

TITLE : TVA INDUSTRIAL RADIOGRAPHY BYPRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: TABLE OF CONTENTS

CHAPTER

- 1.0 RADIOGRAPHY ALARA PROGRAM
- 2.0 LICENSE NUMBER 41-06832-06
- 3.0 ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM
- 4.0 OPERATING AND EMERGENCY PROCEDURES
- 5.0 SUPPORT DOCUMENTS
 - 5.1 10 CFR Parts 19, 20, 21, 30 and 34
 - 5.2 Radioactive Material Shipping Manual (RMSM)
 - 5.3 Quality Assurance Program Description
For Radioactive Material Shipping Packages
Licensed Under 10 CFR 71.

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**TITLE : TVA INDUSTRIAL RADIOGRAPHY BYPRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: ALARA PROGRAM****RADIOGRAPHY ALARA PROGRAM**

TVA shall continue its efforts for achieving a common goal of improved radiation safety for TVA personnel and the general public we serve. TVA shall strive to maintain radiation exposures as low as reasonably achievable (ALARA) for persons who handle, use or supervise the use of by-product material under TVA's License 41-06832-06. This shall include personnel involved in radiography and associated operations such as transport, maintenance and inspection of devices containing radioisotopes. The collective exposure received by individuals under TVA's radiography license will also be maintained as low as reasonably achievable.

TVA's "Industrial Radiography Manual" (IRM) includes the administrative organization, written policy, procedures, and instruction that when implemented shall achieve TVA's ALARA objectives. The ALARA program specifically includes the following elements.

1. All radiography personnel have stop work authority if they perceive that safe radiographic operations are in jeopardy.
2. Management shall maintain an open door policy with personnel regarding questions they may have about ALARA. This open door policy shall extend to the consideration of suggestions that may improve the ALARA program or information concerning observed deviations from ALARA practices (anonymity assured).
3. Collimators shall be used unless radiographic examination geometry prevents the use of collimators. The unavailability of collimators is not an acceptable reason for open tip radiography.
4. Emphasis shall be placed on minimizing worker's time spent in radiation areas through good pre-job planning and the effective use of available shielding.
5. An administrative review of occupational exposure to any individual that exceeds one rem per year. Beyond this level, management review will be conducted to assess whether ALARA practices have been applied. One rem per year shall not be considered an exposure limit, but is simply an amount of exposure requiring review and management approval prior to receiving additional exposure.
6. Annual review of operating procedures. All users shall be encouraged to make suggestions at any time that may lead to new procedures deemed necessary to implement the ALARA concept.
7. A semi-annual review of all radiography personnel who have occupational radiation exposures. The purpose of the review shall be to determine if trends are developing that may impact the quality of the ALARA program.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BYPRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: ALARA PROGRAM

8. Management audits that include a review of personnel qualifications and performance monitoring during radiography. These audits will help to assure that individuals involved in radiography are utilizing proper ALARA practices.
9. An annual administrative review shall be performed to determine the effectiveness of the ALARA program.

NOTE: ALARA reviews shall be viewed as annual \pm 45 days.

2.0 LICENSE

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

TABLE OF CONTENTS

NRC LICENSE #41-06832-06

1. Address where licensed material will be used (*Item 3)
2. Radioactive material (*Item 5)
3. Purpose(s) for which licensed material will be used (*Item 6)
4. Individual(s) responsible for radiation safety program
and their training and experience(*Item 7)
5. Training for individuals working in or frequenting
restricted areas (*Item 8)
6. Facilities and equipment (*Item 9)
7. Radiation safety program (*Item 10)
 - 7.1 Personnel monitoring equipment
 - 7.2 Radiation detection instruments
 - 7.3 Internal inspection program
 - 7.4 Operating and emergency procedures
 - 7.5 Leak testing
8. Waste management (*Item 11)

*NRC Form 313 Item Numbers

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

Item 1

Address(es) where material will be used or possessed.

TVA will possess and use byproduct material at temporary jobsites in states subject to NRC's regulatory authority. TVA's byproduct material storage facility at 1100 Riverfront parkway, Chattanooga, Tennessee, has been replaced by storage areas at temporary jobsites.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

ITEM 2

RADIOACTIVE MATERIAL

<u>Element and Mass Number</u>	<u>Chemical and/or Physical Form</u>	<u>Maximum Amount Possessed at Any One Time</u>
1. Iridium 192	Sealed Source Source Production and Equipment Company Source Model #G-60	Not to exceed 150 curies per source
2. Iridium 192	Sealed Source Source Production and Equipment Company Source Model T-5	Not to exceed 100 curies per source
3. Iridium 192	Sealed Source Sentinel, Amersham Corporation #A-424-9	Not to exceed 100 curies per source
4. Cobalt 60	Sealed Source Sentinel, Amersham Corporation Model #A-424-14	Not to exceed 100 curies per source

<u>Exposure Devices</u>	<u>Manufacturer</u>
<u>Model Number</u>	
1. 660A and 660B	Sentinel, Amersham Corporation
2. 680A and 680B	Sentinel, Amersham Corporation
3. 150	Source Production and Equipment Company

<u>Source Changers</u>	
<u>Model Number</u>	
1. 650 L	Sentinel, Amersham Corporation
2. 771	Sentinel Amersham Corporation
3. SPEC C-1	Source Production and Equipment Company

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

ITEM 3

Purpose(s) for Which Licensed Material Will be Used

The materials will be utilized in industrial radiography of fabrication, installation and reevaluation of base material and welds in piping and other nuclear and non-nuclear components anywhere in the United States.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

ITEM 4

Individual(s) responsible for Radiation Safety Program and their training and experience. Licensed material shall be used by or under the supervision of the following:

1. W. Ed Freeman, Radiation Safety Officer (RSO).
2. Roger W. White, Assistant Radiation Safety Office (ARSO).
2. G. Wayne Hembree, Assistant Radiation Safety Officer (ARSO).
4. Joseph W. Mefford, Radiation Safety Coordinator (RSC).

Or other individuals who have received the training as described in the TVA Operating and Emergency Procedures and who have been designated as radiographers by the Radiation Safety Officer.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: NRC LICENSE #41-06832-06

ITEM 5

Training for Individuals Working in or Frequenting Restricted Areas

Radiographers and radiographer assistants shall receive training in accordance with Chapter 4.0, Attachment 1 of the TVA's Industrial Radiography Manual before their assignment to work in any restricted area. The training will cover all pertinent radiation protection practices and procedures to a degree sufficient to allow the individual to perform his/her assignment without incurring unnecessary radiation exposure. Where personnel other than radiographers or their assistants require access to a restricted area, they must be furnished with a TLD, one calibrated pocket dosimeter and one alarm ratemeter. No person shall gain entry into a restricted area without the approval of the responsible radiographer.

The maintenance of training records is the responsibility of the RSO. They shall be maintained at the office of the RSO.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: NRC LICENSE #41-G6832-06

ITEM 6

FACILITIES AND EQUIPMENT

Equipment

This license is limited to the possession, use, storage and transfer of the radioactive byproduct material and equipment as outlined in Chapter 2.0, Item 2. During periods when the radioactive byproduct materials (sealed sources) are not being used, they will be stored in their exposure device and/or shipping container. The byproduct material(s) will be stored in a vehicle or building which will be locked at all times with limited and controlled access. Posting will be in accordance with 10 CFR Part 20.

Facilities

TVA will possess, use and store byproduct material(s) at our temporary radiography installations anywhere in the United States.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE

SUBJECT: NRC LICENSE #41-06832-06

ITEM 7

RADIATION SAFETY PROGRAM

7.1 Personnel Monitoring Equipment

All radiographic personnel who enter a restricted area shall be required to wear a minimum of one direct reading pocket dosimeter which must have a range of 0 to 200 mrem. All personnel who enter a restricted area shall be required to wear on their person a TLD. The maximum exchange period for the TLD is quarterly. Additionally, all personnel who enter a restricted area shall be required to wear on their person one alarm rate meter set to give an alarm at a preset dose rate of 500 mrem/h or less if required by the nuclear facility where radiography is performed.

7.2 Radiation Detection Instruments

The type of survey instruments used are: Eberline, Model E-130 meters or equivalent with a range from 2-1000 mrem/h. The survey instruments shall be calibrated by TVA's Western Area Radiological Laboratory (WARL) or a TVA nuclear facility at intervals no greater than three months and/or after each repair whichever comes first. These records shall be maintained for a minimum of three years. Survey meter calibration results will indicate that the readings are $\pm 10\%$ of the actual values. The calibration results shall also identify the date of the last calibration and the due date of the next calibration. Survey meter calibration is for a minimum of three months. A calibration label shall be affixed to the survey meter.

7.3 Internal Inspection Program

TVA's Internal Inspection Program consists of audits of radiographers and radiographer assistants at intervals not to exceed three months. Only the RSO, RSCs or personnel who have satisfied the requirements Chapter 3.0 shall conduct quarterly audits of radiographers and radiographer assistants. The purpose of the audits assures management and radiographic personnel alike that regulations, license conditions and provisions, and the operating and emergency procedures provide guidance and an environment conducive to safe radiographic practices.

7.4 Operating and Emergency Procedures

TVA's operating and emergency procedures provide radiographic personnel with clear and specific direction and instructions concerning their job related duties. Chapter 4.0 is TVA's operating and emergency procedures specific to radiographic operations.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: NRC LICENSE #41-06832-06

7.5 Leak Testing

TVA's sealed sources shall be tested for leakage at intervals not to exceed six months. In the absence of a certificate from a transferor that a test has been made within the six months before the transfer, the sealed source shall not be put into service until tested. The leak test shall be taken by TVA's radiographer(s) or Radiological Control personnel who have had a minimum of two years experience. Leak Test Kit - Model 518 or equivalent shall be used and the leak test forwarded to either the source supplier as identified in the license application or a TVA facility for counting that utilizes instrumentation capable of detecting less than 0.005 microcuries. The operating and emergency procedures provide personnel with clear and specific instructions for leak testing of sealed sources.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: NRC LICENSE #41-06832-06

ITEM 8

WASTE MANAGEMENT

Waste Management is accomplished by shipping the depleted sources to an authorized recipient.
The authorized recipient will be the original supplier.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM

TABLE OF CONTENTS

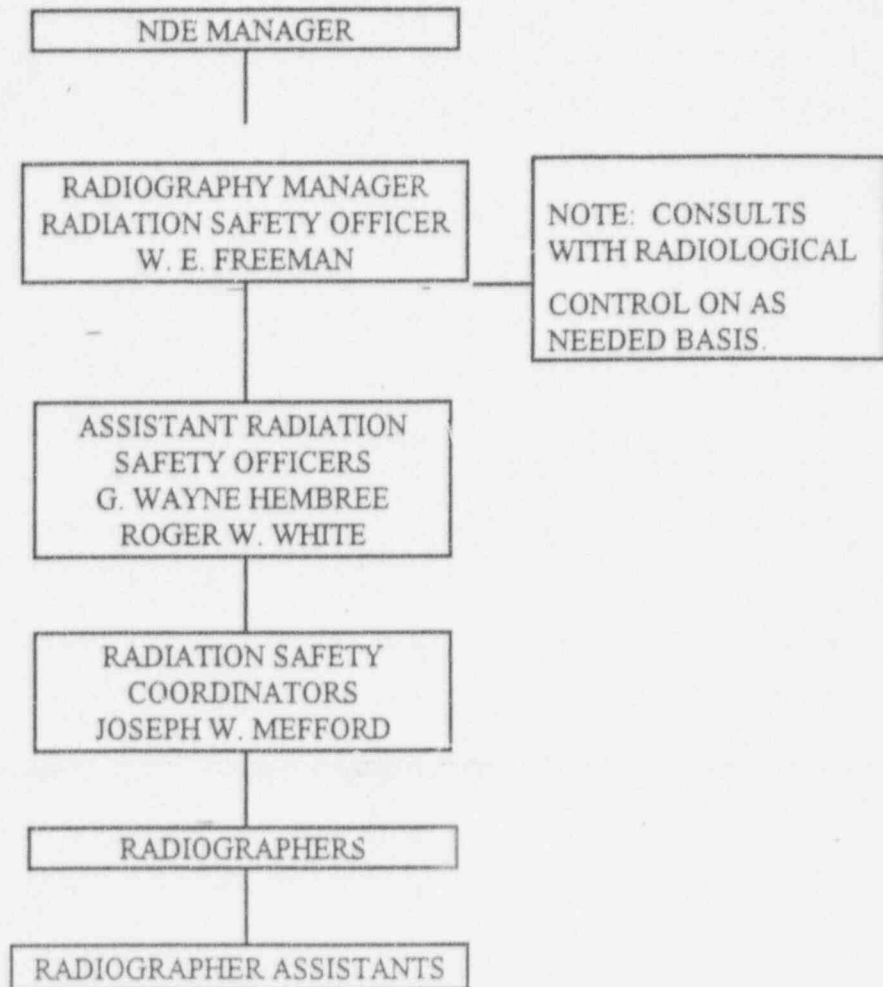
1.0	Flow Chart	
2.0	Organizational Responsibilities	
2.1.1	Radiation Safety Officer	
2.1.2	Assistant Radiation Safety Officer	
2.1.3	Radiation Safety Coordinator	
2.1.4	Radiographer	
2.1.5	Radiographer Assistant	
3.0	Documented Training and Experience of the Radiation Safety Officers and Radiation Safety Coordinators	
4.0	Internal Inspection Program	

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM

1.0 FLOW CHART

ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM



TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE**SUBJECT: ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM****2.0 Organizational Responsibilities**

TVA's Industrial Radiography Program consists of the performance of radiography on nuclear and non-nuclear components. Welds and base material are radiographed to determine component integrity. All radiography is performed at field locations.

