the internal properties are unknown. The only benefit that was taken in the calculations was the distance factor (Inverse Square Law). Wall "A" is a single row of 12" concrete block and which is also the exterior wall.
- 1.1.3 The ceiling (roof) is constructed galvanized corrugated metal (approx. 16 to 20 gage thick) over a wood frame support and decking.
- 1.1.4 There is an 8 ft. chain link fence plus 3 strands of barbed wire to prevent access to the roof area above and near the Cell. This fence has one locked access gate which the Radiation Safety Officer has only the key.
- 1.1.5 There are no "right of ways" nor utility (gas or electric) over or near the Cell roof.
- 1.1.6 There is an 8 ft. high chain link fence outside of Wall "A" this fence also has 3 strands of barbed wire on top. This fence is 24 ft. away from the outside wall. There existed one access gate which cannot be opened because of large tree trunks have grown across the gate. There is also a window just outside of the cell area which can be used for observing this fenced in area of Wall "A".

### 1.2 Restricted Areas around and above Cell:

- 1.2.1 The roof area above Cell shall be a Restricted Area and will be posted (on barrier fence) "CAUTION - RADIATION AREA", (With Radiation Symbols). The locked gate will be posted "CAUTION - RADIATION AREA", (With Radiation Symbols). This area will have a Radiation dose less than 100 mR in one hour and will be off limits to all personnel during exposures. If for a temporary situation the radiation level by calculation, has to exceed 100 mR in one hour, the Radiation Safety Officer will provide surveillance for the roof area to assure that no personnel will enter the "High Radiation Area" and "Restricted Area".
- 1.2.2 The area fenced in outside of Wall "A" shall be posted as a "CAUTION - RADIATION AREA" (With Radiation Symbols) with signs posted on the barrier. This area will have a radiation dose less than 100 mR in one hour.
- 1.2.3 Areas outside of the Restricted Areas will have less than 2 mR in one hour and have less than 100 mR in seven consecutive days.
- 1.2.4 If scatter radiation levels exceed 2 mR in one hour, upon survey outside of the Cell, the Radiographer will post a restricted area and monitor the area to keep unauthorized personnel out.
- 1.2.5 See Appendix A and Chart "A" for purposed radiation levels in these areas.

1.3 Security and Safeguards:

- 1.3.1 There are three different keys and locks to gain access to the source contained in the 660 Gamma Projector; the key to the Cell door which has a Master lock, the key to the projector cabinet which also has a Master lock and the key to the 660 itself.
- 1.3.2 Radioactive sources shall be stored in the Cell when not in use, in locked storage containers. Radiographic equipment shall be stored in the Cell when not in use. The Cell door shall be locked when not in use.
- 1.3.3 A Tech/Ops Model 492D "Gamma Alarm" is installed on the radiation cell. The "Gamma Alarm" emits a high intensity red light when one mR/hr is present. If the door is opened or left open, a loud audible alarm will sound. Audible alarm will discontinue when door is closed. Personnel are warned to keep out of area when red light is present. (When no radiation is present, a green light is on). The "Gamma Alarm" is checked for proper operation when the quarterly inventory of sources is taken.
- 1.3.4 If a failure occurs with the 492D Gamma Alarm which necessitates repairs or replacement of the unit. Radiographic personnel shall wear Alarming Ratemeters while performing radiographic functions in the Cell while the 492D is inoperable.
- 1.3.5 Repair or replacement of the 492D Gamma Alarm shall be dealt with expeditiously, so the downtime of the Cell radiation safeguards are minimized.
- 1.3.6 Outside of the Cell, a type "G" radiation badge (marked "Area 1") is placed 24 hours a day, 365 days a year; at the border of the restricted area, where scatter radiation is likely to occur and unmonitored personnel are likely to occupy. This badge is only to be removed (and shielded) when an 'out of Cell exposure' is being performed in that shop area, which all unauthorized personnel will be evacuated from the Restricted Area.
- 1.3.7 This film badge will be sent in for processing biweekly with the rest of the film badges and is intended to 'monitor exposure to the public'.

## 2 RADIATION DETECTION INSTRUMENTS:

- 2.1 The Niles Steel Tank Company utilizes survey meters, pocket dosimeters and one dosimeter charger, and alarming ratemeters for radiographic functions. They are as follows:

2.1.1 Victoreen Model 492 Survey Meters:

- 2.1.1.1 Survey meters shall be in accordance with 10 CFR 34.24.
- 2.1.1.2 Radiation Detected: Gamma
- 2.1.1.3 Detection Range: 1 mR/hr to 1 R/hr.
- 2.1.1.4 Intended Use: These three instruments shall be used as primary radiation detection instruments. Should one fail, there will be another meter available for back-up. (One meter may be out for calibration at any given time).
- 2.1.1.5 Calibration Method: The survey meter shall be sent every (3) months to Amersham Corporation, for calibration. The type of source they use is Cesium 137. This source is contained in the Tech/Ops Model 571 or the Amertest Model 773 Gamma Survey Meter Calibration Unit. The procedures provide for the operation of this unit are followed by Amersham Corporation.
- 2.1.1.6 The survey meter calibration due date shall be offset of the others to avoid having all meters sent out of the plant at the same time.

2.1.2 Victoreen Model 541R Direct Reading Pocket Dosimeters:

- 2.1.2.1 Radiation Detected: Gamma
- 2.1.2.2 Detection Range: 0-200 mR
- 2.1.2.3 Intended Use: They are used primarily as instant radiation exposure measuring devices, as described in 10 CFR 34.33 (a), (b), (c), (d).
- 2.1.2.4 Radiographers and Radiographer's Assistants shall wear on clothing (charged daily) when conducting Radiographic Operations.
- 2.1.2.5 At any time, report to the Radiation Safety Officer if a dosimeter has been completely discharged during radiography operations. (off scale)
- 2.1.2.6 Calibration will be performed yearly.

2.1.3 Dosimeter Corporation Model No. 1888B & Model No. 33 Alarming Ratemeters:

- 2.1.3.1 Radiation Detected: Gamma
- 2.1.3.2 Anyone performing radiography outside of the Cell shall wear an Alarming Rate Meter as described in 10 CFR 34.33 (f).
- 2.1.3.3 Alarming Ratemeters will sound and audible alarm when it encounters a radiation rate of 500 mR/hr or greater and will continue to sound until the radiation field is reduced below 500 mR/hr.
- 2.1.3.4 Ratemeters will be checked for proper operation at beginning of each shift.
- 2.1.3.5 These rate meters shall be calibrated at least yearly.

- 2.1.4 Film Badges: R.S. Landauer (N.V.L.A.P. accredited) Type "G" film and holders.
  - 2.1.4.1 Badges are replaced biweekly.
  - 2.1.4.2 R.S. Landauer performs all processing and reporting.
  - 2.1.4.3 The Radiation Safety Officer shall review reports as received in the mail from R.S. Landauer.
  - 2.1.4.4 A person's film badge will be immediately sent in if his dosimeter is found to be completely discharged after engaging in radiographic procedures.

### 3 TRAINING PROGRAM

#### 3.1 Radiographer's Assistant Trainee:

- 3.1.1 A Trainee will work with a Radiographer or the Radiation Safety Officer for a period not less than one month to familiarize himself with Niles Steel Tank Company's Radiography Operations, equipment operating manuals and Emergency Procedures. During this time the Trainee is only an observer and shall not make radiographic exposures.
- 3.1.2 Specific instruction on Niles Steel Tank Company's Radiography Operating Procedures and Emergency Procedures will be minimum of 6 hours and 4 hours minimum on the proper use of Niles Steel Tank Company's radiographic equipment.
- 3.1.3 There will be approximately 30 minutes to 1 hour of instruction on each of the following subjects: (He will receive personal copies of 10 CFR Parts 19, 20, and this Manual.)
  - 3.1.3.1 The handling and use of licensed sealed sources and radiographic exposure devices to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in 10 CFR Part 20, Subpart C.
  - 3.1.3.2 Methods and occasions for conducting radiation surveys.
  - 3.1.3.3 Methods for controlling access to radiographic areas.
  - 3.1.3.4 Methods and occasions for locking and securing radiographic exposure devices, storage containers and sealed sources.
  - 3.1.3.5 Personnel monitoring and the use of personnel monitoring equipment.
  - 3.1.3.6 Minimizing exposure of persons in the event of an accident.
  - 3.1.3.7 The procedure for notifying proper persons in the event of an accident.
  - 3.1.3.8 Maintenance of records.
  - 3.1.3.9 The inspection and maintenance of radiographic exposure devices and storage containers.
  - 3.1.3.10 Steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale.
  - 3.1.3.11 The procedure(s) for identifying and reporting defects and noncompliance, as required by 10 CFR Part 21.
- 3.1.4 At the end of the required training period the Radiation Safety Officer will administer a written multiple choice exam to the Trainee. This exam will be a minimum of 25 questions and will be specific to Niles Steel Tank Company's Radiography Operating and Emergency Procedures and the use of Niles Steel Tank Company's radiographic equipment. The Trainee must achieve a minimum 70% score on this exam before he may advance to Radiographer's Assistance.
- 3.1.5 The Radiation Safety Officer shall re-instruct the Trainee on all questions missed on the exam. For failed exams, the Radiation Safety Officer will provide ample re-instruction so the Trainee can retake the exam. There is no minimum or maximum time allotment for this re-instruction and is to the discretion of the Radiation Safety Officer. Then the Radiographer's Assistant will take the Practical



Exam under supervision of the Radiation Safety Officer. (The Practical Exam is described later in this part under paragraph. 3.3.6 Radiographer's "Practical Exam.")

3.2 Radiographer's Assistant (RT Assistant or Level 1):

- 3.2.1 The Radiographer's Assistant will work with the Radiographers with a "hands on" capacity, only under direct visual supervision of the Radiographer (or the Radiation Safety Officer) when working with the radiographic exposure devices.

3.3 Radiographer (RT Level 11):

- 3.3.1 The Radiographer Assistant must work a minimum of nine more months as on the job training before he may be considered a "candidate" for promotion to Radiographer.

- 3.3.2 The candidate shall attend an Isotope Radiation Safety course (outside of Niles Steel Tank Company.) This course must consist of the following:

- 3.3.2.1 A Minimum of 40 hours classroom instruction addressing Isotope Radiography, Radiation Safety and the subject matter addressed in 10 CFR Part 34 - Appendix A.

- 3.3.2.2 A final exam consisting of not less than 50 questions pertaining to the subject matter addressed in 10 CFR Part 34 - Appendix A.

- 3.3.2.3 After April 1, 1990 these exams must return with the candidate for the Radiation Safety Officer's approval and record retention.

- 3.3.3 Niles Steel Tank Company requires a minimum of 75% correct answers on these exams. The Radiation Safety Officer will re-instruct the candidate on missed questions to assure a good understanding of the subject matter.

- 3.3.4 Failed exams will result in a retraining period of not less than one month, then the candidate will retake a 50 question exam, rewritten from the first exam. The Radiation Safety Officer is responsible for the rewriting of this exam.

- 3.3.5 Previously Niles Steel Tank Company used Technical Operations in Burlington, Massachusetts for the administration of the courses. We will use Amersham Corporation's Radiation Safety Course to fulfill the above requirements.

- 3.3.6 Upon completion of the course and passing grade (75%). That candidate will take a practical examination administered by the Radiation Safety Officer. The Radiation Safety Officer will have the candidate setup and shoot a radiographic exposure (under supervision of the Radiation Safety Officer). The following is the list of Check Points:

- 3.3.6.1 Proper Use of Film Badge, Alarming Ratemeter and Dosimeter.

- 3.3.6.1.1 Placement on clothing.

- 3.3.6.1.2 Recharged dosimeter correctly.

- 3.3.6.2 Proper Use of Survey Meter.

- 3.3.6.2.1 Verify if meter is working.

- 3.3.6.2.2 Battery check, calibrated.

- 3.3.6.2.3 Proper surveys before, during and after exposure.