While there are other support documents that complement the industrial radiography program, ultimate radiological safety in accordance with the NRC license herein is shared by TVA's management, Radiation Safety Officers, Radiation Safety Coordinators, and by each qualified radiographer and their assistant. The radiographer has direct responsibility for jobsite safety during the performance of industrial radiography.

2.1 Responsibilities of Key Personnel**2.1.1 Radiation Safety Officer**

- a. The Radiation Safety Officer is the direct link between TVA's management and the enforcement of all applicable licensing conditions. He is the bridge that connects the Radiography program and TVA's management by assuring a direct line of communication that emphasizes safety.
- b. Shall administer and enforce all rules, regulations, and procedures of the radiography program to assure compliance with licensing conditions, and Part 19, 20, 21, 30 and 34 of the Code of Federal Regulations.
- c. Consults with others on matters affecting radiological safety.
- d. Initiates program changes as deemed necessary.
- e. Responsible for the maintenance of records which will be made available for inspection by regulatory inspection agencies.
- f. Shares with the Assistant Radiation Safety Officers in the review and approval of personnel as auditors, radiographers and radiographer assistants.
- g. Responsible for licensing, commitments and coordination of the industrial radiography program within TVA.
- h. Consults with and receives assistance from Radiological Control personnel on an as-needed basis.
- i. Performs ALARA reviews.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE

SUBJECT: ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM

2.1.2 Assistant Radiation Safety Officer

- a. Reviews procedures for compliance with licensing conditions, and compliance with Parts 19, 20, 21, 30 and 34 of the Code of Federal Regulations.
- b. Amends licensing conditions to reflect current program changes.
- c. Consults with Radiation Safety Officer on matters of radiological safety.
- d. Assists Radiation Safety Officer in his responsibilities when so delegated.
- e. Supports the RSO in the review and investigation of emergency situations that may arise and indicate corrective actions necessary to prevent similar future occurrences. Consults with and obtains support from corporate Radiological and Chemistry Control on an as needed basis.
- f. Responsible for the performance of audits of radiographers and radiographer assistants not to exceed three month intervals. NOTE: When personnel have not engaged in industrial radiography in a three month period, then in such an event, no audit is necessary. However, that individual shall receive a field operational audit before first use.
- g. Assures that radioactive sealed sources are always used in a way that exposure is maintained as low as possible to as few a number of people as necessary.
- h. Shares with Radiation Safety Officer in the review and approval of personnel as auditors, radiographers and radiographer assistants.
- i. Assistants as necessary in the maintenance of records supporting licensing activities.
- j. Assists RSO in ALARA reviews.

2.1.3 Radiation Safety Coordinators.

- a. At the request of the ARSO and RSO, reviews and investigates emergency situations that may arise and indicate corrective actions necessary to prevent similar future occurrences.
- b. In support of the ARSO and RSO, performs audits of radiographers and radiographer assistants.
- c. Assures that radioactive sealed sources are always used in a way that exposure is maintained as low as possible to as few a number of people as necessary.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: ORGANIZATIONAL STRUCTURE OF RADIOGRAPHY PROGRAM

d. Assists as necessary in the maintenance of records supporting licensing activities.

e. Assist the ARSO and RSO in their responsibilities when so delegated.

2.1.4 Radiographer

a. Directly supervises the receipt, storage, use and shipment of radioactive sealed sources at assigned jobsites.

b. Supervises radiographic inspections assuring compliance with operation procedures and licensing conditions.

c. Assumes responsibility for radiation safety at his particular jobsite to ensure compliance with TVA and Licensing requirements.

d. Report all emergency accidents and maintains appropriate control measures to minimize radiation exposure.

e. Maintains specified records locally which can be made available for inspection by regulatory agencies and company officials.

2.1.5 Radiographer Assistant

a. Use exposure devices, related handling tools, and survey instruments provided he is under the direct personal supervision of a radiographer.

b. Reports unsafe conditions and incidents to the radiographer.

c. Assists in minimizing and controlling radiation exposure.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

3.0 Documented Training and Experience for Radiation Safety Officer (RSO), Assistant Radiation Safety Officer (ARSO), and Radiation Safety Coordinator(s) (RSC)

3.1 The Radiation Safety Officer (RSO), Assistant Radiation Safety Officer (ARSO), and Radiation Safety Coordinator(s) (RSC) represent day-to-day management and day-to-day supervision of TVA's Industrial Radiography Program. The RSO, ARSO, and RSC shall possess as a minimum one year experience as a radiographer and shall demonstrate their proficiency during the performance of their work duties as identified in Chapter 3, Section 2.0. In accordance with TVA's byproduct material license and to establish their competence, the attached identifies the work history (training and experience) of TVA's RSO and RSCs for License #41-06832-06.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

**ASSISTANT RADIATION SAFETY OFFICER
ROGER W. WHITE**

<u>TRAINING</u>	<u>HOURS</u>	<u>SUBJECT</u>
1. Tulsa School of Aeronautics	180 (certificate)	X-Ray, Gamma Radiography, and Radiation Safety
2. Stone & Webster Engineering Corporation	80 (Employer Sponsored)	Industrial Radiography
3. Stone & Webster Engineering Corporation	24 (Annual Recertification)	Radiation Safety
4. Troxler Electronics Laboratory, Inc.	8 (Certificate)	Operator/Radiation Safety

<u>EXPERIENCE</u>	<u>ISOTOPE/X-RAY</u>	<u>LOCATION/ORGANIZATION</u>
1. 20 months 7/73 - 2/75	X-Ray	Wichita, Kansas, Metanal Laboratory
2. 19 months 9/75 - 3/77	Isotope	Moscow, O./Peabody Testing
3. 15 months 3/77 - 5/78	X-Ray	Oswebo, N.Y./Graver Tank and Manufacturing
4. 9 years and 9 months 5/78 - 1/88	X-Ray/Isotope	Boston, MA and London, England/Stone & Webster Engineering Corporation
5. 2/88 to Present	X-Ray/Isotope	Chattanooga, TN/ Tennessee Valley Authority

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

**ASSISTANT RADIATION SAFETY OFFICER
G. W. HEMBREE**

<u>TRAINING</u>	<u>HOURS</u>	<u>SUBJECT</u>
1. Oak Ridge Training & Technology Oak Ridge, TN (1967)	22 Weeks (Certification)	Radiation Safety X-Ray & Gamma Radiography
2. Watertown Arsenal Watertown, MA (1970)	80 hours (Certification)	Radiographic Inspection Course
3. B. F. Shaw Company Laurens, SC (1972)	40 hours (Company sponsored)	Radiation Safety & ASNT Level II Course
4. Combustion Engineering, Inc. Chattanooga, TN (1973)	40 hours (Certificate)	Basic Radiography
5. Combustion Engineering, Inc. Chattanooga, TN (1975)	48 hours (Company Sponsored)	NAVSHIPS 250-1500-1 Radiography
6. F. L. Clifford Associates Niantic, CT	40 hours (Certificate)	Industrial Radiography Radiation Safety
7. NDE Engineering Company	8 hours (Certificate)	Industrial Radiography
8. Amersham, Tech-Ops Burlington, MA (1988)	16 hours (Certificate)	Maintenance of Exposure Devices
9. Have received training (radiation safety) from various nuclear sites before being admitted to their installations.		

<u>EXPERIENCE</u>	<u>ISOTOPE/X-RAY</u>	<u>LOCATION/ORGANIZATION</u>
1. 6 months (1967)	Isotope and X-Ray	Oak Ridge, TN/Union Carbide
2. 6 months (1968)	X-Ray	Danbury, CT/Automation Ind.
3. 2 years (1969-1971)	X-Ray	Savannah, GA/U.S. Army

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

**ASSISTANT RADIATION SAFETY OFFICER
G. W. HEMBREE**

<u>EXPERIENCE</u>	<u>ISOTOPE/X-RAY</u>	<u>LOCATION/ORGANIZATION</u>
4. 6 months (1971)	X-Ray	Danbury, CT/Automation Ind.
5. 1 Year (1972)	Isotope	Laurens, SC/B.F. Shaw Co.
6. 3 Years (1973-1976)	Isotope/X-Ray	Chattanooga, TN/ Combustion Engineering
7. 11 Years (1976-1987) - License 06-04154-01	Isotope	Windsor, CT/ Combustion Engineering
8. 1987 - Present	Isotope	Chattanooga, TN/TVA

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

**RADIATION SAFETY OFFICER
WESLEY E. FREEMAN, JR.**

TRAINING

1.	1975 Law Engineering Testing Co. Birmingham, Alabama	Radiation Safety for Industrial Radiography	40 hours
2.	1976 Materials Consultants Inter Charlotte, North Carolina	Radiation Safety for Industrial Radiography	40 hours
3.	1977 Tennessee Valley Authority	Basic Radiography, included of Linear Accelerators	40 hours
4.	1981 Schonberg Radiation Corporation Mt. View, California	Maintenance and Operation of Linear Accelerators	40 hours
5.	1982 North Carolina State University Raleigh, North Carolina	Radioisotope Techniques	40 hours

	<u>EXPERIENCE</u>	<u>ISOTOPE/X-RAY</u>	<u>ORGANIZATION/LOCATION</u>
1.	14 Months (1975-1976)	Isotope and X-Ray	Law Eng. Testing/B'ham, AL
2.	16 Months (4-76 to 8-77)	Isotope and X-Ray	Materials Consultants/ Charlotte, N. C.
3.	6 Months (2-78 to 8-78)	Isotope and X-Ray	Law Eng. Testing/B'ham AL
4.	1 year 8 Months (9-78 to 5-80)	Isotope and X-Ray	J. A. Jones/Richland, WA
5.	5 years 8 Months (5-80 to 1-86)	Isotope and X-Ray	J. A. Jones/ Charlotte, NC
6.	12 Months (1-86 to 1-87)	X-Ray	Jones Tech./Charlotte, NC
7.	7/87 to present	Isotope and X-Ray	TVA/Chattanooga, TN

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

**RADIATION SAFETY COORDINATOR
JOSEPH W. MEFFORD**

<u>TRAINING</u>		<u>HOURS</u>	<u>SUBJECT</u>
1.	Union Carbide Training and Technical School	360 (Certificate)	X-Ray, Gamma Radiography and Radiation Safety
2.	Amersham Tech-Ops Corporation	16 hours	Radiographic Equipment Maintenance
3.	Amersham Tech-Ops Corporation	16 hours	Key Aspects in the Management of Isotope Radiography Programs
4.	Amersham Tech-Ops Corporation	40 hours	Radiation Safety
5.	Amersham Tech-Ops Corporation	40 hours	Industrial Radiography
<u>EXPERIENCE</u>		<u>ISOTOPE/X-RAY</u>	<u>LOCATION/ORGANIZATION</u>
1.	2/76 - 5/79	Isotope	Pellefonte Nuclear Plant/TVA
2.	5/79 - 9/82	Isotope	Phipps Bend Nuclear Plant/TVA
3.	9/82 - Present	Isotope	Watts Bar Nuclear Plant/TVA

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

4.0 Internal Inspection Program

- 4.1 Audits of each Radiographer and Radiographer Assistant shall be conducted to ensure compliance to TVA's operating and emergency procedures at intervals not exceeding three months. When a Radiographer or Radiographer Assistant has not been engaged in the performance of industrial radiography for a three-month period or greater, no audit shall be required of that individual. He/she must be observed (audited) and results recorded the next time the individual participates in a radiographic operation.
 - 4.1.1 When a Radiographer or Radiographer Assistant received their initial certification in accordance with Chapter 4.0 Section 17, Attachment 1, they need not be audited as required by this chapter. The satisfactory completion of the field examination check as required by Chapter 4.0, Section 17 shall suffice.
- 4.2 Audits shall be performed by the RSO, ARSO, or RSC. The shift supervisor or radiographer may be so delegated. The auditors must have one year of industrial radiography (isotope) experience. The Internal Inspection Program is administered by the ARSO and RSO. The ARSO and RSO are exempt from audits.
- 4.3 Each Radiographer and Radiographer Assistants shall be evaluated in accordance with the audit checklist. (Pages 13 through 16).
- 4.4 Personnel shall be observed on license (regulation) and posting requirements, applicable records maintained, applicable records maintained, equipment used and observance of individual work practices. Findings shall be identified and corrective action for the findings will be indicated and reported to the RSO for management action as deemed necessary.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

TVA BYPRODUCT MATERIAL LICENSE NO. 41-06832-06

RADIOGRAPHER AND RADIOGRAPHER ASSISTANT AUDIT CHECKLIST

GENERAL INFORMATION

SITE: _____

LOCATION: _____

SOURCE — Co-60

CURIES _____

CAMERA MODEL NO. _____

SOURCE NO. _____

SOURCE IR-192

CURIES _____

CAMERA MODEL NO. _____

SOURCE NO. _____

SURVEY METER MODEL NO. _____

SERIAL NO. _____

CALIBRATION DUE DATE _____

RADIOGRAPHER(S) _____

ASSISTANT(S) _____

I. LICENSE	YES	NO	N/A
A. License and current amendment at site	_____	_____	_____
B. Amendment support documentation at site, i.e., operating and emergency procedure, NRC correspondence, etc.	_____	_____	_____

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

II.	POSTING	YES	NO	N/A
A.	Notice to employees - NRC Form 3	_____	_____	_____
B.	Proper posting to indicate presence of radioactive material (storage area)	_____	_____	_____
C.	Proper labeling of isotope container to indicate presence of radioactive material (Sideplates).	_____	_____	_____
D.	Proper posting of "RADIATION AREA" and "HIGH RADIATION AREA"	_____	_____	_____

RADIOGRAPHER AND RADIOGRAPHER ASSISTANT AUDIT CHECKLIST

III.	RECORDS	YES	NO	N/A
A.	Was utilization log properly completed?	_____	_____	_____
B.	Record of surveys	_____	_____	_____
C.	Record of receipt/transfer of isotopes	_____	_____	_____
D.	Record of leak tests and due date	_____	_____	_____

Due Date _____

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

IV. EQUIPMENT	YES	NO	N/A
A. Equipment maintenance program conducted	_____	_____	_____
B. Equipment condition adequate	_____	_____	_____
C. Were collimators used?	_____	_____	_____
D. Sufficient equipment available for project.	_____	_____	_____
 V. WORK PRACTICES			
A. Are all radiographic personnel wearing TLDs and calibrated dosimeters and Alarming Ratemeters?	_____	_____	_____
B. Did personnel properly survey source container and source tube after each exposure	_____	_____	_____
C. Did personnel properly control restricted area to prevent unauthorized personnel from entering area?	_____	_____	_____
D. Was the restricted area and high radiation properly posted?	_____	_____	_____
E. Did the personnel have and use a calibrated survey meter?	_____	_____	_____
F. Were radioactive isotopes stored properly and kept locked to prevent unauthorized removal?	_____	_____	_____
G. Were the personnel working with defective equipment?	_____	_____	_____
H. Did the radiographer and assistant have sufficient knowledge of safety rules (oral)?	_____	_____	_____
I. Proper surveying of transportation vehicle performed?	_____	_____	_____

**SUBJECT: DOCUMENTED TRAINING EXPERIENCE FOR RADIATION SAFETY OFFICER
AND RADIATION SAFETY COORDINATORS**

VI. COMMENTS

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

AUDIT CONDUCTED BY _____ DATE _____

RADIOGRAPHER/RADIOGRAPHER ASSISTANT ACKNOWLEDGMENT

1. TVA's audit representative has explained and I understand the items requiring corrective action listed above. The items listed above will be corrected in _____ days.
2. No corrective action required.

DATE _____ RADIOGRAPHER/RADIOGRAPHER ASSISTANT _____

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: OPERATING AND EMERGENCY PROCEDURE

TABLE OF CONTENTS

1.0	PURPOSE	
2.0	PERSONNEL MONITORING REQUIREMENTS	
3.0	CONDUCTING SURVEYS	
4.0	METHOD AND OCCASION FOR CONDUCTING RADIATION SURVEYS	
5.0	ACCIDENT NOTIFICATION PROCEDURE AND EMERGENCY INSTRUCTIONS	
6.0	STORAGE AND SECURITY OF SEALED SOURCES	
7.0	CONTROLLING ACCESS TO RADIATION AREAS	
8.0	HANDLING AND USE OF SEALED SOURCES AND EXPOSURE DEVICES	
9.0	LEAK TESTING	
10.0	INSPECTION AND EXPOSURE DEVICES	
11.0	TRANSPORTATION OF SEALED SOURCES	
12.0	MAINTENANCE OF RECORDS	
13.0	INSTRUCTION #1	-Description and operation of survey meters
	INSTRUCTION #2	-Establishment and monitoring of controlled/restricted areas
	INSTRUCTION #3	-Operation and use of Model 660 camera
	INSTRUCTION #4	-Instruction for use of Model 650L source changer
	INSTRUCTION #5	-Instruction for use of SPEC C-1 source changer
	INSTRUCTION #6	-Instruction for use of Model 680 camera
	INSTRUCTION #7	-Operation and use of self reading pocket dosimeter
	INSTRUCTION #8	-Daily Radiological Survey Report
	INSTRUCTION #9	-Guidelines for Daily Inspection of exposure devices
	INSTRUCTION #10	-Description and use of Tech/Ops leak test kit Model 518

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: OPERATING AND EMERGENCY PROCEDURE

TABLE OF CONTENTS

	INSTRUCTION #11	-Quarterly inspection checklist for exposure devices
	INSTRUCTION #12	-Instruction for completing Radiation Incident Report
	INSTRUCTION #13	-Tracking of sealed source
	INSTRUCTION #14	-Notice to Employees (NRC) and Energy Reorganization Act of 1974
14.0	FORM #1	-Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices (Model 660-Camera-USA/9033/B(U)) -Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices (Model 680-Camera-USA/9035/B(U)) -Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices (Source Changer 650 - USA/9032/B(U))
	FORM #2	-Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices (SPEC Model C-1 Source Changer-USA/9036/B)
	FORM #3	-Shipper's Certification for Radioactive Materials (Air Shipment Only)
	FORM #4	-Shipping Document/Radioactive Material (common carrier - other than air freight)
	FORM #5	-TVA Shipping Ticket (Alternate Form - Common Carrier)
	FORM #6	-Radioactive Material Receiving Report
15.0	TABLE #1	-Radiation Level/Distance for Cobalt 60 (unshielded)
	TABLE #2	-Radiation Level/Distance for Cobalt 60 (unshielded)
16.0	CHART #1	-Radioactive Labeling
	CHART #2	-Radioactive Placard
17.0	ATTACHMENT #1	-Radiation Safety Training Program

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: PURPOSE****1.0 Purpose**

This procedure defines mandatory requirements for TVA personnel who handle, use or supervise the use of by product materials for performing industrial radiography to ensure the safety of all personnel in radiation areas.

1.1 Scope

This procedure is applicable to all TVA personnel who may handle, use or supervise the use of byproduct material for the purpose of performing industrial radiography under the general license issued by the NRC (License #41-06832-06) as contained in Chapter 2.0.

1.2 Definitions

- 1.2.1 Becquerel (Bq) - The SI unit for radioactivity, defined as one nuclear disintegration/second. One curie is equal to 37 gigabecquerel (Gbg).
- 1.2.2 High Radiation Area means an area, accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation penetrates. Each high radiation area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words, "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."
- NOTE: The access to each high radiation area shall be under constant visual surveillance.
- 1.2.3 Industrial Radiography means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of by product materials.
- 1.2.4 Lost or Missing Licensed Material means licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced.
- 1.2.5 Quarter means a period of time equal to one-fourth of the year observed by the licensee (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.
- 1.2.6 Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 Gy).

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE**SUBJECT: PURPOSE**

- 1.2.7 Radiation Area means an area, accessible to individuals, in which radiation levels would result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- 1.2.8 Radiographer means any individual who performs or who, in attendance at the project where the sealed source or sources are being used, personally supervises the radiographic operation and who is responsible for assuring compliance with NRC regulation; D.O.T. regulations and license conditions. He is also directly responsible for job site safety as it pertains to the utilization of radioisotopes.
- 1.2.9 Radiographer's Assistant is an individual who uses radiographic exposure devices, sealed sources or related handling tools, or radiation survey instruments in radiography, under the direct personal supervision of a radiographer.
- 1.2.10 Radiographic Exposure Device means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for the purpose of making a radiographic exposure.
- 1.2.11 Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 Sv).
- 1.2.12 Restricted Area means an area, access to which is limited to the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Each restricted area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."
- 1.2.13 Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems).
- 1.2.14 Storage Container means a device in which sealed sources are transported or stored.
- 1.2.15 Source Changer means a device designed and used for replacement of sealed sources in radiographic exposure devices, including those also used for transporting and storage of sealed sources.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: PURPOSE

1.2.16 Survey means an evaluation of the radiological conditions and potential hazards incident to the use, transfer, or presence of radioactive material. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

1.2.17 Unrestricted Area means an area, access to which is neither limited nor controlled by the licensee.

NOTE: The dose in any unrestricted area from external sources shall not exceed .002 rem (0.02 mSv) in any one hour.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: PERSONNEL MONITORING REQUIREMENTS****2.0 PERSONNEL MONITORING REQUIREMENTS**

2.1 TLD Badge - Each individual performing industrial radiography or who has authorization to enter a restricted area shall be issued and wear a TLD badge. The TLD badge used shall be supplied and processed by Western Area Radiological Laboratory (WARL) or by a TVA nuclear facility. For TLDs, the maximum time for exchange and processing is quarterly.

2.1.1 WARL or a TVA nuclear facility shall maintain an Occupational External Radiation Exposure History for each individual with copies forwarded to the RSO for review and comment where applicable.

2.1.2 The RSO shall review TLD results for each monitoring period.

2.2 Pocket Dosimeters - Each individual performing industrial radiography or who has authorization to enter a restricted area shall wear a minimum of one pocket dosimeter. Each pocket dosimeter shall be capable of measuring from zero to 200 mrem minimum.

2.2.1 Pocket dosimeters shall be recharged and recorded at the beginning of each work shift in accordance with Instruction #7 and monitored periodically throughout the shift. Each dosimeter reading must be recorded at the beginning and end of each work shift on the Daily Radiological Survey Report (Instruction #8).

2.2.2 If an individual discovers a pocket dosimeter to be off scale, he shall stop work immediately and notify the Radiation Safety Officer (RSO), Assistant Radiation Safety Officer (ARSO), or Radiation Safety Coordinator (RSC), who will investigate. If determined by the investigation to be a known or suspected exposure to radiation, the individual's TLD shall immediately be processed. The individual involved shall not work with radioactive material or be allowed to enter a restricted area again until the results of the suspected exposure are evaluated by the RSO or ARSO.

NOTE: Nuclear plants may provide a dosimeter that may be used to replace one of the two pocket dosimeters. The nuclear plant dosimeter (at least 0 - 200 mrem range) shall be zeroed prior to use.