- 3.3.6.2.4 Survey's during exposure, check for increasing the Restricted Area.
- 3.3.6.2.5 Did he bring survey meter out of cell with him after locking cell door.
- 3.3.6.3 Proper Placement of the source in the Cell.
  - 3.3.6.3.1 No increase in restricted areas, proper use of Chart "A", using radiation protection formulas and understanding ALARA.
- 3.3.6.4 Proper check of radiographic equipment for damage and proper operation. (Daily inspection requirements.)
- 3.3.6.5 [Radiographic Artistry.]
- 3.3.6.6 During the exposure, ask Candidate question about the Emergency Procedures. ("What if" questions.)
- 3.3.6.7 Securing the source after exposure; proper surveys of the Projector and Cell.
  - 3.3.6.7.1 Is the radiographic source in it's properly shielded position? (Survey of tubes, collimator, etc.)
  - 3.3.6.7.2 Is the Projector locked.
  - 3.3.6.7.3 Base readings.
  - 3.3.6.7.4 Is the Cell door locked.
- 3.3.6.8 [Film Development]
- 3.3.6.9 [Film Interpretations]
- 3.3.6.10 Utilization Log Book filled out properly.
  - 3.3.6.10.1 Dosimeter reading.
  - 3.3.6.10.2 Base readings.
  - 3.3.6.10.3 Exposure logged properly.
  - 3.3.6.10.4 Maintenance check list, OK.
  - 3.3.6.10.5 Survey's recorded.
- 3.3.7 The Practical Exams will be pass/fail on the discretion of the Radiation Safety Officer and errors will be discussed with the Candidate to insure his proficiency. Failed exams will cause the Candidate to retrain under the Radiation Safety Officer's supervision until the Radiation Safety Officer feels that the Candidate has become proficient in Niles Steel Tank Company's radiography activities. The Candidate will be reexamined.
- 3.3.8 Passing grade on the Practical Exam, passing grade on the previously mentioned written exams and have at least one year working experience in Isotope Radiography, he will be promoted to Radiographer.
- 3.3.9 As an option to the above, Niles Steel Tank Company may use the ASNT-IRRSP to qualify it's radiography personnel.
- 3.4 Hiring an employee with previous experience as a Radiographer to qualify for Niles Steel Tank Company Radiographer:
  - 3.4.1 Prove at least one year experience in Isotope Radiography.
  - 3.4.2 Evidence of completion of an approved Radiation Safety Course, as mentioned above.
  - 3.4.3 A copy of the necessary written exams with grades from his previous employer. These exams shall be similar to Niles Steel Tank

Company's exams (one exam shall have a minimum of 50 questions relating to Radiation Safety in regards to 10 CFR Part 34 - Appendix A).

- 3.4.4 Pass a 25 question written exam on Niles Steel Tank Company's Radiography Operations and Emergency Procedures (75%).
- 3.4.5 Pass Niles Steel Tank Company's Practical Exam (mentioned above).
- 3.4.6 If possible, a letter of recommendation from the previous Radiation Safety Officer.
- 3.4.7 As an option to the above, Niles Steel Tank Company may use the ASNT-IRRSP to qualify it's radiography personnel.
- 3.4.8 Failed Examinations:
  - 3.4.8.1 When a candidate fails an exam he will be given ample time to study and/or gain experience to enable him to attempt to pass the exam.
  - 3.4.8.2 The Radiation Safety Officer or Radiographer will spend more time with the candidate to help them with deficient areas.
- 3.5 All exams will be kept as records, for inspection during the duration of a person's employment. Exams will be kept for at least 3 years after an employment has been terminated, for inspection.
- 3.6 Instructors will be Radiographers and/or the Radiation Safety Officer and shall have at least one year working experience in Isotope Radiography and be a certified Radiographer by Niles Steel Tank Company.
  - 3.6.1 The following personnel presently employed shall serve as instructor and supervisory capacity over the Radiographer's Assistant:
    - 3.6.1.1 Name: Robert H. Wood (616-683-9182), Radiation Safety Officer.
- 3.7 Training personnel for auditing the Radiation Safety Officer:
  - 3.7.1 The Auditor will be provided with documents; 10 CFR Part 19, Part 20, Part 34, Part 71, Niles Steel Tank Company's Quality Assurance Program (per 10 CFR Part 71, Subpart H), this Manual and the Audit Checklist for his review.
  - 3.7.2 The Auditor will receive all revisions to the above documents as available.
  - 3.7.3 Questions that may arise as to the interpretation and/or procedural matters will be discussed between the Auditor and the Radiation Safety Officer before auditing is to be performed, as the Auditor does not engage in any other functions of radiographic procedures than auditing the performance and duties of the Radiation Safety Officer.
  - 3.7.4 The Auditor will be issued his film badge, charged dosimeter and an Alarming Ratemeter (if necessary), while performing the audits.

#### 4 RADIOGRAPHY PROCEDURE WITH THE AMERTEST 660 PROJECTOR:

##### 4.1 Exposures inside the Radiation Cell:

- 4.1.1 Carry an operable and calibrated survey meter and be sure meter is on.
- 4.1.2 Wear your film badge and charged pocket dosimeter on clothing that won't be removed during the course of radiographic functions. Note the pocket dosimeter reading after charging.
- 4.1.3 Secure keys to the Cell and the Projector from the Radiation Safety Officer.
- 4.1.4 Approach the Cell door with your survey meter on. If survey the reading is zero mR/hr and the Gamma Alarm light is green. Unlock the Cell door and approach the Projector storage cabinet, noticing survey readings. [Do not enter the Cell if the Gamma Alarm horn sounds and the red light is on. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.1.5 Unlock the Projector storage cabinet and remove the Projector. Survey all sides of the Projector and record surface Base Reading. [No reading shall exceed 200 mR/hr. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.1.6 Inspect the Projector and associated equipment per 5.3 (Daily Inspection) of this manual.
- 4.1.7 Setup the exposure, connect source stop or collimator and guide tubes to the Projector. Inspect the guide tubes for kinks, sharp bends or crushed areas. Inspect the setup and setup area to assure that nothing could cause damage to the equipment during the source exposure.
- 4.1.8 Drive cable connection: Connection of the drive cable assembly as described per the operating manual for the Amertest 660 Operation Manual, as follows:
  - 4.1.8.1 Cable layout: Lay out the control cables with no bend radii less than about one (1) meter.
  - 4.1.8.2 Avoid any risk of crushing by falling objects, moving vehicles or closing doors, etc.
  - 4.1.8.3 The drive cable control unit should be placed as far away from the source focal position as possible (preferably behind shielding).
  - 4.1.8.4 Connect the drive cable to the source Projector as shown in fig. 5.7 (pictorial illustration) of the Amertest 660 Operations Manual.
  - 4.1.8.5 Unlock with the key and turn the selector ring from LOCK to CONNECT. The storage cover will disengage from the Projector.
  - 4.1.8.6 Slide the control cable collar back and open the jaws to expose the male portion of the swivel coupling (ie., the ball-end on the drive cable).
  - 4.1.8.7 Press back the spring-loaded locking pin with a thumb nail and engage the male and female portions of the swivel coupling.



- 4.1.8.8 Release the locking pin and check that the connection is secure.
- 4.1.8.9 Close the jaws of the control cable connector over the swivel coupling.
- 4.1.8.10 Slide the control collar over the connector jaws.
- 4.1.8.11 NOTE: The drive cable connector, when properly installed with the selector ring in the CONNECT position, displaces anti-rotation lugs which allows the selector ring to be rotated to the LOCK position and when required, through to the OPERATE position.
- 4.1.8.12 Push and hold the control cable collar flush against the Projector connector and rotate the selector ring from CONNECT to LOCK.
- 4.1.8.13 Do not rotate past LOCK.
- 4.1.8.14 The drive cable connector is now locked into the Projector.
- 4.1.8.15 Keep the Projector in the LOCK position until ready to start the exposure.
- 4.1.9 Radiographic exposure:
  - 4.1.9.1 Guide tubes: Remove the shipping plug from the Projector and connect the source guide tube(s). DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 4.1.9.2 Projector survey: Check the operation of the survey meter by reading the radiation level at the surface of the Projector. It should read no more than 2 Sv/h (200 mR/h) except for the area just in front of the exit port when the shipping plug is removed.
  - 4.1.9.3 Note that the readings for verification of the source return after exposure. (Base Reading)
  - 4.1.9.4 Verify that the guide tube and drive cable are correctly connected.
  - 4.1.9.5 Ensure that no unauthorized personnel are inside the Restricted Area or the Cell, and that signs are posted and warnings are in operation.
  - 4.1.9.6 CAUTION: Do not apply excess force to the control handle in the exposed direction as this could cause the source assembly to move forward out of the stored position when the lock slide is released.
  - 4.1.9.7 Unlock: Use the key to unlock the Projector lock and rotate the selector ring to the OPERATE position. Ensure there is no tension force in either direction on the drive cable. Push the slide bar (green marking) laterally from left to right (as seen behind the Projector) until the slide bar (red marking) fully appears on the right side of the selector ring and you feel or hear the sleeve snap into slide. When the green marking is visible the source assembly is locked into the safely stored position within the Projector; when the red marking is visible the source assembly is free to be projected from/to the Projector. The source is now free to move.
  - 4.1.9.8 Close and lock the Cell door.



- 4.1.9.9 Return to the drive control unit.
- 4.1.9.10 Project: Rapidly rotate the crank in the 'EXPOSE' direction (counterclockwise) to move the source out of the Projector to the radiographic focal position.
- 4.1.9.11 The hand crank will stop turning when the source reaches its stop. Do not use excessive force.
- 4.1.9.12 Set the brake to ON to prevent movement of the source during exposure.
- 4.1.9.13 Calculate the exposure time from the moment when the source reaches its stop.
- 4.1.9.14 Survey: Survey meter readings observed during the projection operation should increase rapidly from background to a high level as the source emerges from the Projector. Then readings should fall sharply as the source enters a collimator (if used) and remain steady throughout the exposure.
- 4.1.9.15 Actual survey meter readings will depend on the source activity, distance, collimators and shielding.
- 4.1.9.16 The sequence of changes should be observed and the readings noted.
- 4.1.9.17 During source retractions the sequence will reverse.
- 4.1.9.18 During the exposure, use the survey meter to check the perimeter of the Cell to assure that the source exposure site is correct.
- 4.1.9.19 Retract: At the end of the required exposure time, set the brake to OFF and rapidly turn the crank in 'RETRACT' (clockwise) direction until the crank no longer moves. You should hear the slide bar "click" back into it's original position and observe the green marking on the slide bar.
- 4.1.9.20 Apply a slight amount of forward pressure on the crank handle as if to expose the source to insure that the positive locking mechanism has actuated. Allow the crank handle to return to a neutral position, thereby relieving any tension (force) on drive cable which would cause source movement when unlocking the camera. At this point the source cannot be moved out of the stored position.
- 4.1.9.21 In the unlikely event of the locking slide moves toward the lock position before the source is fully stored in the Projector, turn the hand crank in the "RETRACT" (clockwise) direction until the crank stops turning. (The lock slide is designed to lock on the stop ball, not the drive cable.) Do not use excessive force. The source will be in the Projector but not in the fully shielded position. Approach the Projector, from the rear, with a survey meter. The meter will read approximately 40 mR/hr at the rear plate of the Projector when a 100 Ci source is in use.
- 4.1.9.22 CAUTION: Remain clear of the front of the Projector to minimize personal exposure. Reset the lock slide to the open position. Return to the control and turn the hand crank in the retract (clockwise) direction and store the source in the normal manner.

- 4.1.9.23 The survey meter should indicate a continually increasing radiation level as the source retracts, then drop to background when the source is stored in the Projector.
- 4.1.9.24 Check survey: Approach the Projector with the survey meter, observe the green marking on the slide bar and survey it on all sides. The meter should indicate the same radiation level as observed before the exposure. Note particularly the exit port reading.
- 4.1.9.25 Survey the entire source guide tube with the survey meter. If the meter shows a sharp increase, the source is exposed or incompletely shielded.
- 4.1.9.26 If the source is still exposed, attempt to store it properly by cranking the source a short distance toward the source stop and retracting it, repeating if necessary.
- 4.1.9.27 If the source cannot be fully retracted after several attempts, treat the situation as an EMERGENCY.
- 4.1.9.28 If there are more exposures to be taken, rotate selector ring to the LOCK position. Setup the new exposure and proceed from 4.1.9.7 above. If your exposures are complete or you have to leave the direct supervision of the Cell area, proceed below.
- 4.1.9.29 Lock Projector: When the source is properly stored in the Projector, rotate the selector ring from the OPERATE position to the LOCK position.
- 4.1.9.30 WARNING: If after several attempts to return the source, the selector ring cannot be rotated to the lock position (do not use excessive force) or the lock slide is not actuated, one must suspect an accident in which the source could have become disconnected or stuck outside the Projector, giving rise to a very high radiation field. Treat the situation as an EMERGENCY!
- 4.1.10 Dismantling equipment:
  - 4.1.10.1 Guide tubes: Unscrew the source guide tube sections. Screw the shipping plug into the Projector guide tube connector.
  - 4.1.10.2 Drive control unit: Unlock the Projector and then rotate the selector ring from LOCK to CONNECT. The safety control connector will partially disengage.
  - 4.1.10.3 Disengage the drive control unit from the Projector by reversing the sequence of actions described in section 4.1.8.
  - 4.1.10.4 Replace and hold the storage cover on the Projector connector and rotate the selector ring to the LOCK position.
  - 4.1.10.5 Remove the key and push in the lock to secure the Projector.
  - 4.1.10.6 Check the entire circumference of the Projector with the survey meter to ensure the source is properly secured. Record final Base Reading.
- 4.1.11 Put things back in their proper place. Lock Projector in it's storage cabinet. Survey the Cell. Lock the Cell. Secure keys with the Radiation Safety Officer. Record all required information on the Daily Utilization Log.

#### 4.2 Radiographic Exposures Outside of the Cell:

- 4.2.1 Carry an operable and calibrated survey meter and be sure meter is on.
- 4.2.2 Wear your film badge, charged pocket dosimeter and calibrated Alarming Ratemeter on clothing that won't be removed during the course of radiographic functions. Note the pocket dosimeter reading after charging.
- 4.2.3 Secure keys to the Cell and the Projector from the Radiation Safety Officer.
- 4.2.4 Approach the Radiation Cell door with your survey meter on. If the survey reading is zero mR/hr and the Gamma Alarm light is green. Unlock Cell door and approach the Projector storage cabinet, noticing survey readings. [Do not enter Cell if the Gamma Alarm horn sounds and the red light is on. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.2.5 Unlock the cabinet and remove the Projector. Survey all sides of the Projector and record surface Base Reading. [No reading shall exceed 200 mR/hr. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 4.2.6 Inspect the Projector and associated equipment per 5.3 (Daily Inspection) of this manual.
- 4.2.7 Load the radiographic equipment onto a "two wheel cart". [Radiation Safety Officer's personal suggestion: It is advised that you do not carry the 660 by hand to the exposure area because radiation levels at the surface of the 660 are high. By carrying this unit like a "suitcase" and by it's shear weight, you cannot eliminate the close body contact; which defeats the principal of ALARA. Use "two wheel carts" for transporting the 660, except for very short distances.]
- 4.2.8 Visually survey the area and where the source placements are to be.
- 4.2.9 Calculate and post the High Radiation (100 mR/hr) areas and rope off and post the Restricted Area (2 mR/hr) with "CAUTION - RADIATION AREA". Be slightly excessive in regards to your distances as an additional safety factor.
- 4.2.10 Use a collimator when ever possible. When shooting panoramic exposures, cover (shield) openings in vessels with at least the thickness of the material to be exposed. This will eliminate "hot areas" which makes it hard to calculate your restricted areas.
- 4.2.11 Setup the exposure, connect source stop or collimator and guide tubes to the Projector. Inspect the guide tubes for kinks, sharp bends or crushed areas. Inspect the setup and setup area to assure that nothing could cause damage to the equipment during source exposure.
- 4.2.12 Drive cable connection: Connection of the drive cable assembly as described per the operating manual for the Amertest 660 Operation Manual, as follows:
  - 4.2.12.1 Cable layout: Lay out the control cables with no bend radii less than about 1m.
  - 4.2.12.2 Avoid any risk of crushing by falling objects, moving vehicles or closing doors, etc.

- 4.2.12.3 The drive cable control unit should be placed as far away from the source focal position as possible (preferably behind shielding).
- 4.2.12.4 Connect the drive cable to the source Projector as shown in fig. 5.7 (pictorial illustration) of the Amertest 660 Operations Manual.
- 4.2.12.5 Unlock with the key and turn the selector ring from LOCK to CONNECT. The storage cover will disengage from the Projector.
- 4.2.12.6 Slide the control cable collar back and open the jaws to expose the male portion of the swivel coupling (ie. the ball-end on the drive cable).
- 4.2.12.7 Press back the spring-loaded locking pin with a thumb nail and engage the male and female portions of the swivel coupling.
- 4.2.12.8 Release the locking pin and check that the connection is secure.
- 4.2.12.9 Close the jaws of the control cable connector over the swivel coupling.
- 4.2.12.10 Slide the control collar over the connector jaws.
- 4.2.12.11 NOTE: The drive cable connector, when properly installed with the selector ring in the CONNECT position, displaces anti-rotation lugs which allows the selector ring to be rotated to the LOCK position and when required, through to the OPERATE position.
- 4.2.12.12 Push and hold the control cable collar flush against the Projector connector and rotate the selector ring from CONNECT to LOCK.
- 4.2.12.13 Do not rotate past LOCK.
- 4.2.12.14 The drive cable connector is now locked into the Projector.
- 4.2.12.15 Keep the Projector in the LOCK position until ready to start the exposure.
- 4.2.13 Radiographic exposure:
  - 4.2.13.1 Guide tubes: Remove the shipping plug from the Projector and connect the source guide tube(s). DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 4.2.13.2 Projector survey: Check the operation of the survey meter by reading the radiation level at the surface of the Projector. It should read no more than 2 Sv/h (200 mR/h) except for the area just in front of the exit port when the shipping plug is removed.
  - 4.2.13.3 Note that the readings for verification of the source return after exposure. (Base Reading)
  - 4.2.13.4 Verify that the guide tube and drive cable are correctly connected.
  - 4.2.13.5 Ensure that no unauthorized personnel are inside the Restricted Area and that signs are posted and warnings are in operation.



- 4.2.13.6 CAUTION: Do not apply excess force to the control handle in the exposed direction as this could cause the source assembly to move forward out of the stored position when the lock slide is released.
- 4.2.13.7 Unlock: Use the key to unlock the Projector lock and rotate the selector ring to the OPERATE position. Ensure there is no tension force in either direction on the drive cable. Push the slide bar (green marking) laterally from left to right (as seen behind the Projector) until the slide bar (red marking) fully appears on the right side of the selector ring and you feel or hear the sleeve snap into slide. When the green marking is visible the source assembly is locked into the safely stored position within the Projector; when the red marking is visible the source assembly is free to be projected from/to the Projector. The source is now free to move.
- 4.2.13.8 Return to the drive control unit.
- 4.2.13.9 If an odometer is fitted, adjust the reset knob to read zero.
- 4.2.13.10 Project: Rapidly rotate the crank in the 'EXPOSE' direction (counterclockwise) to move the source out of the Projector to the radiographic focal position.
- 4.2.13.11 The hand crank will stop turning when the source reaches its stop. Do not use excessive force.
- 4.2.13.12 The odometer (if fitted) will indicate the approximate total distance traveled. (about 2.1m (7 ft) for each guide tube section).
- 4.2.13.13 Set the brake to ON to prevent movement of the source during exposure.
- 4.2.13.14 Calculate the exposure time from the moment when the source reaches its stop.
- 4.2.13.15 Survey: Survey meter readings observed during the projection operation should increase rapidly from background to a high level as the source emerges from the Projector. Then readings should fall sharply as the source enters a collimator (if used) and remain steady throughout the exposure.
- 4.2.13.16 The sequence of changes should be observed and the readings noted.
- 4.2.13.17 During source retractions the sequence will reverse.
- 4.2.13.18 Actual survey meter readings will depend on the source activity, distance, collimators and shielding. If necessary, extend the Restricted Area perimeter. Make notes of surveys and distances for the Daily Utilization Log.
- 4.2.13.19 The Radiographer shall have full observation or access control of the Restricted Area while the source is exposed.
- 4.2.13.20 At anytime that an unauthorized (unmonitored) person should enter the Restricted Area, the source will be immediately retracted and secured.
- 4.2.13.21 Retract: At the end of the required exposure time, set the brake to OFF and rapidly turn the crank in 'RETRACT' (clockwise) direction until the crank no longer moves. You



- should hear the slide bar "click" back into it's original position and observe the green marking on the slide bar.
- 4.2.13.22 Apply a slight amount of forward pressure on the crank handle as if to expose the source to insure that the positive locking mechanism has actuated. Allow the crank handle to return to a neutral position, thereby relieving any tension (force) on drive cable which would cause source movement when unlocking the camera. At this point the source cannot be moved out of the stored position.
- 4.2.13.23 In the unlikely event of the locking slide moves toward the lock position before the source is fully stored in the Projector, turn the hand crank in the "RETRACT" (clockwise) direction until the crank stops turning. (The lock slide is designed to lock on the stop ball, not the drive cable.) Do not use excessive force. The source will be in the Projector but not in the fully shielded position. Approach the Projector, from the rear, with a survey meter. The meter will read approximately 40 mR/hr at the rear plate of the Projector when a 100 Ci source is in use.
- 4.2.13.24 CAUTION: Remain clear of the front of the Projector to minimize personal exposure. Reset the lock slide to the open position. Return to the control and turn the hand crank in the retract (clockwise) direction and store the source in the normal manner.
- 4.2.13.25 The odometer (if supplied) should read approximately zero when the source assembly has returned to the Projector.
- 4.2.13.26 The survey meter should indicate a continually increasing radiation level as the source retracts, then drop to background when the source is stored in the Projector.
- 4.2.13.27 Check survey: Approach the Projector with the survey meter, observe the green marking on the slide bar and survey it on all sides. The meter should indicate the same radiation level as observed before the exposure. Note particularly the exit port reading.
- 4.2.13.28 Survey the entire source guide tube with the survey meter. If the meter shows a sharp increase, the source is exposed or incompletely shielded.
- 4.2.13.29 If the source is still exposed, attempt to store it properly by cranking the source a short distance toward the source stop and retracting it, repeating if necessary.
- 4.2.13.30 If the source cannot be fully retracted after several attempts, treat the situation as an EMERGENCY.
- 4.2.13.31 If there are more exposures to be taken, rotate selector ring to the LOCK position. Setup the new exposure and proceed from 4.2.8 above. If your exposures are complete or you have to leave the direct supervision of the restricted area, proceed below.
- 4.2.13.32 Lock Projector: When the source is properly stored in the Projector, rotate the selector ring from the OPERATE position to the LOCK position.
- 4.2.13.33 WARNING: If after several attempts to return the source, the selector ring cannot be rotated to the lock position (do

not use excessive force) or the lock slide is not actuated, one must suspect an accident in which the source could have become disconnected or stuck outside the Projector, giving rise to a very high radiation field. Treat the situation as an EMERGENCY!

- 4.2.14 Dismantling equipment:
  - 4.2.14.1 Guide tubes: Unscrew the source guide tube sections. Screw the shipping plug into the Projector guide tube connector.
  - 4.2.14.2 Drive control unit: Unlock the Projector and then rotate the selector ring from LOCK to CONNECT. The safety control connector will partially disengage.
  - 4.2.14.3 Disengage the drive control unit from the Projector by reversing the sequence of actions described in section 4.2.12.
  - 4.2.14.4 Replace and hold the storage cover on the Projector connector and rotate the selector ring to the LOCK position.
  - 4.2.14.5 Remove the key and push in the lock to secure the Projector.
  - 4.2.14.6 Check the entire circumference of the Projector with the survey meter to ensure the source is properly secured.
- 4.2.15 Load everything back up on to the two wheel cart and take it back to the Cell. Put things in their proper place. Lock Projector in its storage cabinet. Survey the Cell. Lock the Cell. Secure keys with the Radiation Safety Officer.
- 4.2.16 Record all information on the Daily Utilization Log.