2.2.3 Pocket dosimeters shall be checked by WARL or a TVA nuclear facility at intervals not to exceed one (1) year for correct response to radiation.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: PERSONNEL MONITORING REQUIREMENTS**

- 2.3 Alarming Ratemeter - Each individual performing industrial radiography or who has authorization to enter a restricted area shall be issued and wear an alarming rate meter . Each alarming rate meter must:
 - 2.3.1 Be checked to ensure that the alarm functions properly (sounds) prior to use at the start of each shift.
 - 2.3.2 Be set to give an alarm signal at a preset dose rate of 500 mrem/h or less if required by a nuclear facility where radiography is performed.
 - 2.3.3 Require special means to change the preset alarm function and
 - 2.3.4 Be checked by WARL or a TVA nuclear facility at intervals not to exceed one year for correct response to radiation. Acceptable s must alarm within ± 20 percent of the true radiation dose rate.
- 2.4 Failure of any employee to wear their pocket dosimeters, TLD badge and alarming rate meter while working with licensed sealed sources shall be cause for disciplinary action up to and including termination of employment.
- 2.5 All TLDs, dosimeters, and alarming rate meters shall be stored away from sources of radiation that exceed background levels when they are not being used for monitoring purposes.
- 2.6 In the event an individual loses his/her TLD or the TLD is stolen, that individual shall not be allowed to continue radiographic operations. They shall immediately inform the RSO and nuclear facility of the circumstances surrounding the missing TLD. The RSO shall report the missing TLD to WARL. After a joint investigation conducted by the RSO and appropriate radiological control staff, they shall determine the accumulative dose to be included on the report for the respective individual (personal history record). Upon evaluation, the RSO will make the determination concerning continued work and disciplinary action if any.
- 2.7 Requirements for notification and reports to individuals reference Chapter 4.0 Section 12.0 Maintenance of Records.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: CONDUCTING SURVEYS****3.0 Conducting Surveys**

- 3.1 When conducting surveys, calibrated survey meters shall be used. Each radiographer shall be provided an operable and currently calibrated survey meter capable of measuring the range of 2 through 1,000 mrem/hs. Specific instructions for operation and description of survey instruments are detailed in Instruction #1.
- 3.2 Each radiation survey instrument shall be calibrated at intervals not to exceed three months and after each instrument repair and shall bear a current calibration sticker. It shall be the responsibility of each radiographer to verify operability and current calibration before use of any radiation survey instrument.
- 3.3 When making a survey, cautiously approach the camera from the rear with the survey meter extended in front of the body. The exposure device shall be surveyed 360°. Radiographic exposure devices measuring less than four (4) inches from the sealed source storage position to any exterior surface of the device (model 660) shall have no radiation level in excess of 50 mrem/h at six (6) inches from any exterior surface of the device. Radiographic exposure devices measuring a minimum of four (4) inches (model 680) from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources shall have no radiation level in excess of 200 mrem/h at any exterior surface, and ten (10) mrem/h at one meter from any exterior surface.
- 3.4 If the dose rate limits in 3.3 are exceeded initiate the accident notification procedure in Chapter 4.0, Section 5.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: METHOD AND OCCASION FOR CONDUCTING RADIATION SURVEYS

4.0 Method and Occasion for Conducting Radiation Surveys

4.1 Radiographers and their assistants are required to make radiation surveys for the following conditions.

- 4.1.1 Upon receipt and before shipment, packages shall be monitored as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours. Packages shall be monitored no later than 3 hours from the beginning of the next working day if they are received after working hours. Receipt shall be recorded on Form 7.
- 4.1.2 Before entering a radiographic storage facility.
- 4.1.3 Before securing an exposure device in a storage facility.
- 4.1.4 Before removing an exposure device from a storage facility.
- 4.1.5 Before removing a source from its fully shielded position.
- 4.1.6 For determining and monitoring the perimeter of the restricted area.
- 4.1.7 After returning a source to a fully shielded position. NOTE: The dose rate observed must be approximately the dose-rate before the exposure at contact.
- 4.1.8 Determining the radiation levels in and around vehicles used for transporting radioactive materials.
- 4.1.9 Determining that sources are in a safe storage position following source exchange and that the dose rates are acceptable.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: INCIDENT, THEFT, MISSING OR LOSS OF LICENSED MATERIAL
NOTIFICATIONS**

5.0 Incident, Theft, Missing or Loss of Licensed Material Notifications

- 5.1 In the event of an accident or incident involving radioactive sealed sources, initiate the procedure outlined in paragraph 5.3, then immediately notify one of the following persons:

<u>Name</u>	<u>Position</u>	<u>Work Phone</u>	<u>Home Phone</u>
W. E. Freeman	RSO	423-843-4393	423-894-1196
R. W. White	ARSO	423-843-4388	423-886-5527
G. W. Hembree	ARSO	423-843-4046	423-886-4789
J. W. Mefford	RSC	423-843-4273	423-775-0639

- (a) Emergency instructions will be given by one of the above personnel.
- (b) Where necessary, and by direction of the RSO, one of the following will be called upon for assistance.
- (c) When the event causes or threatens to cause personnel exposure, the RSO or ARSO shall review the event to determine if immediate or 24-hour notification to the NRC is required as specified in 10 CFR Part 20. The RSO shall determine whether it is necessary to make a report to the NRC using the criteria provided in 10 CFR Part 20.

<u>Name</u>	<u>Work Phone</u>
US NRC (Applicable Region) Region II	1-800-577-8510
NRC Operations Center	301-951-0550
Amersham Corporation	1-617-272-2000 or 1-800-225-1383

- 5.2 Reports of theft, or loss of licensed material must be made to the RSO immediately after its occurrence becomes known. The RSO or ARSO shall review the circumstances and report to the NRC as required in 10 CFR Part 20.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: INCIDENT, THEFT, MISSING OR LOSS OF LICENSED MATERIAL
NOTIFICATIONS**

5.3 Regardless of any equipment emergency circumstance, proceed as follows:

- a. Make an immediate radiation survey of the area surrounding the source.
- b. Establish or adjust barricades and postings restricting access to the area.
- c. Maintain direct surveillance of the area until the situation is corrected. If you are required to leave the scene, designate a reliable and responsible person to restrict access and provide him with explicit information and direction.
- d. Do not attempt to recover a sealed source that has fallen free of its container. Notify the Radiation Safety Officer, Assistant Radiation Safety Officer, or the Radiation Safety Coordinators. Inform him of details concerning the emergency and obtain directions on how to handle the situation.
- e. Within 24 hours, prepare a complete written report (Instruction 12) with details of the extent of exposure to radiation, levels of radiation, cause and nature of the accident and corrective steps taken to prevent recurrence. Submit the report to the Radiation Safety Officer.

5.3.1 Minimizing Personnel Radiation Exposure

5.3.1.1 Significant radiation exposure to personnel, associated with radiographic operations, almost always occurs as a direct result of failure to survey. Along with failure to wear personnel dosimetry, failure to survey cannot be tolerated. Reference Section 3.0 Conducting Surveys for specific information.

5.3.1.2 Accidents involving radioactive materials can occur. Incidents involving unplanned exposure to personnel must not occur. Some of the most probable accidents could include:

- a. Malfunctions of handling equipment during operations.
- b. Malfunctions of equipment in the transfer of sources from one container to another.
- c. Detachment of a radioisotope from its positioning equipment.
- d. Damage to a source or its container during transportation.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

**SUBJECT: INCIDENT, THEFT, MISSING OR LOSS OF LICENSED MATERIAL
NOTIFICATIONS**

- e. Fire damage to a source and/or its container.
- f. Human error, such as not properly attaching a source to its connector.

5.3.1.3 A radiation incident is the suspected or known exposure to personnel in excess of planned acceptable amounts. Examples are but not limited to:

- a. Unauthorized entry of monitored or non-monitored personnel in a restricted area.
- b. Dosimeter of radiographer observed to be off scale due to suspected or known exposure to radiation.

5.3.1.4 When accidents or incidents occur, exposure to personnel will be kept to a minimum only when surveys are properly performed. Additionally, the time, distance and shielding philosophy must be applied.

5.4 Regardless of the accident or incident, follow notification procedure and emergency instructions as set forth in Section 5.1, 5.2 and 5.3 above. The RSO shall maintain a "possible incident" file for review by management and/or regulatory authorities. (Reference Instruction #12).

5.5 If radiography personnel discover any malfunction or defect in the basic component of the radiography equipment, the RSO or ARSO shall be notified. The RSO or ARSO shall assess whether there is a substantial safety hazard that requires reporting under the requirements of 10 CFR Part 21 and/or Part 34.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: STORAGE AND SECURITY OF SEALED SOURCES

6.0 Storage and Security of Sealed Sources

- 6.1 Each radiographic exposure device and storage container shall be provided with a lock, designed to prevent unauthorized or accidental removal of, or exposure to a sealed source. They shall be kept locked at all times except when in use and under the direct surveillance of a radiographer.
- 6.2 Each radiographic exposure device containing a sealed source shall be stored in a container, room or exclusive use vehicle which is provided with locks and other safeguards necessary to prevent unauthorized removal. Each area or room which is used to store licensed material shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words, "CAUTION, RADIOACTIVE MATERIALS" or "DANGER, RADIOACTIVE MATERIALS."

NOTE: Constant surveillance of containers having sealed sources shall be maintained when containers are in a controlled or unrestricted area and not in storage.

- 6.3 A physical radiation survey shall be made at the outside surfaces of each storage area, and radiation levels at the surface shall not exceed 2 mrem/h. The radiation survey results shall be documented.
- 6.4 When the radiography van is used for storage, i.e., when the sources are not being transported, the posting requirements for a restricted area are applicable, and the vehicle shall be posted with "CAUTION - RADIOACTIVE MATERIAL" signs at each storage area access point. The radiation level at any exterior surface of the vehicle shall not exceed 2 mrem/h.
- 6.5 Only radiographers will maintain possession of keys to each source container or radiographic exposure device and source storage area and are responsible for controlling access.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: CONTROLLING ACCESS TO RADIATION AREAS

7.0 Controlling Access to Radiation Areas

- 7.1 Notification Instruction - Before establishing any temporary restricted area for radiography, the responsible radiographer or radiographer's assistant shall notify all personnel in the vicinity to evacuate the area.
- 7.2 Establishment of Controlled Access Area - Each radiographic area (radiation area) shall be barricaded, and roped off (yellow and magenta rope) or under constant direct surveillance of a radiographer or assistant radiographer. Whether the area is barricaded and roped off or under direct surveillance, posting shall always be required. The posting shall read "CAUTION RADIATION AREA." The perimeter of the high radiation area can be determined by referencing Table 1 or Table 2 as applicable. A radiation survey shall be made to adjust the boundaries of the radiation areas as necessary, once the source has been exposed. If the restricted area is established at the 2 mrem/h distance from the source, then the source may be safely exposed for the entire hour. If the exposure time is such that the source will be exposed only a short time, the dose rate at the perimeter of the restricted area may exceed 2 mrem/h provided that unmonitored personnel will not receive a cumulative dose greater than 2 mrem in any one hour at the perimeter of the newly established restricted area. The radiographer and/or assistant radiographer shall keep entrance or access points to the high radiation area under constant surveillance to protect against unauthorized entry. General purpose flashing warning lights (battery powered) should be used at entrances to the radiation area.
- 7.3 Detailed instructions for establishing radiographic areas are defined and shall be in accordance with Instruction #2.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: HANDLING AND USE OF SEALED SOURCES AND EXPOSURE DEVICES****8.0 Handling and Use of Sealed Sources and Exposure Devices**

- 8.1 Only radiographers or radiographer assistants under the direct supervision of a radiographer shall handle or use sealed sources or exposure devices.
- 8.2 Before the handling and use of exposure devices containing sealed sources, the radiography personnel shall:
- a. Assure they have on their person personal dosimetry consisting of one TLD badge, two pocket dosimeters capable of reading 0-200 mrem at a minimum, and one alarming . They shall assure that pocket dosimeters are zeroed and recorded at the beginning and at the end of the shift on the Daily Radiological Survey Report.
 - b. Inspect all safety equipment for proper operability. This shall consist of but not be limited to, exposure devices, crank assemblies, source guide tubes, survey meters, flashing lights, etc. Document results on the Daily Radiological Survey Report. Defective equipment shall be removed from the equipment inventory. Defective equipment shall not be utilized in the performance of industrial radiography. Assuring adequate equipment and satisfactory working condition of all equipment is the responsibility of the radiographer.
 - c. Utilize the measures outlined in Section 7.0 "Controlling Access to Radiation Areas" and minimize and limit radiation exposure to personnel, and proceed as follows.

- 8.2.1 After removal from storage, monitor radiation levels around the entire circumference of exposure device and record on Daily Radiological Survey Report (Instruction #8).

8.2.1.1 Radiation levels shall not exceed the following:

200 mrem/h at any exterior surface and 10 mrem/h at one meter (39.37 inches) for all storage containers for sealed sources or radiographic exposure devices, where the sealed source is stored inside at a minimum of 4 inches from any exterior surface and 50 mrem/h at 6 inches from any exterior surfaces for containers for sealed sources or radiographic exposure devices when the sealed source is stored less than 4 inches from any exterior surface.

- 8.2.1.2 If the radiation level exceeds those specified above for the particular device being monitored, isolate and post the area and follow the accident notification procedure as specified in Section 5.0.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: HANDLING AND USE OF SEALED SOURCES AND EXPOSURE DEVICES

- 8.3 The operating procedures for each of the radiographic exposure device are typically the same since control mechanisms and cable connections are interchangeable.