## 5 INSPECTION AND MAINTENANCE REQUIREMENTS:

- 5.1 Projectors and associated equipment must be maintained regularly to ensure consistent and safe operation.
- 5.2 Equipment should be completely serviced after it has been subjected to severe conditions (eg. Immersed in water or mud, in a sand storm, dropped, etc.).
- 5.3 Daily Inspection:
  - 5.3.1 Survey all sides of the Projector for excessive radiation readings. [No reading shall exceed 200 mR/hr. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
  - 5.3.2 Inspect Projector for visible damage.
  - 5.3.3 Inspect drive cable housing for cuts, dents and broken or worn fittings. Ensure that the 'available length of drive cable is greater than the total length of the guide tubes (plus source stop) to be used. DO NOT connect more than three (3) guide tubes together and ALWAYS use the source stop "probe" or preferably the collimator.
  - 5.3.4 Inspect the source guide tubes for obstructions, cuts, dents (or signs of crushing) and heat damage. Inspect fittings for same, but inspect female 'swivel' coupling for freedom of movement.
  - 5.3.5 During the course of radiographic activities, check the general operation of the Projector. Check that the selector ring, slide bar, lock mechanism and crank assembly moves freely and the characterizations of their movements have not changed significantly.
  - 5.3.6 If when cranking out the source and you encounter excessive resistance, return the source to it's stored/shielded position. Survey and check that the slide bar is set on green to assure proper source shield position. Investigate the reason for the resistance, ie., too tight of bend radius in drive cable housings and/or source guide tubes, and correct situation.
  - 5.3.7 If excessive resistance is still encountered, do not force the exposure. Store source properly in its stored/shielded position (survey) and perform maintenance on all components as outlined below. [5.4 Quarterly Maintenance.] Take unit out of service until such maintenance is conducted and is check for proper operation. Contact the Radiation Safety Officer about the situation and inform him of the cause of the failure.
  - 5.3.8 Record all information on the Daily Utilization Log.
- 5.4 Quarterly maintenance:
  - 5.4.1 Clean (if necessary), inspect and maintain the drive cable assembly.
  - 5.4.2 Clean (if necessary) and inspect the source guide tubes.
  - 5.4.3 Clean (if necessary) and inspect the Projector for wear or obvious damage. Report to the Radiation Safety Officer any defect which might effect safe operation and withdraw it from service until repairs can be effected.
  - 5.4.4 See that the radioisotope warning labels are secure and legible. Do not cover with any other labels.
  - 5.4.5 Check that the source outlet shipping plug is in place and that the screw and nut turn freely, but are not loose.

- 5.4.6 Check for wear in the cable connector using the NO GO gauge. There are four NO GO tests -- ball diameter; ball shank; slot width; and connector gap width.
- 5.4.7 Any component that fail any of these tests, must be replaced before it can be used. Withdraw unit from service and contact the Radiation Safety Officer.
- 5.4.8 Check that the selector ring and lock mechanism operate freely. If operation is faulty, withdraw unit from service and notify Radiation Safety Officer.
- 5.4.9 If for any reason that you feel that a Projector or it's components are not or will not operate properly or safely; withdraw it from service, label it "DO NOT USE" and report it to the Radiation Safety Officer promptly.
- 5.4.10 Record on the Daily Utilization Log in the "comments" section that this maintenance procedure was performed on that date.
- 5.4.11 Other maintenance and/or repairs to the 660 Projector (or components) will not be performed by Niles Steel Tank Company personnel, except that in the case that the Radiation Safety Officer determines that in the unlikely event that the locking assembly needs additional lubrication. This can only be done if there is an empty source changer on hand (during source changes) and is only to be performed by the Radiation Safety Officer.
- 5.4.12 All other repairs will be completed by the Manufacturer, or his representative, by qualified personnel.

## 6 INTERNAL INSPECTION AND MANAGEMENT CONTROL

### 6.1 Audits of radiographic personnel:

6.1.1 There shall be quarterly audits of the Radiographic Operations, Radiographer's Assistant and Radiographers.

6.1.1.1 Radiography Operations will be reviewed by the Radiation Safety Officer to insure that the Operating and Emergency Procedures, proper safety techniques and ALARA, etc. are being performed. The Radiation Safety Officer will use a checklist to document these audits.

6.1.2 If a Radiographer or an Assistant has not performed radiography in a period of three (3) months, he shall be reexamined before he may perform radiography.

### 6.1.3 Audits of the Radiation Safety Officer:

6.1.3.1 Audit of the Radiation Safety Officer will be performed by management personnel trained in the auditing procedure described in 3.7 of this Manual.

6.1.3.2 The audit will be performed from a checklist of the Radiation Officer's responsibilities. A comprehensive review of documents required by this Manual and 10 CFR will also be included on this checklist. [see Exhibits; Radiation Safety Officer Audit Checklist]

6.1.3.3 The Auditor will not actually be engaged in the radiographic functions performed, but only as an observer.

6.1.3.4 Audits will be performed annually.

6.1.3.5 The person responsible for auditing the Radiation Safety Officer is: James A. Coleman, President/Owner of Niles Steel Tank Company.

### 6.2 Deficiencies and Corrective Action:

#### 6.2.1 Deficiencies found during a Quarterly Audits:

6.2.1.1 If a person is found deficient in their duties during an audit, he will be instructed about his deficiencies.

6.2.1.2 The Radiation Safety Officer may require a more comprehensive examination or more closely monitor this person while performing their duties.

### 6.3 Intentional Violations:

6.3.1 Intentional violations of this Radiography Operating Manual, Emergency Procedures, NRC requirements by radiography personnel will undergo disciplinary action.

6.3.2 Severity of the violations will be a judgment of the Radiation Safety Officer and his employer.

6.3.3 Violations and disciplinary action will be recorded and will be maintained a minimum of 5 years.

6.4 Violations that require NRC notification will be performed as prescribed in 10 CFR Part 21.

6.5 Internal inspection and management control shall be the responsibility of the Radiation Safety Officer.



6.6 Radiation Safety Officer: Robert H. Wood

6.7 Duties of the Radiation Safety Officer are as follows:

- 6.7.1 Conduct the Training Program.
- 6.7.2 Quarterly audits of Radiographers' and Radiographer Assistants' performances to assure they are performing their duties in the prescribed manner.
- 6.7.3 Review radiographic operations to determine that all persons involved are performing their duties as prescribed by this manual and current 10 CFR Regulations.
- 6.7.4 Review personal monitoring records. Assuring that the occupational dose limits are within the limits described in 10 CFR Part 20, Subpart C.
- 6.7.5 Review Daily Utilization Logs.
- 6.7.6 Quarterly Inventory of sealed sources.
- 6.7.7 Review of Calibration Records for Pocket Dosimeters, Survey Meters and Alarming Ratemeters and to make sure that the instruments are current and documented as to their required calibration intervals.
- 6.7.8 Supervise receipt and return of Radioactive Packages and the records of such.
- 6.7.9 Review of Quarterly Maintenance Records and to make sure that equipment is current as to the frequency of such.
- 6.7.10 On an annual basis; review the NRC License, current CFR, Niles Steel Tank Company's Radiographic Operations Manual, etc. to make sure that Niles Steel Tank Company radiography program is current.
- 6.7.11 On periodic basis review radiographic operations to determine that all personnel are performing their duties as prescribed.
- 6.7.12 At anytime: Halt the duties of any personal when his pocket dosimeter has been discharged off-scale. This persons film badge will be immediately be sent (overnight) for processing. This person will not perform any radiographic "hot" (not to be allowed in a Restricted Area) functions until the result of his film badge is returned.
- 6.7.13 At anytime: Halt the duties of radiography personnel if he is not performing in accordance to this manual, defeating safety and security systems, or knowingly making misrepresentations.

6.8 Personal Monitoring:

- 6.8.0.1 The Radiographer is responsible for changing of film badges and presenting the dosimeter reports to the Radiation Safety Officer for his review.
- 6.8.0.2 Film badges are the type "G" as supplied by R.S. Landauer Company, N.V.L.A.P. accredited.
- 6.8.0.3 Film badges are replaced and processed biweekly.
- 6.8.0.4 It is the responsibility of each monitored individual to be using the current film badge. It is the responsibility of the Radiation Safety Officer (or his delegate) to collect the film badges at expiration, and send them in for processing.
- 6.8.0.5 The reports of the film badge dosages shall be reviewed by the Radiation Safety Officer.

6.8.0.6 The Radiation Safety Officer shall halt any "hot" activities of any personnel that accumulated dosages that reach or exceed the dosage parameters set forth by 10 CFR Part, Subpart C. The Radiation Safety Officer will make required notifications and reports as provided in 10 CFR 20.2202 and 20.2203.

6.8.0.7 Film badge reports will be filed until which time the NRC authorizes their disposal.

6.9 Utilization Log:

6.9.1 A log (NST/R1) of radiographic functions shall be kept by radiographic personnel.

6.9.2 Radiography personnel are instructed to fill in the spaces as follows:

6.9.2.1 Date of exposures(s) that were taken.

6.9.2.2 Mark if either the exposures were taken inside the Cell or outside, in the plant area.

6.9.2.3 Source strength.

6.9.2.4 Survey meter readings before entering Cell.

6.9.2.5 Number of exposures taken - time of each exposure - serial number or identification of article radiographed.

6.9.2.6 Surveys performed during exposure.

6.9.2.7 Pocket dosimeter readings at start of shift and end of shift.

6.9.2.8 Fill out the daily inspection report questions (bottom half of form NST/R1); YES?/NO?

6.9.2.9 Indicate that all equipment is has been locked and secured.

6.9.2.10 Cell survey reading before Cell door is locked.

6.9.2.11 Signatures of radiographic personnel attesting to the above.

6.10 Quarterly Inventory:

6.10.1 Each quarter of the year, the Radiation Safety Officer shall list the following information, which will be kept on record for review:

6.10.1.1 Isotope of the sealed source.

6.10.1.2 Source activity at the time of the inventory.

6.10.1.3 Serial number of the source.

6.10.1.4 Location of the source.

6.10.1.5 Date of inventory.

6.11 Instrument Calibration:

6.11.1 The Radiographer is responsible for sending out the survey meters for calibration to Amersham Corporation, upon reaching their calibration due date. He will also assure that proper documentation accompanies the meter when it has returned from Amersham.

6.11.2 The Radiation Safety Officer will verify that a file of this documentation is properly completed.

6.12 Training Program:

6.12.1 It is the duty of the Radiation Safety Officer to initiate and/or conduct the training. He may designate responsibility to the radiographer as required. The Radiation Safety Officer will conduct all personnel qualification examinations.

## 7 LEAK TESTING:

- 7.1 Under normal circumstances source are not retained at Niles Steel Tank Company for more than six months, by which leak testing is not required.
- 7.2 If a source is retained for six months or more, a leak test will be performed per 10 CFR 34.25. Under such conditions the Radiographer shall use a Amersham 518 Leak Test Kit and perform the test in accordance with instruction provided with the test kit.
  - 7.2.1 Remove the shipping plug from the Projector and survey the source exit port. This is the nearest accessible point to the source. You will want to swab this port, but this is where the highest amount of radiation is exiting the Projector. Keep exposure time to a minimum at this port.
  - 7.2.2 After thoroughly wiping the source exit port with the swab, as described in the kit instructions. Place the swab and the applicator stick in the plastic bag without touching any part of your body or clothing because of possibility of radioactive contamination on the swab.
  - 7.2.3 Replace shipping plug into Projector.
  - 7.2.4 Take bagged swab out of the Cell and to an area where there is no radioactive source emissions. Make sure (operable) survey meter is reading zero and slowly bring swab close to the front right corner of the survey meter. If the survey meter remains reading zero, seal bag with staples or tape. Fill out the leak test form with the required information and send the complete leak test kit to Amersham for radioassay.
  - 7.2.5 If the survey meter reading rises off of zero, take the bagged swab back into the Cell and secure. Take Projector and all other components that were used with this Projector out of service, and tag them "DO NOT USE". Contact the Radiation Safety Officer promptly.
  - 7.2.6 The Radiation Safety Officer will then evaluate the situation and contact Amersham (source manufacturer) as to the next course of action to be taken. If radioassay readings exceed 0.005 uCi the requirements of 10 CFR 34.25(d) will be imposed.
  - 7.2.7 The contaminated equipment shall not be put back into service until which time the radioassay of the swab reveals that the amount of contamination is acceptable or the Projector and effected components were decontaminated by Amersham or their representative.
  - 7.2.8 Records of leak test results shall be maintained three years.
  - 7.2.9 All of the above operations shall be verified by the Radiation Safety Officer.

## 8 EMERGENCY OPERATING PROCEDURES:

### 8.1 An emergency shall be constituted in the event of the following:

- 8.1.1 The disconnection of a source outside of the stored/shielded position in the Projector.
- 8.1.2 The loss or theft of a source, Projector or source changer.
- 8.1.3 If the source will not completely return to its stored/shielded position in the Projector, after several attempts. [Notify Radiation Safety Officer if there are any problems regarding the return of a source to it's stored/shielded position on the first attempt.]
- 8.1.4 A Projector or source changer emitting excessive radiation, ie., 200 mR/hr at any surface or 10 mR/hr at one meter.
- 8.1.5 Any signs of external contamination on a source changer or Projector after receipt from the carrier.