For specific instructions on the operations of each exposure device reference:

- a) Instruction #3 -Amersham Model 660A or 660B capacity 100 curies Ir-192
- b) Instruction #4 -Amersham Model 650L capacity 200 curies Ir-192 (source changer)
- c) Instruction #5 - Amersham Model 680A or 680B capacity 100 curies Co-60

8.3.1 Typical instructions on the handling and use of sealed sources and exposure devices are:

- a) Once the requirements of paragraph 8.2.1 have been satisfied and the source secured, remove the protector cap from the lock box thereby exposing the pigtail connection. (The device is locked with the source secured, the lock box must be in the connect position with Amersham equipment).
- b) Crank the control cable forward slightly to facilitate connecting to the pigtail.
- c) Connect control cable to pigtail (double check the connection by gently tugging on the control cable).
- d) Crank control cable in until the connecting studs engage with the lock box.
- e) Remove safety plug from the "out" connection of the exposure device and connect the guide tube. Make sure that the master guide tube with the snout or source stop at the end is connected at the end of the guide tube.
- f) Extend the guide tube and control cables in as near a straight line as possible and place free end of guide tube at the exposure position.
- g) Unlock exposure device. Unit is ready to operate.
- h) Crank source out as smoothly as possible. When you anticipate that the sources approaching end of source guide tube, reduce to a slow turning speed so that source capsule does not strike the end of the source guide tube with undue force.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: HANDLING AND USE OF SEALED SOURCES AND EXPOSURE DEVICES

- i) Survey the perimeter of the restricted area to assure the radiation levels are within limits.
- j) At the end of the exposure, retract the source into the unit.
- k) Carefully survey the entire circumference of the camera to be sure that the source has returned to a safe shielded position and compare to the readings obtained in Step 8.2.1. If these readings exceed the initial intensity, maintain control of the area, and follow the accident and notification procedure as outlined in Section 5.0. If the radiation level compares with the readings obtained in Step 8.2.1, then, lock the camera and remove the key. Continue survey to include source guide tube to extent that all accessible portions of the source guide tube have been surveyed.
- l) Disconnect guide tube, replace safety plug.
- m) Disconnect control cable and pigtail, place protector cap in lock position.
- n) Return exposure device and associated equipment to storage area. Before storage, survey entire circumference of camera to determine if source is properly stored. These readings should compare with those obtained in Step 8.2.1. (Record on Daily Radiological Survey Report shown as Attachment to Instruction #8.)

8.3.2 Whenever it becomes necessary to replace sealed sources within radiographic projectors, the operation shall be performed in accordance with Instruction #5a, (Instruction for use of Tech/Ops Model 650L source changer) or Instruction #5b, (SPEC) Source Protection and Equipment Company Model C-1 (source changer).

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: LEAK TESTING**9.0 Leak Testing

- 9.1 Each sealed source shall be tested for leakage at intervals not to exceed six months. In the absence of a certificate from a transferor or that a test has been made within the preceding six month period, the sealed source shall not be placed into use until leak test results have been evaluated and confirmed that leakage does not exist. Leak test shall also be performed when the source is suspected of leakage due to damage or container deterioration.

NOTE: Use or shipment of a sealed source by common carrier shall not take place until results are confirmed that leakage does not exist (a documented teleconversation is acceptable).

- 9.2 Each source container shall possess a label indicating when the initial leak test was performed by the manufacturer.
- 9.3 The source supplier is responsible for leak testing the source before shipment to TVA. The radiographer is responsible for the leak test at the jobsite. Leak tests shall be conducted before:
- a) Six months due date expiration.
 - b) Or upon suspected leakage. The source shall not be utilized when leakage is suspected and the source shall not be shipped by common carrier until results have been confirmed as no detectable leakage.
- 9.4 Personnel performing the leak test shall wear one TLD badge and a minimum of one dosimeter and an alarming rate meter. A calibrated survey meter shall also be utilized while performing the leak test in accordance with Instruction #10.
- 9.5 Leak testing of source changers are the responsibility of the source supplier.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: INSPECTION OF EXPOSURE DEVICES****10.0 Inspection of Exposure Devices**

- 10.1 All radiographic exposure devices, storage containers, and source changers shall be inspected for obvious defects each day they are in use. The inspection shall be performed by the radiographer.
- 10.2 All equipment that is rendered inoperable shall be immediately removed from circulation. The immediate supervisor shall be informed so the necessary action will take place, i.e., repair or replace.
- 10.3 The daily inspection shall consist of checking for unusual defects of all connectors for: drive cables, source guide tubes and other moving parts that could impair radiography safety. (Reference Instruction #9/Note on DRSR results). Additionally, each radiographic exposure device must have attached to it a durable, legible, clearly visible label bearing:
- a) Chemical symbol and mass number of radionuclide in the device;
 - b) Activity and the date on which this activity was last measured;
 - c) Model number and serial number of the sealed source;
 - d) Manufacturer of the sealed source; and
 - e) TVA location, and emergency telephone number.
- 10.4 A more detailed equipment inspection must take place quarterly. The radiographer inspects for wear and deterioration of the equipment. Dismantling of the equipment will be necessary where required. The inspection shall not exceed three months (plus or minus 2 weeks) or before the first use thereafter. A list of items to inspect are described on the Quarterly Inspection Checklist (Instruction #11 with Attachment).
- 10.5 Special non-routine inspections are to take place should the following conditions exist:
- a) Exposure device dropped.
 - b) Exposure device submerged in water.
 - c) Exposure device exposed to fire.

Once the exposure device, storage container or source changer has been surveyed, the radiographer must contact the RSO, ARSO, RSC. Details of the situation must be given. The radiographer must complete the Quarterly Inspection Checklist to determine the extent of damage. The results shall be forwarded to the RSO for evaluation and dispositioning.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: TRANSPORTATION OF EXPOSURE DEVICES****11.0 Transportation of Sealed Sources**

11.1 Radiographers are responsible for arranging transportation for the sealed sources. Generic requirements are:

- a) Radiographers are responsible for notifying the RSO or his designee before transporting or shipping any isotope from one location to another.
- b) Whenever a radiographic exposure device containing a sealed source is transported, it shall be secured and locked to prevent theft or loss, and the device and/or container shall be securely fastened to prevent shifting in transit.
- c) A physical radiation survey shall be performed as outlined in paragraph 8.2.1. If the radiation level exceeds these requirements or if at the vehicle exterior surface of the driver's compartment exceeds 2 millirem/h, the radiographic exposure device will not be transported without the RSO or his designee cognizance and approval.
- d) The radiographer must exercise the utmost discretion to protect the vehicle and its contents from damage, theft, or loss. The vehicle must be kept locked unless under direct surveillance of the radiographer or assistant radiographer.
- e) Leak test analysis is not required before shipment by common carrier or TVA exclusive use vehicle when a test has been performed and documented within the preceding six months.
- f) An exposure device requiring a "Radioactive Yellow III" label requires vehicle placarding. No shipment of materials requiring Radioactive Yellow III labeling shall be made without prior approval and instructions from the RSO, A&SO, or RSC.
- g) Radioactive materials may be shipped only in approved containers that meet Department of Transportation (DOT) Type B packaging specifications. The RSO maintains a certificate of compliance (COC) for all source packaging.
- h) Before each shipment, ensure that the quality control requirements located on the reverse side of shipping Form 1 have been met.
- i) Proper shipping papers must be completed for all radioactive material shipments.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: TRANSPORTATION OF EXPOSURE DEVICES

11.2 Package QA Program Requirements

11.2.1 Quality related functions involved with radioactive material shipping packages for NRC material license 41-06832-06 are described in TVA's Quality Assurance Program Description for Radioactive Material Shipping Packages. The Package Quality Assurance Program (PQAP) is directed at providing appropriate control of quality in relation to the importance of the activity or item to radiological safety. The PQAP describes the activities that satisfy the requirements of subpart H of 10 CFR 71. These activities include, in part, provisions for the following:

- a) Training, qualification and proficiency of employees used in the performance of quality related activities involving licensed shipping packages.
- b) Maintaining current vendor instructions and drawings involved in the maintenance and preparation of packages for shipping.
- c) Instructions for preparing, packaging, transporting and receiving of licensed packages.
- d) Control of documents and records that involve QA activities.
- e) Identification and resolution of adverse conditions.

11.3 Shipment of Radioactive Materials

11.3.1 When the shipment is by TVA exclusive use vehicle (enclosed vehicle only), the following is applicable:

Select the appropriate form as it pertains to the container being shipped.

e.g., Form 1 - 660A/660B Camera - USA/9033/B(U)
 - 680A/680B Camera - USA/9035B (U)
 - 650L Source Changer - USA/9269(U)

11.3.2 The forms referenced in paragraph 11.3.1(a) include the following information:

- a) The DOT proper shipping name is "Radioactive Material, Special Form n.o.s." Also, the hazard identification number is 7, special form is "UN2974".

NOTE: n.o.s. means "Not Otherwise Specified". Additionally, for the purpose of TVA's NRC byproduct material license, special form means encapsulated Iridium-192 or Cobalt-60.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: TRANSPORTATION OF EXPOSURE DEVICES**

- b) The name of the radionuclide - either Iridium-192 or Cobalt-60.
- c) Physical and chemical form of the material - indicate "Special Form".
- d) The activity contained in each package measured in curies - This applies to camera/source changers loaded with a sealed source. For empty cameras/source changers reference paragraph 11.3. The letters RQ shall be entered if the package contents are equal to or more than 10 curies.
- e) The category of label applied to each package - Radioactive White I, Radioactive Yellow II, or Radioactive Yellow III also reference Chart 1.
- f) The package certificate identification.
- g) Shipper's certification statement (49 CFR)

11.3.3 Shipments by air shall not take place until approval and instructions have been provided by the RSO.

11.4 Shipment of Empty Uranium Shielded Containers

11.4.1 Ensure that the package does not contain a radioactive source.

11.4.2 If the package is to be placed inside an outer enclosure, the outer enclosure must be strong enough to withstand the normal conditions of transportation. The package must be placed in the outer enclosure with sufficient blocking to prevent shifting during transportation. The outer enclosure must be secured from unauthorized access and will serve as the final shipping package once and will serve as the final shipping package once labels have been applied to the enclosure.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: TRANSPORTATION OF EXPOSURE DEVICES

11.4.3 Survey the package at the distance of one meter from the surface to determine the proper radioactive shipping labels to be applied to the package.

- (a) If the surface radiation level does not exceed 0.5 mrem/h and there is no measurable radiation level at one meter from the surface, no label is required.

Mark the outside of the package with the proper shipping name and identification number (Radioactive Material, Excepted Package - Articles Manufactured from Depleted Uranium, UN 2910) and the statement "EXEMPT FROM SPECIFICATION PACKAGING, SHIPPING PAPER AND CERTIFICATION, MARKING AND LABELING AND EXEMPT FROM THE REQUIREMENTS OF 49CFR PARTS 171 - 178 Except requirements within those parts relating to the reporting of incidents. This exemption is Authorized per 49 CFR 173.426."

Additionally, a notice must be enclosed in or on the package, included with the packing list or otherwise forwarded with the package. The notice must include the name of the consignor or consignee and the statement:

"This package conforms to the conditions and limitations specified in 49CFR173.426 FOR Exempted radioactive Material, Articles Manufactured from Depleted Uranium, UN 2910".

- (b) If the surface radiation level exceeds 0.5 mrem/h, or if there is a measurable radiation level at one meter (39.37 inches) from the surface, use the criteria of Chart 1 to determine the proper radioactive shipping labels to be applied to the package. Mark the outside of the outer package "RADIOACTIVE-LSA" with the proper shipping name (RADIOACTIVE MATERIAL, LSA, n.o.s., 7, UN2912) and the Identification Number (UN2912). If the container is packaged inside a crate or other outer packaging and mark the outer package with the statement: "Inside Package Complies with Prescribed Specifications."

Properly complete the shipping papers indicating:

- 1) Proper shipping name (Radioactive Material, LSA, n.o.s., 7, UN2912) and identification number (UN2912)
- 2) Name of Radionuclide (Depleted Uranium)
- 3) Physical and Chemical Form (Solid Metal)

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: TRANSPORTATION OF EXPOSURE DEVICES

- 4) Activity (in curies or millicuries)
- 5) Category of Label Applied (i.e., Radioactive Yellow II)
- 6) Transport Index
- 7) USNRC Identification Number or DOT Specification Number
- 8) Shipper's Certification

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

12.0 Maintenance of Records

- 12.1 The records shall be maintained at the office of the RSO. The records shall be available or inspection when requested by regulatory authorities. Maintenance of the following records are the responsibility of the RSO.