### 8.2 The Emergency Operating Procedures are as follows:

- 8.2.1 Immediately, but calmly evacuate surrounding personnel until the Restricted Area perimeters can be established. Keep your own exposure as low as possible!
- 8.2.2 Establish Restricted Area and rope off boundaries. If necessary, post guards at the boundaries (entrust them only after explaining the full 'gravity' of the situation) if you have to leave full control of the emergency area; when contacting the Radiation Safety Officer or proceeding with other safety related activities concerning the Emergency.
- 8.2.3 Notify the Radiation Safety Officer promptly (if not at work, his home address and phone number are as follows):

Robert H. Wood      683-9182  
1505 Valley View Drive  
Niles, Mi.

- 8.2.4 At no time shall the Radiographer try to retrieve or attempt to place a disconnected source in it's shielded position. Qualified personnel will conduct this operation.
- 8.2.5 Maintain direct surveillance and control over the area. If a emergency occurs in the Cell, lock Cell door and post a warning "Emergency - Do Not Enter" over the lock.
- 8.2.6 If possible (and as soon as possible), write down the events that caused the emergency. This information could be quite beneficial for the location and retrieval procedure.
- 8.2.7 In the case of a Projector or source changer that is emitting excessive radiation or has indications of contamination, or has damage that would give indications that the unit could not operate properly, or that the integrity of the shield or the safety mechanisms are disabled:
  - 8.2.7.1 Immediately move this unit into the Cell and place within the Exposure Area, survey to make sure that the Restricted Area does not have to be increased; if so, do so. Lock door

and post notice over the Cell door lock "Emergency - Do Not Enter".

- 8.2.7.2 Contact the Radiation Safety Officer so he can make the proper responses and reports to the NRC.
- 8.2.7.3 Required reports will be filed per 10 CFR Part 21, 10 CFR 30.50, 10 CFR 34.30 and over exposures will be reported in pursuant to 10 CFR 20.2202 and 20.2203.



## 9 SURVEY METERS, POCKET DOSIMETERS, FILM BADGES AND ALARMING RATEMETERS: (PROCEDURES)

### 9.1 Survey meters

- 9.1.1 Survey meters shall be operable and calibrated before they may be used.
- 9.1.2 If a survey meter is not operating properly, no radiographic operations may be performed. Report this situation to the Radiation Safety Officer.
- 9.1.3 Survey meters are to be sent out every three months from the last calibration date for calibration (used or not) as described in 2.0 of this manual.
- 9.1.4 Victoreen Model 492:
  - 9.1.4.1 Turn switch to the battery check position.
  - 9.1.4.2 Meter should move on scale to area marked as 'battery Check'.
  - 9.1.4.3 If battery strength is adequate, as indicated by the meter, move the switch to the desired range.
  - 9.1.4.4 If battery is inadequate:
    - 9.1.4.4.1 Turn off meter.
    - 9.1.4.4.2 Remove cover.
    - 9.1.4.4.3 Remove old batteries.
    - 9.1.4.4.4 Replace with fresh batteries.
    - 9.1.4.4.5 Reassemble meter.
    - 9.1.4.4.6 (Return to 9.1.4.1)
  - 9.1.4.5 Check to see if the survey is operating in reaction to radiation; approach the Projector and survey surface. If the survey meter does not respond, do not use. [Even an empty 660 Projector emits about 2.5 mR/hr at the surface.] If you feel that you aren't getting a proper response from the survey meter, check the previous Daily Utilization Logs in regards to Projector base readings and verify your readings. If another survey meter is available you can verify reading between the two of them.
  - 9.1.4.6 If you find a survey meter to be unresponsive to radiation or responding incorrectly, tag and take the unit out of service. Contact Radiation Safety Officer so he can evaluate the situation and arrange for the unit to be replaced, repaired and/or calibrated.

### 9.2 Victoreen Model 541 (0-200 mR range) direct reading Pocket Dosimeters:

- 9.2.1 Place dosimeter on charger and reset as close to zero as possible and the beginning of the day or before conducting radiographic functions.
- 9.2.2 Log your charged dosimeter reading, recharge if reading is 10 mR or above.
- 9.2.3 Wear your dosimeter on clothing that will not be removed during radiographic procedures.

- 9.2.4 It is advised to check dosimeter readings at various intervals while performing radiographic activities.
  - 9.2.5 Remove and log your dosimeter readings after all radiographic procedures are completed for the day.
  - 9.2.6 If your dosimeter has gone off scale, while performing radiographic activities. Immediately stop radiographic functions, except securing and storing the source, Projector, etc. Report directly to the Radiation Safety Officer, so that your film badge can be immediately sent for processing.
- 9.3 Alarming Ratemeters:
- 9.3.1 Ratemeters shall be used while conducting radiographic operations outside of the Cell.
  - 9.3.2 Dosimeter Corporation Model No. 1888B:
    - 9.3.2.1 Turn on Ratemeter. After a few second the Ratemeter will emit a short "beep" indicating that it is operational
    - 9.3.2.2 Place Ratemeter on clothing that will not be removed during the course of radiographic functions.
    - 9.3.2.3 A solid tone from the rate meter signifies that you are in a very high radiation field. You may here this sometimes when you are cranking in or out the source to the focal point.
  - 9.3.3 Dosimeter Corporation Model No. 33
    - 9.3.3.1 Turn on Ratemeter. Push the "Test" button. If a tone sounds the Ratemeter is operational.
    - 9.3.3.2 Place Ratemeter on clothing that will not be removed during the course of radiographic functions.
    - 9.3.3.3 A solid tone from the rate meter signifies that you are in a very high radiation field. You may here this sometimes when you are cranking in or out the source to the focal point.
  - 9.3.4 The main purpose of the Ratemeter is for a secondary warning device in case that a survey meter has become inoperable during an exposure and the source is not completely in its safe/shielded position. It is also a measure to warn a Radiographer that there is an exposed source, because he or his assistant did not survey properly.
  - 9.3.5 Alarming Ratemeters shall be calibrated annually.
- 9.4 Film Badges:
- 9.4.1 R.S. Landauner type "G" film badges will be worn on clothing that will not be removed during radiographic procedures.
  - 9.4.2 Film Badges will be returned to Landauner (N.V.L.A.P. accredited) biweekly for processing.
  - 9.4.3 The Radiation Safety Officer will review the reports when they are received.
  - 9.4.4 At anytime that a pocket dosimeter is totally discharged while performing radiographic functions, this person's film badge will be immediately sent for processing.

**10 RECEIPT, CHANGING AND SHIPPING OF SOURCES IN SHIPPING PACKAGES:  
(T/O 650L, AMERTEST 650L SOURCE CHANGER & AMERTEST 660 PROJECTOR)**

**10.1 Receipt of shipping package:**

- 10.1.1 Upon receipt of the Shipping Package, before removal from the possession of the final delivering carrier, a survey reading shall be taken of all external sides to assure that the source is properly stored in it's shield. Readings should be below 200 mR/hr and less than 10 mR/hr at one meter at an surface. If radiation levels exceed 200 mR/hr at any surface or 10 mR/hr at one meter from any surface, the shipping package shall be immediately removed from the carrier by the Radiation Safety Officer (preferably) or the Radiographer, if the Radiation Safety Officer is not immediately available. [THIS CONSTITUTES AN EMERGENCY.] Quickly and safely put the Shipping package into the Cell, post and secure, and extend the Restricted Areas if necessary. The appropriate regional office of the NRC is to be immediately contacted by telephone, along with the final delivering carrier and Amersham Corporation (source vendor).
- 10.1.2 At any time there is a discrepancy in the Shipping Package, such as severe damage, radioactive contamination, abnormally high survey readings, violations of shipping seals and locks, or mismarking; the Radiation Safety Officer shall be notified immediately. The shipping package shall be secured in the Cell, monitored and not moved until the discrepancies are resolved by the Radiation Safety Officer.
- 10.1.3 The Radiation Safety Officer will file the necessary reports and notifications as required by 10 CFR 20.1906, 20.2202, 20.2203, 10 CFR Part 21, 10 CFR 30.50, 10 CFR 34.30; respectively.

**10.2 Removal of old source from Projector: (The instructions herein do not supersede the instructions provided with the T/O 650L - Amertest 650L source changer. Follow the instructions provided with the source changer; if there are any discrepancies, consult the Radiation Safety Officer.)**

- 10.2.1 Changing of source shall be performed in the Cell. An operable, calibrated survey meter should always be at the Radiographer's side. Entrances, surveys, safety procedures, etc. are still enforced as previously stated.
- 10.2.2 Locate the source changer so that one (1) section of guide tube reaches between the fittings on the Projector and the source changer. Remove the source changer cover. Fasten the guide tube to the EMPTY chamber of the source changer. The EMPTY chamber of the source changer is now your source stop.
- 10.2.3 Crank (expose) the source from the Projector until it stops in the empty chamber of the source changer.
- 10.2.4 Unlock and reenter Cell with survey meter, surveying the Projector first, then the source guide tube then the source changer. Assure that the sources are stored/shielded properly in the source changer. Open source guide clamps to see that only the connector portion of the pigtail is exposed.
- 10.2.5 Disconnect the old source from the drive cable, being careful not to accidentally extract the source from it's stored/shielded position in the source changer. After disconnection, push the connector downward to make sure the source is in the full stored/shielded position (as far as it will go).

- 10.2.6 Survey to make sure that the source changer is not emitting excessive radiation, no more than 200 mR/hr at any surface.
- 10.2.7 [This is a good time to do your Quarterly Maintenance on the Projector.]
- 10.3 Installation of a new source:
  - 10.3.1 Remove shipping cap and hold down from the channel holding the new source. Open source channel guides. Connect the source guide tube to this channel and connect the drive cable to the new source pigtail
  - 10.3.2 Close the source guides. Exit the Cell, lock and control as usual. Crank the control cable to retract the new source into the Projector.
  - 10.3.3 Survey the Projector to assure that the source is in it's properly stored/shielded position. [No reading shall exceed 200 mR/hr from any surface. THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!] Check that the slide bar reads green.
  - 10.3.4 Remove old source identification plate from the Projector and install it to the "old source" channel of the changer. Affix new source identification plate to the Projector.
  - 10.3.5 Replace the source changer covers. Tighten bolts, lock and seal with the tamperproof seals provided.
  - 10.3.6 If shipping the 660 (with or without a source) attach a tamperproof seal through the shipping plug and secure the Projector in a rigid enclosed skid/crate to minimize damage that could be incurred during shipping. This action will minimize having to repair or replace warning signs, identification labels, etc.
  - 10.3.7 Survey all sides of the source changer. [No reading shall exceed 200 mR/hr or 10 mR/hr at one meter; THIS IS AN EMERGENCY! CONTACT THE RADIATION SAFETY OFFICER IMMEDIATELY!]
- 10.4 Return of old source:
  - 10.4.1 Appropriate D.O.T. Radioactive Yellow shipping labels will be affixed to the shipping container (T/O 650L, Amertest 650L) or "Contents Contains" (and appropriate) Radioactive Yellow labels on the outermost package (660 Projector).
  - 10.4.2 D.O.T. shipping labels inform of the following:
    - 10.4.2.1 Isotope
    - 10.4.2.2 Strength of source contained
    - 10.4.2.3 Transport Index - mR/hr reading @ one meter. [No reading shall exceed 200 mR/hr or 10 mR/hr at one meter.]
  - 10.4.3 When shipping the Amertest 660 with a source in it. You must mark the outer crate with the following:
    - 10.4.3.1 "Inside Package Complies With Prescribed Specifications USA/9033/B(U) Type B - Which contains Special Form, n.o.s., UN2974 Iridium 192 (activity & Transport Index)."
    - 10.4.3.2 The appropriate D.O.T. Radioactive Yellow Labels which will note the isotope, activity and T.I., and will be applied on at least two sides of the outer crate.



- 10.4.3.3 In addition to the above, the 660 (inside the crate) will have the D.O.T. Radioactive Yellow labels on it describing the source contents, activity and T.I.
- 10.4.4 When shipping a Shipping Package (T/O 650L, Amertest 650L or Amertest 660) that does not contain a source you must attach an "EMPTY" labels on the shipping containers. You will still have to classify the 650L or 660 as "Radioactive II" because of the D-Uranium shielding materials inside of the units.
  - 10.4.4.1 The crate containing the 660 shall be marked "Radioactive Materials, D-Uranium Shielding Material Only, LSA, n.o.s., UN2912" and "Inside Package Complies With Prescribed Specification, USA/9033/B(U), Type B (EMPTY)".
  - 10.4.4.2 The Bill Of Lading will contain the required information per CFR 49. (Including the Emergency Phone Number.)
- 10.4.5 The transportation of the shipping package will be scheduled with a qualified commercial trucking company. Niles Steel Tank Company will visibly assure that the pickup driver (by reviewing his C.D.L.) is qualified to receive hazardous materials.
- 10.4.6 Loading of the shipping package shall be observed by radiographic personnel.
- 10.4.7 All receiving and shipments shall be in strict accordance with 10 CFR Part 71 (for Special Form sources and Type B(U) Shipping Containers).
- 10.4.8 When the shipping container (and old source) is returned to Amersham Corporation. A copy of the original Bill Of Lading will be mailed to the Consignee (Amersham Corporation) to alert them that a radioactive package is on route to them. Amersham will then, after receipt of the shipping package, acknowledge the receipt of the shipping package and contents within.
- 10.4.9 Record all functions of receipt, source changes and shipments of Radioactive Packages on the (special) Form NST/R1 "Source Change" and attach all documentation with this form for review of the NRC Inspector.



APPENDIX B

INSTRUCTIONS FOR POSITIONING SOURCE IN CELL

*The walls of the Cell are described as follows:*

Wall "A" = North wall is constructed of 12" concrete block (.0125 attenuation factor)

Wall "B" = East wall is constructed of 24" concrete block (.00016 attenuation factor)

Wall "C" = South wall is constructed of 24" concrete block (.00016 attenuation factor)

Wall "D" = West wall is constructed of 24" concrete block, including split section (.00016 attenuation factor)

- The collimator shall be used whenever possible. The port side ( $30^{\circ}$  x  $60^{\circ}$ ) shall not be pointed at Walls "C" and "D" unless the collimator is at least four feet away, three feet away from Wall "B".
- The collimator port should not be pointed at the ceiling whenever possible. If this case should arise, consult Chart "A". For maximum source exposure times.
- Unless otherwise instructed by Radiation Safety Officer, unshielded (uncollimated) source exposures and panoramic vessel exposures must stay within the orange lines painted on the floor and below the orange diagonal lines painted on the walls. This is the "Exposure Area". Use Chart "A" to find the maximum time allowable that the source can be exposed in a hour's time. {This is to limit the roof from being a High Radiation Area}
- If for any reason the above cannot be adhered to, contact the Radiation Safety Officer for further instructions and calculations.
- See Appendix A for dimensions of the boundaries of the exposure area.
- In all cases, in panoramic exposures (uncollimated) exposures, with the strict adherence to Chart "A" and the correct minimum distances to the walls, the radiation levels through the walls will be quite minimal.

## ROOF RADIATION PROTECTION

### CHART "A" EXPLANATION

- \* Chart "A" is a spread sheet showing the intensity rates at a minimum of 12 feet, from the roof at given curie strengths, from the source. Also shown, are shielding effects of different thickness of steel (tanks) which are commonly produced at Niles Steel Tank Company. Shown with these intensity rates (mR/min) are the maximum allowable source exposure times (single or multiple) in one hour's time.
- \* If the Radiographer cannot use the collimator (to protect the roof area) or has a "panoramic" exposure, he shall use this chart to determine his maximum allowed exposure time per hour.
- \* In the case that film exposure time calculations exceed the maximum allowable times as shown on Chart "A", the Radiographer shall contact the Radiation Safety Officer. The Radiation Safety Officer will then recalculate the planned exposure to the roof area using more precise values. These calculation may appear on the backs of the pages of the Daily Utilization Log.
- \* Note: Chart "A" does not take in account of the shielding factor of the metal roof or use the allowable extra distance of 30 cm. from the surface of the roof. Also Chart "A" uses the old R/hr of 5.9 R/hr @ one foot per curie of Iridium 192. The new accepted value is actually 5.2 R/hr @ one foot per curie of Iridium 192.
- \* If the Radiation Safety Officer cannot attain a <100 mR/hr dose for the roof (30 cm from the surface), it will become a High Radiation Area. The area will be posted and the area will be provided with constant surveillance, so that no person shall enter this area while these exposures are being performed.

Curies  
Max.

Attenuation Factor 1.00

.90

.77

.66

.54

.43

.3

.26

.21

.16

.08

	Minimum Source to Roof Nominal Vessel Thickness	(@ 12 Ft.) No Shield	(@ 12 Ft.) 10 Ga.	(@ 12 Ft.) 1/4"	(@ 12 Ft.) 3/8"	(@ 12 Ft.) 1/2"	(@ 12 Ft.) 3/4"	(@ 12 Ft.) 1"	(@ 12 Ft.) 1 1/8"	(@ 12 Ft.) 1 1/4"	(@ 12 Ft.) 1 1/2"	(@ 12 Ft.) 2"
120	4916.67 mR/hr. Total Exposure Time allowed per hour...	81.94 mR/min. 1 min.	73.75 mR/min. 1 min. 20 sec.	63.09 mR/min. 1 min. 30 sec.	54.08 mR/min. 1 min. 50 sec.	44.25 mR/min. 2 min. 15 sec.	35.24 mR/min. 2 min. 50 sec.	24.58 mR/min. 4 min.	21.30 mR/min. 4 min. 40 sec.	17.21 mR/min. 5 min. 50 sec.	13.11 mR/min. 7 min. 40 Sec.	6.56 mR/min. 16 min.
110	4506.94 mR/hr. Total Exposure Time allowed per hour...	75.27 mR/min. 1 min. 20 sec.	67.74 mR/min. 1 min. 20 sec.	57.95 mR/min. 1 min. 40 sec.	49.68 mR/min. 2 min.	40.64 mR/min. 2 min. 30 sec.	32.36 mR/min. 3 min.	22.58 mR/min. 4 min. 20 sec.	19.57 mR/min. 5 min. 15 sec.	15.81 mR/min. 6 min. 20 sec.	12.04 mR/min. 8 min. 20 sec.	6.02 mR/min. 16 min.
100	4097.22 mR/hr. Total Exposure Time allowed per hour...	68.42 mR/min. 1 min. 20 sec.	61.58 mR/min. 1 min. 30 sec.	52.69 mR/min. 1 min. 45 sec.	45.16 mR/min. 2 min.	36.95 mR/min. 2 min. 45 sec.	29.42 mR/min. 3 min. 20 sec.	20.53 mR/min. 4 min. 50 sec.	17.79 mR/min. 5 min. 30 sec.	14.37 mR/min. 7 min. 08 sec.	10.95 mR/min. 9 min.	5.47 mR/min. 16 min.
90	3687.50 mR/hr. Total Exposure Time allowed per hour...	61.58 mR/min. 1 min. 30 sec.	55.42 mR/min. 1 min. 40 sec.	47.42 mR/min. 2 min.	40.64 mR/min. 2 min. 30 sec.	33.25 mR/min. 3 min.	26.48 mR/min. 3 min. 50 sec.	18.47 mR/min. 5 min. 30 sec.	16.01 mR/min. 6 min. 15 sec.	12.93 mR/min. 7 min. 45 sec.	9.85 mR/min. 10 min.	4.93 mR/min. 20 min.
80	3277.78 mR/hr. Total Exposure Time allowed per hour...	54.74 mR/min. 1 min. 50 sec.	49.27 mR/min. 2 min.	42.15 mR/min. 2 min. 20 sec.	36.13 mR/min. 2 min. 45 sec.	29.56 mR/min. 3 min. 25 sec.	23.54 mR/min. 4 min. 20 sec.	16.42 mR/min. 6 min. 15 sec.	14.23 mR/min. 7 min. 8 sec.	11.50 mR/min. 9 min.	8.76 mR/min. 12 min. 30 sec.	4.38 mR/min. 25 min.
70	2868.06 mR/hr. Total Exposure Time allowed per hour...	47.90 mR/min. 2 min.	43.11 mR/min. 2 min. 15 sec.	36.88 mR/min. 2 min. 45 sec.	31.61 mR/min. 3 min. 10 sec.	25.86 mR/min. 3 min. 50 sec.	20.60 mR/min. 4 min. 50 sec.	14.37 mR/min. 7 min.	12.45 mR/min. 8 min.	10.06 mR/min. 10 min.	7.66 mR/min. 13 min.	3.83 mR/min. 25 min.
60	2458.33 mR/hr. Total Exposure Time allowed per hour...	41.05 mR/min. 2 min. 25 sec.	36.95 mR/min. 2 min. 45 sec.	31.61 mR/min. 3 min.	27.10 mR/min. 3 min. 40 sec.	22.17 mR/min. 4 min. 30 sec.	17.65 mR/min. 5 min. 30 sec.	12.32 mR/min. 8 min.	10.67 mR/min. 9 min.	8.62 mR/min. 11.5 min.	6.57 mR/min. 15 min.	3.28 mR/min. 30 min.
50	2048.61 mR/hr. Total Exposure Time allowed per hour...	34.21 mR/min. 2 min. 50 sec.	30.79 mR/min. 3 min. 15 sec.	26.34 mR/min. 3 min. 50 sec.	22.58 mR/min. 4 min. 25 sec.	18.47 mR/min. 5 min. 20 sec.	14.71 mR/min. 6 min. 45 sec.	10.26 mR/min. 9 min. 45 sec.	8.89 mR/min. 11 min.	7.18 mR/min. 14 min.	5.47 mR/min. 18 min.	2.74 mR/min. 36 min.
40	1638.89 mR/hr. Total Exposure Time allowed per hour...	27.37 mR/min. 3 min. 30 sec.	24.63 mR/min. 4 min.	21.07 mR/min. 4 min. 45 sec.	18.06 mR/min. 5 min. 30 sec.	14.78 mR/min. 6 min. 45 sec.	11.77 mR/min. 8 min. 30 sec.	8.21 mR/min. 12 min.	7.12 mR/min. 14 min.	5.75 mR/min. 17 min.	4.38 mR/min. 22 min.	2.19 mR/min. 45 min.
30	1229.17 mR/hr. Total Exposure Time allowed per hour...	20.53 mR/min. 4 min. 45 sec.	18.47 mR/min. 5 min. 30 sec.	15.81 mR/min. 6 min. 30 sec.	13.55 mR/min. 7 min. 30 sec.	11.08 mR/min. 9 min.	8.83 mR/min. 11 min.	6.16 mR/min. 16 min.	5.34 mR/min. 18 min.	4.31 mR/min. 23 min.	3.28 mR/min. 30 min.	1.64 mR/min. Unlimited
20	819.44 mR/hr. Total Exposure Time allowed per hour...	13.68 mR/min. 7 min. 15 sec.	12.32 mR/min. 8 min.	10.54 mR/min. 9 min. 30 sec.	9.03 mR/min. 11 min.	7.39 mR/min. 13 min. 30 sec.	5.88 mR/min. 17 min.	4.11 mR/min. 24 min.	3.56 mR/min. 28 min.	2.87 mR/min. 34 min.	2.19 mR/min. 45 min.	1.09 mR/min. Unlimited
10	409.72 mR/hr. Total Exposure Time allowed per hour...	6.84 mR/min. 14 min.	6.16 mR/min. 16 min.	5.27 mR/min. 19 min.	4.52 mR/min. 22 min.	3.69 mR/min. 27 min.	2.94 mR/min. 34 min.	2.05 mR/min. 48 min.	1.78 mR/min. 56 min.	1.44 mR/min. Unlimited	1.09 mR/min. Unlimited	.55 mR/min. Unlimited
5	204.86 mR/hr. Total Exposure Time allowed per hour...	3.42 mR/min. 29 min.	3.08 mR/min. 32 min.	2.63 mR/min. 38 min.	2.26 mR/min. 44 min.	1.85 mR/min. 54 min.	1.47 mR/min. Unlimited	1.03 mR/min. Unlimited	.89 mR/min. Unlimited	.72 mR/min. Unlimited	.55 mR/min. Unlimited	.27 mR/min. Unlimited

## INSTRUCTIONS:

- 1) Find Curie amount of your source, using this value as a maximum (i.e., if you have a 51 Curie source you will use 60 Curies on the chart).
- 2) Find thickness of vessel that source will be shielded by.
- 3) Where the points intersect read time in minutes and seconds. This is the maximum allowed time for source exposure in one hour. This may be a single or multiple exposure but may not exceed the total time given on chart.
- 4) Any questions or problems, see R.S.O. for further instruction.