<u>Record</u>	<u>Retention Period</u>
a. Survey Instrument Calibration (not to exceed three months after servicing)	3 years
b. Quarterly Equipment Inventory	3 years
c. Utilization Logs (Daily Radiological Survey Report) which indicate; exposure device or storage container for each source; the radiographer assigned, this site used and dates of use.	3 years
d. Quarterly Inspection of Exposure Devices	3 years
e. Personnel Monitoring	
(1) Dosimeter readings	3 years
(2) TLD results	Until Release by NRC
f. Radioactive Material Receiving Report	2 years
g. Records of Radioactive Material & Transfer	5 years
h. Quarterly Audit of Radiographer & Radiographer Assistants	3 years
i. Leak test results	3 years
j. ALARA Program Audits and Reviews	3 years

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: MAINTENANCE OF RECORDS**

Survey instrument calibration, dosimeter calibration, and TLD results are maintained by Western Area Radiological Laboratory (WARL) or a TVA nuclear facility, with copies forwarded to the RSO.

- 12.2 The Daily Radiological Survey Report shall serve as a utilization log and a daily equipment inspection check. The report shall be completed on a daily basis only when the source is out of storage for the purpose of performing industrial radiography. The report is not required when the source is in storage. By the 15th of the month, the preceding months original DRSRs shall be forwarded to the RSO.

- 12.3 Radiographers shall complete a Tracking of Sealed Sources Form as event occurs. This inventory shall serve as source tractability, i.e., when and where shipped and received by whom. The inventory is applicable for exposure devices and their contents only (Instruction #13).

Leak testing of source changers are the responsibility of the sources supplier.

- 12.4 Reports of individual exposure monitoring

TVA shall advise each worker annually of the worker's dose. At the request of the worker formerly engaged in licensed activity, TVA shall furnish to the worker a report of the worker's exposure within 30 days from the time the request was made or within 30 days after the exposure of the worker has been determined.

- 12.5 Manual Control

- 12.5.1 TVA's Industrial Radiography Manual Log, provides the RSO a listing of all assigned controlled manuals.

- 12.5.2 TVA's Industrial Radiography Manual Transmittal Procedure serves to assure the auditor and auditee that this manual is accurate and up to date.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: MAINTENANCE OF RECORDS

SUBJECT: TVA'S INDUSTRIAL RADIOGRAPHY MANUAL

TRANSMITTAL PROCEDURE

BULLETIN TITLE RECEIVED

DATED

FILED

#1

#2

#3

#4

#5

#6

#7

#8

#9

#10

TVA'S INDUSTRIAL RADIOGRAPHY MANUAL LOG

[illegible]

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTIONS

TABLE OF CONTENTS

INSTRUCTION #1	-	Description & operation of survey meters
INSTRUCTION #2	-	Establishment and monitoring of controlled/restricted areas
INSTRUCTION #3	-	Operation and use of Tech/Ops Model 660A or 660B camera
INSTRUCTION #4	-	Instruction for use of Tech/Ops Model 650L source changer
INSTRUCTION #5	-	Instruction for use of SPEC C-1 source changer
INSTRUCTION #6	-	Instruction for use of Tech/Ops Model 680A or 680B camera
INSTRUCTION #7	-	Operation and use of self-reading pocket dosimeter
INSTRUCTION #8	-	Daily Radiological Survey Report
INSTRUCTION #9	-	Guidelines for Daily Inspection of exposure devices
INSTRUCTION #10	-	Description and use of Tech/Ops leak test kit Model 518
INSTRUCTION #11	-	Quarterly inspection checklist for exposure devices
INSTRUCTION #12	-	Instruction for completing Radiation Incident Report
INSTRUCTION #13	-	Tracking of sealed sources
INSTRUCTION #14	-	Notice to Employees (NRC) and Energy Reorganization Act of 1974

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #1
DESCRIPTION AND OPERATION OF SURVEY METERS

Operation of the Eberline Model E-130, Ludlum 5-5 and ND2000

1. Survey meters shall have a range such that 2 milliroentgens through one roentgen per hour can be measured.
2. Check for physical damage and current calibration.
3. Turn the switch or depress the button to BATTERY check position as applicable. The meter should indicate within the BATT OK area.
4. Adjust the switch to the highest position before approaching the exposure device. As you approach the exposure device, observe the meter reading.
5. Adjust the RESPONSE control to get the most desirable compromise between speed of response and meter fluctuation.

NOTE: A field operational check of the survey instrument shall be performed to verify that it is functioning and reliable. This shall be accomplished by placing the survey meter in contact with the exterior surface of the exposure device. Record the response in milliroentgen on the Daily Radiological Survey Report (Instruction #8), in the Removed From Storage Block.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #2

ESTABLISHMENT AND MONITORING OF CONTROLLED/RESTRICTED AREAS

1. Use this instruction for all radiographic operations (except cabinet).
2. Obtain the following equipment before conducting radiographic operations:
 - a. Survey meters
 - b. Pocket Dosimeters and alarming rate meters
 - c. TLDs
 - d. Signs

NOTE: In addition to required radiation and high radiation signs, at least one plant entrance shall be posted with information signs notifying plant personnel where and when radiography is to be performed.

- e. Yellow and magenta rope/ribbon
 - f. Flashing lights
3. Before establishing a controlled/restricted radiation area, ensure that appropriate supervisors are aware of scheduled radiographic operations.

NOTE: When performing industrial radiography on TVA's nuclear facilities, site Radiological Control (RADCON), instructions must be followed as long as they meet the minimum requirements of the byproduct material license.

4. Determine the approximate exposure time based on the parameters of the technique.
5. Remove unauthorized personnel from the proposed restricted area. Make voice amplified announcements to clear the immediate area of non-radiography personnel. Establish the restricted area boundary so that no individual could receive in excess of 2 mrem in any one hour. Place any ropes and postings at a height of approximately three feet.

NOTE: An area is not a restricted area until all required postings and barriers have been established.

6. The perimeter of the restricted area shall be under surveillance that is conducted in a manner that prevents unauthorized entry into the high radiation area. (Refer to Step 12 for unauthorized entry into the restricted area.)
7. Flashing lights shall be used to augment required postings. They should be located at the highest probable barrier approaches, e.g., doors, corridors, ladders, etc.
8. Post 100 mrem/h distance with "High Radiation Area" signs.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #2 (Continued)

ESTABLISHMENT AND MONITORING OF CONTROLLED/RESTRICTED AREAS

9. Maintain direct surveillance of access points to the high radiation area perimeter, and proceed in accordance with the applicable equipment operation technique.
10. During the initial exposure(s), verify the dose rate at the perimeter and make any necessary adjustments to the restricted area boundary.
11. At the discretion of the radiographer, essential non-radiography personnel (e.g., fire watch) requesting entry into the area where radiography is being performed may be allowed controlled entry providing:
 - a. The source is in a fully retracted/shielded position.
 - b. A (minimized) portion of the boundary has been removed to allow a controlled point of entry and exit. This would normally involve dropping a section of the barrier rope, signs face down and lights turned off or relocated away from the area where the rope has been deleted.
 - c. At least one radiographer or assistant radiographer shall control the entry point where the barrier was deleted.
 - d. In conjunction with c above, one additional radiographer or assistant radiographer shall be available to provide continuous surveillance of the source container.
 - e. Radiography shall resume when all non-radiography personnel have been accounted for and have exited the area.
12. If unauthorized personnel enter the controlled/restricted area:
 - a. Minimize exposure by:
 1. Retracting the source in a safe manner that minimizes exposure to personnel, and
 2. Taking the individual outside the area and obtain their statement.
 - b. Notify the Radiation Safety Officer (RSO), Assistant Radiation Safety Officer (ARSO), or the Radiation Safety Coordinator (RSC) (reference Instruction #12).

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: INSTRUCTIONS**INSTRUCTION #3OPERATION AND USE OF TECHNICAL OPERATIONS MODEL 660 CAMERA
CAPACITY - 100 CURIES, IRIIDIUM-192

This unit has lightweight portable storage safe using depleted uranium for a shielding material. The control unit, which includes control cables and guide tubes, is a removable storage reel.

Size: 14" x 4-1/2" x 9-1/2"

Weight: 38 pounds

Guide Tube: 21 ft. long (three 7-ft. sections)

Control Cable: 25 ft. long

1. Remove the protector cap from the lock box, thereby exposing the pigtail connection.
2. Crank the control cable forward slightly to facilitate connection to the pigtail.
3. Connect control cable to pigtail.
4. Crank control cables in until the connecting studs engage with the lock box.
5. Remove safety plug from the "out" connection of the exposure device and connect the guide tubes. Make sure that the master guide tube with the snout or source stop at the end is connected at the end of the guide tube.
6. Extend guide tube and control cables in as near a straight line as possible and place free end of guide tube at the exposure position. Ensure that the available length of drive cable is greater than the total length of guide tubing.
7. Unlock exposure device. Rotate the selector ring to operate. Push the slide bar from left to right until the red marking fully appears on the right side of the selector ring (snaps in place).
8. Survey to determine that radiation levels do not exceed 2 mrem/h at the boundaries or perimeter of the radiographic area.
9. At the end of exposure, retract source into unit.
10. Survey Camera and Guide Tube carefully to be sure that source has returned to safe position.
11. Disconnect guide tube, replace and lock safety plug.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #4

INSTRUCTION FOR USE OF TECH/OPS MODEL 650L SOURCE CHANGER

GENERAL DESCRIPTION:

The source changer model 650L is a portable, shielded container for transferring encapsulated radioisotope sources into model 660 radiography projectors. The changer is designed to safely contain the radiographic sources during shipment to permit field exchange of old for new sources without exposing the operator to unsafe radiation levels. The source changer has depleted uranium, for shielding.

QUICK REFERENCE:

Source Types	Sealed sources
	Isotope: Iridium-192
	Radiation: Gamma Rays
Container Capacity	Iridium-192: 200 Curies \pm 20%
Shielding	Depleted Uranium (U238), Weight 42 lbs.
Housing	Steel
Design	Type B Package - USA/9269B(U)
Dimensions	8.25 in. wide; 10 in long; 13.25 high
Shipping Weight	90 lbs maximum

OPERATION:

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

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

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: INSTRUCTIONS**INSTRUCTION #4 (Continued)INSTRUCTION FOR USE OF TECH/OPS MODEL 650L SOURCE CHANGER

Operations

NOTE: All the precautions used when making radiographic exposures must be followed during a source changing operation.

1. Upon receipt of the source changer, survey the source changer to ensure that the source is in the proper storage position. Radiation levels should be less than 200 milliroentgens per hour at the surface of the container and less than 10 milliroentgens per hour at one meter from the surface.

If either of these radiation levels are exceeded, place the source changer in a restricted area and notify the Radiation Safety Officer. The Radiation Safety Officer must notify the U.S. Nuclear Regulatory Commission, the final delivering carrier and Amersham immediately.

Visually inspect the source changer for signs of damage, and assure that the seal wire has not been tampered with.

2. Locate the source changer and radiographic exposure device in a restricted area. Arrange them so that one length of guide tube will fit between them without any sharp bends or kinks in the tube.

The bend radius of the source guide tube during source changing operations should be greater than 20 inches.

NOTE: THE SOURCE CHANGER MUST REMAIN UPRIGHT AT ALL TIMES. DO NOT LAY THE SOURCE CHANGER ON ITS SIDE.