## **RADIOGRAPHER & RADIOGRAPHER'S ASSISTANT QUARTERLY AUDIT**

NAME \_\_\_\_\_ DATE \_\_\_\_ / \_\_\_\_ / 19 \_\_\_\_

An "OK" will be marked if the function being audited is acceptable. A "XX" will be marked if the function was not audited. A "NO" will be marked if the function being audited is unsatisfactory. Comments or notes can be written in the spaces between the categories or in the "Other Comments" section.

Proper Use of Film Badge, Alarming Ratemeter and Dosimeter. \_\_\_\_\_

Placement on clothing. \_\_\_\_\_ Recharged dosimeter correctly. \_\_\_\_\_

Verify if Ratemeter is operational. \_\_\_\_\_ Battery check, calibrated? \_\_\_\_\_

Proper Use of Survey Meter. \_\_\_\_\_

Battery check, calibrated? \_\_\_\_\_ Verify if survey meter is operational \_\_\_\_\_

Proper surveys before, during and after exposure. \_\_\_\_\_

Survey's during exposure, check for increasing the restricted area. \_\_\_\_\_

Did he bring survey meter out of cell with him after locking cell door? \_\_\_\_\_

Proper Check of Radiographic Device for Damage and Proper Operation. (Daily inspection requirements.) \_\_\_\_\_

Proper Placement of Source in Cell. \_\_\_\_\_

No increase in restricted areas, proper use of Chart "A", using radiation protection formulas. \_\_\_\_\_

Proper Restricted Area boundaries and postings. (If audit is performed during out of Cell exposures.) \_\_\_\_\_

Understanding and implementing ALARA. \_\_\_\_\_

***RADIOGRAPHER & RADIOGRAPHER'S ASSISTANT QUARTERLY AUDIT, Continued***

Name \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / 19 \_\_\_\_

Securing source after exposure; proper surveys of projector and Cell. Survey of tubes, collimator, etc. \_\_\_\_\_

Is projector locked & stored properly? \_\_\_\_\_

Is Cell door locked? \_\_\_\_\_

Utilization Log Book filled out properly. \_\_\_\_\_

Base readings. \_\_\_\_\_

Dosimeter reading. \_\_\_\_\_

Exposure logged properly. \_\_\_\_\_

Maintenance check list, OK? \_\_\_\_\_

Survey's recorded. \_\_\_\_\_

Other Comments

Auditor \_\_\_\_\_ Date \_\_\_\_\_



# Radiation Safety Officer Audit

## Duties of the Radiation Safety Officer Checklist

1. Conduct the Training Program.
2. Quarterly audits of Radiographers' and Radiographer Assistants' performances to assure they are performing their duties in the prescribed manner.
3. Review radiographic operations to determine that all persons involved are performing their duties as prescribed by this manual and current 10 CFR Regulations.
4. Review Personal monitoring records. Assuring that the occupational dose limits are within the limits described in 10 CFR Part 20, Subpart C.
5. Review Daily Utilization Logs.
6. Quarterly Inventory of sealed sources.
7. Review of Calibration Records for Pocket Dosimeters, Survey Meters and Alarming Ratemeters and to make sure that the instruments are current and documented as to their required calibration intervals.
8. Supervise receipt and return of Radioactive Packages and the records of such.
9. Review of Quarterly Maintenance Records and to make sure that equipment is current as to the frequency of such.
10. On an annual basis; review the NRC License, current CFR, NST Co.'s Radiographic Operations Manual, etc. to make sure that NST Co. radiography program is current.
11. On periodic basis review radiographic operations to determine that all personnel are performing their duties as prescribed.
12. At anytime: Halt the duties of any person when his pocket dosimeter has been discharged off-scale. This person's film badge will be immediately sent (overnight) for processing. This person will not perform any radiographic "hot" (not to be allowed in a Restricted Area) functions until the result of his film badge is returned.
13. At anytime: Halt the duties of radiography personnel if he is not performing in accordance to this manual, defeating safety and security systems, or knowingly making misrepresentations.
14. The Radiation Safety Officer shall halt any "hot" activities of any personnel that accumulated dosages that reach or exceed the dosage parameters set forth by 10 CFR Part, Subpart C. The Radiation Safety Officer will make required notifications and reports as provided in 10 CFR 20.2202 and 20.2203.

### Reports and Notifications

1. Reports to workers - 10 CFR 19.13.
2. Report of loss or theft of licensed material - 10 CFR 20.2201 and NST Co's. Radiography Operation Manual.
3. Notification of incidents - 10 CFR 20.2202.
4. Reports of over exposures - 10 CFR 20.2202 & 20.2203.
5. Reports of individual monitoring - 10 CFR 20.2206 .
6. Reports per 10 CFR 30.50.
7. Reports per 10 CFR 34.30 and NST Co's. Radiography Operation Manual.
8. Leak test results.
9. Reports per 10 CFR 34.25 (d) and NST Co's. Radiography Operation Manual.
10. Source receipt documents per 49 CFR 172.201, 172.202, 172.203 and NST Co's. Radiography Operation Manual.
11. Source shipping documents per 49 CFR 172.201, 172.202, 172.203 and NST Co's. Radiography Operation Manual.
12. Internal records not required for NRC reporting.

Name \_\_\_\_\_ Date \_\_\_\_\_

## WRITTEN EXAM FOR THE QUALIFICATION OF RADIOGRAPHER'S ASSISTANTS

FULL NAME \_\_\_\_\_ DATE \_\_\_\_ / \_\_\_\_ / 199\_\_

SOCIAL SECURITY # \_\_\_\_ - \_\_\_\_ - \_\_\_\_

DATE OF BIRTH \_\_\_\_ / \_\_\_\_ / 19\_\_

---

PART A: Selected Questions from text materials.

1. Name three (3) items of Personal Monitoring Devices:

2. Define the "Inverse Square Law":

$$\text{(clue)} \quad \frac{I_a}{I_b} = \frac{D_b^2}{D_a^2}$$

3. List the advantages and disadvantages of the film badge:

4. What should you do if you find that your Pocket Dosimeter has been completely discharged (off scale) during radiographic operations?

Name \_\_\_\_\_

Date \_\_\_\_\_

5. How can you determine that your Survey Meter is operational and is reacting to the presents of radiation?
6. Define ALARA (or A.L.A.R.A.)
7. Where can you find you permissible Occupational Dose Limits?
8. Briefly explain the Operating Procedures, from acquiring the keys and before using the projector to make exposures (in order): [There should be at least 7 basic items.]
9. What action should be taken if a source fails to return to it's stored/shielded position after many attempts?

Name \_\_\_\_\_ Date \_\_\_\_\_

10. What do you do if a source is unintentionally disconnected outside of its stored/shielded position in the projector?

11. What is your maximum whole body exposure in one (1) calendar year as permitted by 10 CFR, Subpart C?

PART B: True or False and Multiple Choice (Circle answers)

1. You may unlock and enter the Cell as long as you are wearing a film badge.

True

False

2. You may operate the 660B Gamma Projector without the supervision of a Radiographer.

True

False

3. To operate the 660B inside the Cell you must have your film badge, a charged pocket dosimeter and a survey meter.

True

False

4. When exposing the source in the Cell and you have a lengthy exposure time, you can lock the Cell door and leave the area.

True

False



5. After entering the Cell, all sides of the Projector Cabinet must be surveyed.

True

False

6. After taking the 660B from the cabinet you must remove the shipping plug and survey all surfaces of the projector.

True

False

7. Surface survey readings of the 660B or a 650 source changer shall not exceed:

[1.] 200 mR/hr

[2.] 300 mR/hr

[3.] 500 mR/hr

8. When cranking out the source and if undue resistance is encountered, you immediately reverse the direction of cranking until the source is back into it's stored/sheilded position.

True

False

9. When the source is exposed in the Cell, radiation doses at 30 cm from the exterior of the Cell shall not exceed:

[1.] 5 mR in one hour

[2.] 2 mR in one hour

[3.] 10 mR in one hour

10. When all exposures are complete, lock the Cell door and survey the area.

True

False

11. Signs shall be posted stating, "CAUTION - HIGH RADIATION AREA" at the perimeter where the radiation level is calculated to be 100 mR/hr.

True

False

12. Out of Cell exposure, you rope off and post a Restricted Area with signs stating, "Caution - Radiation Area". At what dose level do you establish the boundary of the Restricted Area?

[1.] 5 mR in one hour

[2.] 2 mR in one hour

[3.] 10 mR in one hour

13. When an exposure is complete, confirm the Base Reading by surveying a surfaces of the projector and check to see if the Slide Bar has actuated to the green position.

True

False

14. It is necessary to keep a daily utilization log in which describes each exposure made and all safety precautions used.

True

False

15. It is not necessary for everyone to wear film badges and dosimeters in a Restricted Area.

True

False

16. A Radiographer's Assistant:

[1.] Must have outside "formal" training in Radiation Safety per 10 CFR - Appendix A.

[2.] Must have on-the-job training.

[3.] Must understand and comply with operating and emergency procedures.

[4.] Must stand guard.

17. You must record your dosimeter reading before performing radiographic functions and after all radiographic functions are completed.

True

False

18. Leak testing of sealed sources must be performed:

[1.] Every three months

[2.] Every six months

[3.] Annually

19. Survey meters must be calibrated:

[1.] Every three months

[2.] Every six months

[3.] Annually

20. Which of the following illustrates the most means of protection from external radiation sources:

[1.] Wearing film badges, pocket dosimeters and alarming ratemeters.

[2.] Lead, concrete and steel.

[3.] Time, distance and shielding.

21. Using Chart "A", what is the total allowable exposure time per hour of panoramic shots on 24" dia. x 1 1/2 inch thick pipe tanks. Your source activity is 26 Curies.

[1.] 10 minutes

[2.] 13 minutes

[3.] 45 minutes

[4.] 90 minutes

[5.] None of the above

Name \_\_\_\_\_ Date \_\_\_\_\_

22. What happens when your pocket dosimeter goes off scale during radiographic functions?

- [1.] Go to the hospital and get a blood test.
- [2.] Send film badge in immediately for processing. Cease all radiographic functions.
- [3.] Recharge dosimeter and continue with radiographic functions.
- [4.] Ignore it, a dosimeter can discharge accidentally bumping it or dropping it.

23. Dosimeters shall be charged:

- [1.] Daily
- [2.] Weekly
- [3.] Monthly
- [4.] Daily, only if you plan to make radiographic exposures for that day.
- [5.] When completely discharged or off scale.

24. Dosimeters shall be calibrated:

- [1.] Daily
- [2.] Weekly
- [3.] Monthly
- [4.] Quarterly
- [5.] Yearly

# WRITTEN EXAM FOR THE QUALIFICATION OF RADIOGRAPHER'S ASSISTANTS

## Master

---

PART A: Selected Questions from text materials.

1. Name three (3) items of Personal Monitoring Devices:

Film badge, pocket dosimeter & Alarming Ratemeter.

2. Define the "Inverse Square Law":

The intensity is inversely proportional to the square of the distance.

Double the distance, divide the intensity by four.

$$\text{(clue)} \quad \frac{I_a}{I_b} = \frac{D_b^2}{D_a^2}$$

3. List the advantages and disadvantages of the film badge:

Advantages: Permanent record of doses and more accurate.

Disadvantage: Not direct reading of doses, has to be sent in for processing.

4. What should you do if you find that your Pocket Dosimeter has been completely discharged (off scale) during radiographic operations?

Halt all radiographic functions, except for properly securing radiographic equipment per the procedures, and report to the Radiation Safety Officer, immediately.

5. How can you determine that your Survey Meter is operational and is reacting to the presents of radiation?

Check the survey of the projector. An empty 660B emits 2.5 mR/hr. If you feel that you are getting an improper response look at previous logged Base Readings or get another meter to verify the readings in question

6. Define ALARA (or A.L.A.R.A.)

Dosages or exposure "As Low As Reasonably Achievable."

7. Where can you find you permissible Occupational Dose Limits?

10 CFR Part 20 - Subpart C or 10 CFR Part 20.1201 or 10 CFR Part 20

8. Briefly explain the Operating Procedures, from acquiring the keys and before using the projector to make exposures (in order): [There should be at least 7 basic items.]

Film badge and charged dosimeter (and ratemeter if needed).

Survey meter on & currently calibrated.

Survey Cell door area and check the Gamma Alarm that it is not activated.

Unlock Cell door and approach Projector storage cabinet, surveying all sides for excessive radiation.

Unlock storage cabinet, remove the projector and survey all side at the surface for excessive radiation. Make note of the highest surface reading for future reference and log entrees.

Inspect projector for damage that could impair it's proper and safe operation.

Inspect guide tubes, source stops and control cable assembly for damage or obstructions.

9. What action should be taken if a source fails to return to it's stored/shielded position after many attempts?

Help the Radiographer post Restricted Area, remove unauthorized personnel from the Restricted Area, secure and monitor the area. Contact the Radiation Safety Officer after you are confident that the area involved is secure, but promptly. (Try to limit your own exposures as much as possible.)



10. What do you do if a source is unintentionally disconnected outside its stored/shielded position in the projector?

Help Radiographer evacuate surrounding personnel until the Restricted Area perimeters can be established. Establish Restricted Area and rope off boundaries. Keep your own exposure as low as possible! Help maintain surveillance over the Restricted Area, assuring that no unauthorized persons enter the Restricted Area.

11. What is your maximum whole body exposure in one (1) calendar year as permitted by 10 CFR, Subpart C?

5 REM

PART B: True or False and Multiple Choice (Circle answers)

1. You may unlock and enter the Cell as long as you are wearing a film badge.

False

2. You may operate the 660B Gamma Projector without the supervision of a Radiographer.

False

3. To operate the 660B inside the Cell you must have your film badge, a charged pocket dosimeter and a survey meter.

True

4. When exposing the source in the Cell and you have a lengthy exposure time, you can lock the Cell door and leave the area.

False

5. After entering the Cell, all sides of the Projector Cabinet must be surveyed.

True

6. After taking the 660B from the cabinet you must remove the shipping plug and survey all surfaces of the projector.

False

7. Surface survey readings of the 660B or a 650 source changer shall not exceed:

[1.] 200 mR/hr

8. When cranking out the source and if undue resistance is encountered, you immediately reverse the direction of cranking until the source is back into it's stored/shielded position.

True

9. When the source is exposed in the Cell, radiation doses at 30 cm from the exterior of the Cell shall not exceed:

[2.] 2 mR in one hour

10. When all exposures are complete, lock the Cell door and survey the area.

False

11. Signs shall be posted stating, "CAUTION - HIGH RADIATION AREA" at the perimeter where the radiation level is calculated to be 100 mR/hr.

True

12. Out of Cell exposure, you rope off and post a Restricted Area with signs stating, "Caution - Radiation Area". At what dose level do you establish the boundary of the Restricted Area?

[2.] 2 mR in one hour

13. When an exposure is complete, confirm the Base Reading by surveying all surfaces of the projector and check to see if the Slide Bar has actuated to the green position. Survey guide tubes and collimator (if used.)

True

14. It is necessary to keep a daily utilization log in which describes each exposure made and all safety precautions used.

True

15. It is not necessary for everyone to wear film badges and dosimeters in a Restricted Area.

False

16. A Radiographer's Assistant:

[1.] Must have outside "formal" training in Radiation Safety per 10 CFR - Appendix A.

[2.] Must have on-the-job training.

[3.] Must understand and comply with operating and emergency procedures.

[4.] Must stand guard.

17. You must record your dosimeter reading before performing radiographic functions and after all radiographic functions are completed.

True

18. Leak testing of sealed sources must be performed:

[2.] Every six months

19. Survey meters must be calibrated:

[1.] Every three months

20. Which of the following illustrates the most means of protection from external radiation sources:

[3.] Time, distance and shielding.

21. Using Chart "A", what is the total allowable exposure time per hour of panoramic shots on 24" dia. x 1 1/2 inch thick pipe tanks. Your source activity is 26 Curies.

[5.] None of the above

22. What happens when your pocket dosimeter goes off scale during radiographic functions?

[2.] Send film badge in immediately for processing. Cease all radiographic functions.

23. Dosimeters shall be charged:

[4.] Daily, only if you plan to make radiographic exposures for that day.

24. Dosimeters shall be calibrated:

[5.] Yearly

UTILIZATION, INSPECTION & MAINTENANCE REPORT: Sht \_\_\_\_ of \_\_\_\_ Date \_\_\_\_

T/O Model \_\_\_\_ Gamma Ray Projector using IR<sup>192</sup> Assigned to: Mr. R.H. Wood  
Projector Used Inside/Outside Radiation Cell Radiological Safety Officer

Number of Curies \_\_\_\_ Reading of \_\_\_\_ MR/HR Before Entering Cell

BASE READING @ START \_\_\_\_ MR/HR BASE READING @ FINISH \_\_\_\_ MR/HR

Exposure(s):

Number	Time	Serial No.
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Survey Readings During Exp. Pocket Dosimeter Reading Before Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR Pocket Dosimeter Reading After Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR All Equipment Locked \_\_\_\_\_

Comments: \_\_\_\_\_ Survey Reading After all Exps. \_\_\_\_ MR/HR

Changes in Operating Characteristics of Unit \_\_\_\_\_ Rust, Dirt, or Sludge Build-Up in the Source Tube \_\_\_\_\_

Proper Operation of Source Position Indicator Mechanism \_\_\_\_\_ Proper Positioning of Source Inside the Shield \_\_\_\_\_

Proper Operation of the Crank Mechanism \_\_\_\_\_ Shifting of the Shield Inside the Projecting Housing \_\_\_\_\_

Proper Operation of Locking Mechanism \_\_\_\_\_ Proper Connection of all Mating Components \_\_\_\_\_

Source and Drive - Cable Wear or Damage \_\_\_\_\_ Damage to the Device, Which May Impair its Operation \_\_\_\_\_

Damaged or Worn Source and Drive Cable Tube and Connector Wear and Damage \_\_\_\_\_ Cable Drive Gear-Box Damage and Wear \_\_\_\_\_

REMARKS: \_\_\_\_\_ Proper Labeling \_\_\_\_\_

Radiographer \_\_\_\_\_

Radiographer's Assist. \_\_\_\_\_

NST/R1



UTILIZATION, INSPECTION & MAINTENANCE REPORT: Sht \_\_\_\_ of \_\_\_\_ Date \_\_\_\_

T/O Model \_\_\_\_ Gamma Ray Projector using IR<sup>192</sup> Assigned to: Mr. R.H. Wood  
Radiological Safety Officer

Projector Used Inside/Outside Radiation Cell

SOURCE CHANGE

NEW SOURCE S/N \_\_\_\_

Shipping Package No. \_\_\_\_ (Model) Serial No. \_\_\_\_

1. survey @ 1 meter	____	MR/HR	Projector Base Reading	____	
2. surface survey	____	MR/HR	Old Source In	____	MR/HR
3. wipe test	____		Projector Base Reading	____	
4. sealed properly	____		Old Source Out	____	MR/HR
			Projector Base Reading	____	
			New Source In	____	MR/HR

OLD SOURCE S/N \_\_\_\_

1. survey @ 1 meter	____	MR/HR
2. surface survey	____	MR/HR
3. sealed properly	____	

COMMENTS

Survey Readings During Exp. \_\_\_\_

Pocket Dosimeter Reading Before Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

Pocket Dosimeter Reading After Exp. \_\_\_\_ MR/HR

AT \_\_\_\_ FT \_\_\_\_ MR/HR

All Equipment Locked \_\_\_\_

AT \_\_\_\_ FT \_\_\_\_ MR/HR

Survey Reading After all Exps. \_\_\_\_ MR/HR

Comments: \_\_\_\_

Changes in Operating Characteristics  
of Unit \_\_\_\_

Rust, Dirt, or Sludge Build-Up in  
the Source Tube \_\_\_\_

Proper Operation of Source Position  
Indicator Mechanism \_\_\_\_

Proper Positioning of Source Inside  
the Shield \_\_\_\_

Proper Operation of the Crank  
Mechanism \_\_\_\_

Shifting of the Shield Inside the  
Projecting Housing \_\_\_\_

Proper Operation of Locking  
Mechanism \_\_\_\_

Proper Connection of all Mating  
Components \_\_\_\_

Source and Drive - Cable Wear  
or Damage \_\_\_\_

Damage to the Device, Which May  
Impair its Operation \_\_\_\_

Damaged or Worn Source and Drive Cable  
Tube and Connector Wear and Damage \_\_\_\_

Cable Drive Gear-Box Damage and  
Wear \_\_\_\_

Proper Labeling \_\_\_\_

REMARKS: \_\_\_\_

Radiographer \_\_\_\_

Radiographer's Assist. \_\_\_\_

NST/R2



NILES STEEL TANK COMPANY  
713 WAYNE STREET  
P.O. BOX 728  
NILES, MICHIGAN 49120  
TELEPHONE (616) 683-1910

March 4, 1988

Subject: Education, Work Experience & Qualifications of Robert H. Wood.

To Whom It May Concern:

Below listed are my Educational Background, Work Experience and Qualifications pertaining to Radiography work I perform at Niles Steel Tank Company.:

Graduated Howe Military School in June of 1974.

Attended Michigan Technological University in September of 1974, to May of 1975.

Hired at Niles Steel Tank Company, February 16, 1976, as Q.C. Inspector and Radiography Trainee. My duties were mainly Q.C. Inspection but I was to observe some Radiographic functions in spare time.

Successfully completed "Radiation Safety" at Technical Operation in September of 1980.

Passed RT Level I (Radiographer's Assistant) Exam at Niles Steel Tank Company with a composite score of 89%, on September 20, 1980.

Passed re-exam for RT Level I on February 26, 1982.

May 21, 1982, I attended RT Level II (40-hr Radiographer) course at Nondestructive Test Engineering Section of Hartford Steam Boiler Inspection & Insurance Company. My exam scores were as follows: General 84%, Specific 90%, and Practical 99%. Composite Score was 92.7%. My duties after this were RT Level II (Radiographer) at Niles Steel Tank Company.

Attended A.S.N.T.'s Level III Refresher Course in August of 1986.

March 1987, I took A.S.N.T.'s Level III Radiography Exam and passed. (It is A.S.N.T.'s policy not to publish exam scores, only pass/fail).

In addition to the above, our current R.S.O. has deligated many of his functions (for his review) for me to perform as part of my training. Also, I have been Niles Steel Tank Company's representative during the last three of our Audits that the N.R.C. conducts routinely.

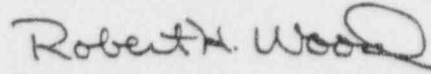
I am currently "Acting R.S.O.", while our current R.S.O., J. C. Wood is preparing for retirement and have been appointed R.S.O. upon N.R.C. approval.

PAGE 2

All of the above mentioned documentation is a permanent record at Niles Steel Tank Company and may be examined per your request.

Very truly yours,

NILES STEEL TANK COMPANY

A handwritten signature in dark ink, appearing to read "Robert H. Wood". The signature is fluid and cursive, with a large, stylized "W" at the end.

Robert H. Wood  
Q.C. Manager &  
Acting R.S.O.

RHW/sh

Enc.



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

REGION III  
801 WARRENVILLE ROAD  
LISLE, ILLINOIS 60532-4351

July 19, 1996

Robert H. Wood  
Radiation Safety Officer  
Niles Steel Tank Company  
P. O. Box 728  
713 Wayne Street  
Niles, MI 49120

SUBJECT: ACKNOWLEDGEMENT OF CORRESPONDENCE  
( Letter ☒ Application \_ Dated July 15, 1996 )

Dear Licensee:

In response to your request, we have completed the initial processing, which is an administrative review of your application for a(n):

☐ New License                      ☒ Amendment                      ☐ Renewal  
☐ Termination                      ☐ Auth User (Amendment not required)                      ☐ QMP Revision  
☐ Other \_\_\_\_\_

No administrative deficiencies were identified during this initial review. However, it should be noted that a technical review may identify omissions in the submitted information, technical issues that require additional information, or policy/technical issues that require coordination with headquarters or other NRC regional offices.

It appears that your request is routine (see 1-3 below, as applicable) and complete.

1. New and amendment actions are normally processed within 90 days, unless we find major deficiencies, or policy issues requiring central program office assistance.
2. Renewal actions are normally processed within 180 days, however, under timely filing (before expiration), you may continue to operate under your existing license.
3. Termination actions are normally processed within 90 days, unless confirmatory surveys following decontamination/decommissioning activities are involved.

A copy of your correspondence has been forwarded to our Licensing Fee and Debt Collection Branch (301/415-6097) for approval of the fee category and amount.

If you have a compelling safety or business-related reason for requesting expedited review, please contact the Materials Licensing Branch at (708) 829-9887. We will try to complete your request as soon as practicable. Any correspondence about this request should reference the control number.

Nuclear Materials Support Branch

Mail Control No. 301603  
License No. 21-04741-01