3. Locate the control as far away as possible from the exposure device and the source changer, preferably behind any available radiation shielding.
4. Remove the cover from the source changer by breaking the seal wire and removing the four bolts.
5. Remove the source holddown caps by unthreading the caps.
6. Open the lock above the empty chamber of the source changer by inserting key, turn key clockwise until it releases, pull slide out. Connect one end of the guide tube extension to the exposure device and the other end to the outlet fitting above the empty chamber.
7. Set the radiographic exposure device as for an exposure.
8. Assure no unauthorized personnel are in the restricted area and all access points are secured.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

9. Position survey meter close to the operation control point so as to continuously monitor dose rate to which operator is exposed.
10. At the exposure device controls, crank the source rapidly from the exposure device to the source changer. The radiation intensity should greatly increase as the source is first exposed, decrease slightly as the source is being cranked out from the exposure device to the source changer and then drop to background when the source is in the source changer.
11. Approach the exposure device with a survey meter; survey the exposure device on all sides, survey the guide tube and survey the source changer on all sides to assure the source has been properly transferred and stored. The maximum radiation level should be less than 200 mR/hr at the surface of the source changer and less than 10 mR/hr at one meter from the surface of the source changer.
12. When you have assured the source is in the fully shielded position, lock the spent source in the source changer by pushing the lock slide in, rotating the key counter clockwise and depressing the lock. Disconnect and pull back the guide tube to expose the source/drive cable connection. Disconnect the drive cable from the source assembly by moving the lock pin of the source connector down towards the source and slide the drive cable out through the keyway.
13. **WITHOUT UNLOCKING THE SOURCE**, couple the drive cable to the new source by depressing the lock pin, sliding the drive cable connector into the keyway and releasing the lock pin. Assure that the connection is secure before continuing.
14. Connect the guide tube to the outlet fitting of the lock. Unlock new source by inserting key, turn key clockwise until it releases, pull slide out. Assure no unauthorized personnel are in the restricted area.
15. At the exposure device controls, crank the new source from the source changer to its storage position in the exposure device. Observe the survey meter operation. The radiation intensity should increase as the source exits the source changer. The radiation intensity should steadily increase as the source travels to the exposure device and drop to background when the source is properly stored in the exposure device.
16. Approach the exposure device with the survey meter, survey the exposure device on all sides, survey the length of the guide tube, and survey the source changer on all sides to assure the source has been properly transferred to its storage position in the exposure device. Radiation levels should be less than 200 mR/hr at the surface and less than 10 mR/hr at one meter from the surface.
17. When the source is determined to be properly stored, lock the exposure device and remove the guide tube and controls. Disconnect the guide tube from the source changer.
18. Attach a source holddown cap over the old spent source in the source changer. Attach the identification plate of the old source to the holddown cap. Attach a holddown cap to the empty chamber.
19. Affix the identification plate of the new source to the exposure device.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

20. Bolt the source changer cover in place and seal wire. If the source changer is to be shipped inside outer packaging or barrel, mark the outside package "INSIDE PACKAGE COMPLIES WITH PRESCRIBED SPECIFICATIONS USA/9269/B(U) Type B." If an outer barrel is used as an over pack, it must be fastened with seal wire.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #5

INSTRUCTION FOR USE OF SPEC C-1 SOURCE CHANGER

1. Survey exterior of shipping package. If radiation intensity exceeds 200 mrem/h., notify Radiation Safety Officer. Otherwise, proceed as follows.
2. Inspect tamper seal on package (drum) closure ring. If not intact, notify RSO. Otherwise, proceed as follows.
3. Remove tamper seal, open drum, remove decay chart envelope, and remove C-1 source changer from drum.

Source Exchange Preparation

IMPORTANT: Use only a properly functioning and calibrated survey meter at all times.

1. Place C-1 and exposure device on flat stable surface approximately two feet apart. position outlet end of exposure device toward rear of C-1.
2. Rotate C-1 carrying handle to fall against rear wall (toward exposure device).
3. Unlock C-1 padlock using key provided in decay chart envelope. Open top door.
4. Gently lay C-1 on its back. (The C-1 will be slightly inclined due to resisting upon carrying handle). Open front door.
5. Remove changer tube and connect to exposure device and EMPTY side of C-1. Pull both connections to ensure secure installation.
6. Open EMPTY side of C-1 by pulling up string-loaded plunger knob rotating slightly. The knob must be rotated in either direction to keep plunger in the retracted (open) position.

NOTE: The spring-loaded plunger secures a source in the C-1 by pushing a rod against the pigtail cable (directly behind the source capsule) once the source has been fully installed within the shield. If the plunger is not retracted, the source is able to enter the C-1, but WILL NOT be in the shielded area and WILL NOT be able to be secured in place.

THE EMPTY SIDE PLUNGER OF C-1 MUST BE RETRACTED BEFORE PROCEEDING

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #5 (Continued)

INSTRUCTION FOR USE OF SPEC C-1 SOURCE CHANGER

Exchanging Source
From Exposure Device to C-1

1. Attach control assembly according to normal operating procedures.
2. With survey meter in hand, extend control assembly to it fullest extent, unlock exposure device and crank source into C-1.
3. While apply slight forward pressure on crank arm, approach C-1 with survey meter. Carefully survey exchanger tube, C-1, and exposure device. If high radiation intensity is detected, return source to exposure device and notify RSO. If radiation intensity is safe, proceed as follows.
4. Rotate plunger knob until plunger snaps into its original engaged (closed) position.
5. Extend control assembly and very gently attempt to crank source out of C-1. Resistance will indicate that the source is properly secure. Verify by surveying.
6. While applying forward pressure on crank arm, carefully disconnect end of exchanger tube attached to C-1. CAUTION: Once disconnected, DO NOT pull exchanger tube away from C-1. Remember, the source is still attached to the drive cable.
7. Gently crank FORWARD until approximately two feet of drive cable has been exposed.
8. Carefully disconnect drive cable from source according to normal operating procedures.
9. Verify that the source has been properly secured in the shielded position by surveying.

Exchanging Source
From C-1 to Exposure Device

CAUTION: The C-1 lock plunger must remain in its original, fully engaged (closed) position until instructed otherwise. (Step 14)

10. Connect control assembly to EMPTY exposure device according to normal operating procedures.
11. Connect exchanger tube to exposure device and loaded side of C-1 to establish proper distance between the units. Disconnect exchanger tube from C-1 and crank forward until approximately two feet of drive cable is exposed.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #5 (Continued)

INSTRUCTION FOR USE OF SPEC C-1 SOURCE CHANGER

Exchanging Source
From C-1 to Exposure Device

12. Connect drive cable to source according to normal operating procedures.
13. Gradually crank drive cable backward until all slack is removed. Connect the exchanger tube to C-1 and gently pull both exchanger tube ends to ensure secure connections.
14. Open lock plunger by pulling up and rotating slightly. (Refer to Step 6 above.)
15. With survey meter in hand, extend the control assembly completely and crank source into exposure device.
16. Approach exposure device with survey meter in hand, survey exchanger tube, exposure device and C-1. If high radiation intensity is detected, crank source back into C-1 following step 2 through 5 above and notify RSO.

NOTE: If unable to shield source in either unit, immediately follow established emergency procedures found in Section 5.0 of this manual.

If survey indicates safe radiation intensity, lock exposure device, and proceed as follows.

17. Disconnect exchanger tube, insert inside C-1, close and lock C-1, and prepare for shipping. Instructions follow.
18. Place C-1 in shipping drum, insert packing material as needed to prevent excessive movement of C-1 inside drum, install lid, closure ring, and tamper seal.
19. Survey exterior of drum. Radiation intensity must not exceed 200 mrem/h at surface or 10 mrem/h at one (1) meter. Prepare shipping documents according to applicable requirements.

NOTE: If transported EMPTY, the labeling and documents must be completed accordingly.

20. The CONSIGNOR or CARRIER of this package is required to comply with any requirement of the Government of any country through or into which the package is to be transported. Contact Source Production & Equipment Company, Inc., if assistance is required.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #6

INSTRUCTION AND USE OF TECH/OPS MODEL 680 CAMERA
CAPACITY - 100 CURIES, COBALT-60

This unit is a portable storage safe using depleted uranium for a shielding material. The control unit, which includes control cables and guide tubes, is a removable storage reel.

Size: 21" x 14-3/4" x 11-3/16"

Weight: 405 pounds

Guide Tube: 21 Ft. Long (Three 7 Ft. Sections)

Control Cable: 25 Ft. Long

1. Remove the protector cap from the lock box thereby exposing the pigtail connections.
2. Crank the control cable forward slightly to facilitate connection to the pigtail.
3. Connect control cable to pigtail.
4. Crank control cables in until the connecting studs engage with the lock box.
5. Remove safety plug from the "out" connection of the exposure device and connect the guide tubes. Make sure that the master guide tube with the snout or source stop at the end is connected at the end of the guide tube.
6. Extend guide tube and control cables in as near a straight line as possible and place free end of guide tube at the exposure position. Ensure that the available length of drive cable is greater than the total length of guide tubing.
7. Unlock exposure device. Rotate the selector ring to operate. Push the slide bar from left to right until the red marking fully appears on the right side of the selector ring (snaps in place).
8. Survey to determine that radiation levels do not exceed 2 mrem/h at the boundaries or perimeter of the radiographic area.
9. At end of exposure, retract source into unit.
10. Survey Camera and Guide Tube carefully to be sure that the source has returned to safe position.
11. Disconnect guide tube, replace and lock safety plug.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #7

OPERATION AND USE OF THE SELF-READING POCKET DOSIMETER

1. A dosimeter charger shall be provided for each separate radiography operation or a central location convenient to all operations.
2. All personnel using radiation producing devices shall use a minimum of one self-reading pocket dosimeters (0-200 mrem range).
3. These devices shall be work at all times when an individual is in a restricted area. Dosimeter reading shall be recorded daily.

NOTE: Do not use a broken or suspect dosimeter.

4. Failure of personnel to wear pocket dosimeters will be cause for disciplinary action up to and including termination of employment.

Charging and zeroing the Dosimeter

5. Remove the cover form the charging socket on the charger and insert the dosimeter in the socket.
6. Hold the dosimeter in contact (downward pressure required) with the charging socket.
7. While looking through the eye piece, turn the large knob on the charger to adjust the "hairline" to zero.
8. Remove the dosimeter from the charger and check the "hairline" position by looking through the eye piece with the opposite end directed toward a light source.
9. If the "hairline" is not on zero, it may be necessary to get the "hairline" position slightly off zero when charging to compensate for the charge on removal from the charger.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #7 (Continued)

OPERATION AND USE OF THE SELF-READING POCKET DOSIMETER

Using the Dosimeter

1. Each radiographer and radiographer's assistant shall charge and zero their dosimeters each day before starting radiographic work.
2. He shall read each dosimeter periodically during the work.
3. If, for any reason, the "hairline" is above 150 mrem, the dose should be recorded and the dosimeter zeroed. This will keep the dosimeter from going "off scale" unnecessarily.
4. If you suspect that you have entered a High Radiation Area, you should immediately read your dosimeter.
5. If a dosimeter goes "off scale," proceed as follows:
 - a. Stop work.
 - b. Secure the source.
 - c. Contact RSO or RSC, who will arrange for immediate processing of your TLD badge.
 - d. DO NOT enter a radiation area until you have been issued a new TLD badge and dosimeter. Also, you must be instructed by the Radiation Safety Officer or Coordinator that you may resume work in a radiation area.

NOTE: If an individual discovers a pocket dosimeter to be off scale, he shall stop work immediately and notify the RSO, ARSO, or RSC, who will investigate. If determined by the investigation to be a known or suspected exposure, the individual's TLD shall immediately be processed. The individual involved shall not work with radioactive material or be allowed to enter a restricted area again until the results of the suspected exposure are evaluated by the RSO or ARSO.

Recording Dosimeter Readings

1. For each day used each radiographer and radiographer's assistant shall record total dosimeter reading on the "Daily Radiological Survey Report." Each dosimeter reading shall be recorded at the beginning and end of the workshift.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

INSTRUCTION #8

DAILY RADIOLOGICAL SURVEY REPORT

1. Data will be inserted as it is generated.
2. Parts I, II, and applicable portions of Part III shall be completed before starting radiographic operations.
3. All blanks shall be "NA'd" if not used.

Part I - Personnel Data

4. Radiographer/assistant radiographer completing this report shall print his name in the "Radiographer name" blank and complete the entries for Social Security No., date and shift.
5. If additional personnel are required, the radiographer shall print their name(s) under "Additional Personnel Required" Part 1.
6. The radiographer/assistant radiographer shall record his badge number, dosimeter serial number, calibration due dates, and record "out" and "in" for the dosimeter reading at beginning and end of shift.
7. Complete the above information for any additional personnel.
8. Verify equipment operability before use and initial.

Part II - Survey Meters

9. Record model and serial number.
10. Check calibration sticker and record expiration date. NOTE: DO NOT USE IF THE EXPIRATION DATE HAS BEEN EXCEEDED.
11. Check the batteries and operation. If acceptable, indicate "OK", if unacceptable, replace batteries or DO NOT USE.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

INSTRUCTION #8 (Continued)

DAILY RADIOLOGICAL SURVEY REPORT

Part III - Isotope

12. Isotope; Record serial number, type, curies, and leak test due date.
13. Record exposure device serial number and model number.
14. Record survey reading taken at the surface of the exposure device when removed and returned returned to storage.

Part IV - Isotope Exposure History

15. Record location where work was performed.
16. Record the average exposure time and number of exposures performed.

Part V - Comments

17. Record any additional information pertinent to the completion of this report.

Part VI - Responsible Radiographer

18. The responsible radiographer shall sign the report, and record the date that radiography was completed.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

DAILY RADIOLOGICAL SURVEY REPORT

Report Number _____

I. PERSONNEL AND EQUIPMENT OPERABILITY

NAME (1) _____ SSN _____ TLD No. _____

Dosimeter # _____ Cal. due date _____ Out _____ In _____

A.R. Meter # _____ Cal. due date _____

Name _____ SSN _____ TLD No. _____

Dosimeter # _____ Cal. due date _____ Out _____ In _____

A.R. Meter # _____ Cal. due date _____

Name _____ SSN _____ TLD No. _____

Dosimeter # _____ Cal. due date _____ Out _____ In _____

A.R. Meter # _____ Cal. due date _____

Name _____ SSN _____ TLD No. _____

Dosimeter # _____ Cal. due date _____ Out _____ In _____

Dosimeter # _____ Cal. due date _____ Out _____ In _____

A.R. Meter # _____ Cal. due date _____

VERIFY EQUIPMENT OPERABILITY PRIOR TO USE

II. SURVEY METERS

Model No. _____ Serial No. _____ Cal. due date _____ Bat. Ck. _____

Model No. _____ Serial No. _____ Cal. due date _____ Bat. Ck. _____

III-ISOTOPE

☐ Ir192

Isotope Serial No. _____ Type: ☐ Co60 No. Curies _____ Lea: Test Due _____

Exposure Device Serial No. _____ Model No.: ☐ 660 ☐ 680

STORAGE: Isotope Removed: _____ millirem/h Isotope Returned: _____ millirem/h

IV-ISOTOPE EXPOSURE HISTORY (OPTION ON BACK)

Work Location _____ Average Exposure Time _____ No. Exposures _____

V-COMMENTS:

(1) Responsible Radiographer

Signature

Date

SUBJECT: INSTRUCTIONS

[illegible]

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

INSTRUCTION #9

GUIDE LINES FOR DAILY INSPECTION OF EXPOSURE DEVICES

Technical Operations 660 Projector/680 Projector/650 & C-1 Source Changers

1. Survey for excessive radiation levels.
2. Inspect control and indicator assembly for loose hardware and damage.
3. Inspect control cables for cuts, breaks, and broken fittings.
4. For Models with detachable controls:
 - a. Check connector (ball and socket) for proper operation.
 - b. Check lock for ease of operation.
 - c. Check operation of control cable locking ring.
5. Inspect shifting of shield inside device.
6. Check labels for legibility.
7. Inspect source tubes for cuts or kinks.
8. Inspect source tube and cap.
9. Inspect connectors for thread damage.
10. Inspect lock, hasp, and shipping plug.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT: INSTRUCTIONS**INSTRUCTION #10DESCRIPTION AND USE OF LEAK TEST KIT MODEL 518Description

This kit is designed for use on Gamma Ray Projectors. It provides a convenient and safe method of performing leak test of radiographic sources in accordance with NRC regulations, which require such testing at intervals not to exceed six months.

Contents

1. Flexible swab-holder with swab.
2. Vial of EDTA solution.
3. Plastic envelope.
4. Mailing box.
5. Identification sheet.

Instruction

1. Assure source is fully retracted into projector (use a survey meter to assure radiation levels are normal).
2. Remove source tube from face of shield or remove shipping plug.
3. Wet the swab with EDTA solution. Shake off excess and insert the swab into the hole in the shield. Wipe the interior of the hole thoroughly by rotating the swab holder.
4. Withdraw swab and place in plastic envelope.
5. The swab should now be monitored by turning the survey meter to its most sensitive range. Place the meter in a low background area and move the swab in its plastic envelope to the meter, not the meter to the swab.
6. If there is no indication on the meter, or if the indication is no more than 0.2 mrem/h above background, place the plastic envelope with the swab in the mailing box and mail to the supplier. Be sure to fill out and return the identification sheet.
7. If the swab should show more than 0.2 mrem/h DO NOT MAIL. Immediately inform the RSO, who will contact the supplier for specific instructions. TVA WARL personnel will also be notified.
8. When received by the supplier, the wipe-test swab will be subjected to a precise radioassay and a leak test certificate will be mailed promptly.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

INSTRUCTION #11

QUARTERLY INSPECTION CHECKLIST FOR RADIOGRAPHIC EXPOSURE DEVICES

Technical Operations 660 Projector/680 Projector & 650 Source Changer & SPEC-1

I. Projector(s) and Changers

1. Inspect caps.
2. Check lock and Lock box for ease of operation.
3. Check handle (should be firmly attached to projector housing).
4. Verify proper labeling.
5. Check for any abnormal readings.
6. Check outlet nipples or threads for damage.
7. Check width of female drive connector with NO-GO gauge; if the gauge width can fit into the female slot, the connector is worn and the source must be replaced.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #11 (Continued)

II. Control Cable and Crank Assembly

8. Check all cables for damage (cuts, breaks).
9. Inspect crank for damage and loose hardware.
10. Check operation of the control for freedom of drive cable movement.
11. Check for any loose or missing screws.
12. Check cable flexibility and connections.
13. Check male connector of the drive cable with no-go gauge; if the ball of the connector fits through the hole of the gauge or the ball shank fits into the slot in the gauge, the connector is worn and the cable should be replaced.

III. Source Tube

14. Inspect for any physical damage.
15. Check connections.
16. Inspect for dirt or sludge.
17. Check end caps.

NOTE: IF ANY EQUIPMENT IS FOUND TO BE INOPERABLE, PROCEED AS FOLLOWS:

- a. Identify equipment
- b. Remove from use
- c. Notify immediate supervisor

Date _____

QUARTERLY INSPECTION CHECKLIST FOR RADIOGRAPHIC EXPOSURE DEVICES
(TYPICAL OR ALTERNATE ALLOWED)

[illegible]

SUBJECT: INSTRUCTIONS

Date _____

[illegible]

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #12

INSTRUCTIONS FOR COMPLETING RADIATION INCIDENT REPORT

Information necessary to document known or suspected exposure to radiation varies in quantity and detail. The following instructions shall be used as a guide in preparing a narrative report to the RSO. The report describing the event shall be in sufficient detail to allow the RSO to make a determination of exposure received (if any) and corrective action(s) necessary to prevent recurrence.

The radiographer shall document on the attached RIR any incident involving known or suspected exposure to personnel. This shall include but not limited to: unauthorized personnel entering a restricted area (2 mrem boundary); defective equipment resulting in exposure; theft, missing, or loss of sealed source. The incident shall be immediately reported to the RSO or ARSO.

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

RADIOGRAPHIC INCIDENT REPORT

Number _____
NRC Reportable Yes _____ No _____

Section I

Date _____ Project/Site _____

Time _____ RSO Notified (Date & Time) _____

Org. Performing Radiography _____

Radioactive Materials License No. _____

NRC or State Issued (Identify State) _____

Description of Incident

(Attach Sketch if Necessary Providing Distances, Involved Shielding, etc.)

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: INSTRUCTIONS

Section II

Cause Analysis of Incident: _____

Radiation Safety Officer's Recommendations: _____

RSO's Signature _____ Date _____

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMFRGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #13

TRACKING OF SEALED SOURCES

Accountability for each container (camera/projector) shall be maintained. Sealed sources when received from the supplier are either housed in a camera/projector or a source changer. When sources are received in a changer they are immediately to be transferred into a camera. The now empty changer or the changer with a depleted source is shipped to the supplier.

1. All days of the month shall be recorded in the date column.
2. Columns "Location" through "Individual" shall be completed anytime:
 - a. A source is changed from one container to another.
 - b. An exposure is made at the permanent storage location or elsewhere.
 - c. A source is transported from permanent storage regardless of subsequent use.
 - d. Sources are received from or shipped to TVA suppliers.

Entries must be made as events occur. Three entries shall be made if a source is transported to a work location, exposures are taken and the source is returned to permanent storage in the same day. The first entry records transport to the work location. The second entry is for removal from temporary (vehicle) storage. The third entry records transport back to permanent storage.

Tracking of Sealed Sources
Month of _____, 19____

[illegible]

!!!MAKE ENTRIES AS EVENTS OCCUR!!!

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: INSTRUCTIONS

INSTRUCTION #14

NOTICE TO EMPLOYEES (NRC) AND ENERGY REORGANIZATION ACT OF 1974

As established by the Commission under regulations for posting, the licensee and applicant shall post the latest NRC FORM 3 and the Energy Reorganization Act of 1974 Section 206. Any notice of violation involving radiological working conditions, proposed imposition of civil penalty or orders involving requirements, modifications, suspension, or revocation of a license and the responses by the licensee shall be posted within two working days after dispatch by licensee. Such documents shall remain posted for a minimum of five working days or until action correcting the violation has been completed whichever is later.

As required by the Commission, these notices shall be conspicuously posted in such a manner as to permit individuals engaged in licensed activities to observe them on the way to or from any particular licensed activity location. These notices shall be replaced if defaced or altered.

TVA Industrial Radiography Manuals, that include License No. 41-06832-06, 10 CFR Parts 19, 20, 21, 30, and 34 of the Code of Federal Regulations and Emergency Operating Procedures are available to radiography personnel at the work location.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: FORMS

FORMS

TABLE OF CONTENTS

FORM #1	-	Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices [Tech/Ops Model 660 - Camera - USA/9033/B(U)]
	-	Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices [Tech/Ops Model 680 - Camera - USA/9035/B(U)]
	-	Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices [Tech/Ops Source Change 650L - USA/9269/B(U)]
FORM #2	-	Shipping Document for TVA Sole Use Transport of Radioactive Isotopes and Exposure Devices [SPEC Model C-1 Source Changer - USA/9036/B)
FORM #3	-	Shipper's Certification for Radioactive Materials (<u>Air</u> Shipment Only)
FORM #4	-	Shipping Document/Radioactive Source (common carrier - other than air freight)
FORM #5	-	TVA shipping ticket (Alternate Form - Common carrier)
FORM #6	-	Radioactive Material Receiving Report

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: FORMS

FORM 1

**RADIOACTIVE MATERIAL SHIPPING DOCUMENT
(TVA SOLE USE)
NRC LICENSE NUMBER 041-06832-06**

SHIPMENT ORIGIN		SHIPMENT DESTINATION	
<p>1. DATE _____ TIME _____</p> <p>*2. DATE _____ TIME _____</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <input type="checkbox"/> BROWNS FERRY <input type="checkbox"/> WATTS BAR <input type="checkbox"/> BELLEFONTE <input type="checkbox"/> ALLEN <input type="checkbox"/> BULL RUN <input type="checkbox"/> CUMBERLAND <input type="checkbox"/> STC <input type="checkbox"/> GALLATIN <input type="checkbox"/> OTHER _____ </div> <div style="width: 48%;"> <input type="checkbox"/> JOHN SEVIER <input type="checkbox"/> JOHNSONVILLE <input type="checkbox"/> KINGSTON <input type="checkbox"/> PARADISE <input type="checkbox"/> SHAWNEE <input type="checkbox"/> WIDOWS CREEK <input type="checkbox"/> COLBERT <input type="checkbox"/> SEQUOYAH </div> </div> <p><input type="checkbox"/> *STC/SQN ROUND TRIP ONLY</p>	<p>1. DATE _____ TIME _____</p> <p>*2. DATE _____ TIME _____</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <input type="checkbox"/> BROWNS FERRY, ATHENS, AL <input type="checkbox"/> WATTS BAR, SPRING CITY, TN <input type="checkbox"/> BELLEFONTE, SCOTTSBORO, AL <input type="checkbox"/> ALLEN, MEMPHIS, TN <input type="checkbox"/> BULL RUN, OAK RIDGE, TN <input type="checkbox"/> CCFF, CUMBERLAND CITY, TN <input type="checkbox"/> SEQUOYAH, SODDY-DAISY, TN <input type="checkbox"/> GFP, GALLATIN, TN </div> <div style="width: 48%;"> <input type="checkbox"/> JSFP, ROGERSVILLE, TN <input type="checkbox"/> JFP, NEW JOHNSONVILLE, TN <input type="checkbox"/> KFP, KINGSTON, TN <input type="checkbox"/> PFP, DRAKESBORO, KY <input type="checkbox"/> SHAWNEE, PADUCAH, KY <input type="checkbox"/> WCFF, STEVENSON, AL <input type="checkbox"/> CFP, COLBERT, CHEROKEE, AL <input type="checkbox"/> STC, SODDY-DAISY, TN </div> </div> <p><input type="checkbox"/> OTHER _____</p>		

RQ ☐ ≥ 10 curies RADIOACTIVE LABELING: WHITE I ☐, YELLOW II ☐, YELLOW III ☐

<p>BOX 1 RADIONUCLIDE: IRIIDIUM-192 SHIPPING NAME: RADIOACTIVE MATERIAL SPECIAL FORM, n.o.s., 7, UN2974 TYPE B PACKAGE</p> <p>DEVICE MODEL 660A/660B USA/9033/B(U), WT. <u>53 lbs.</u></p> <p>SOURCE S/N: _____ CURIES: _____</p> <p>DEVICE S/N: _____ TI: _____</p> <p>DOSE RATE SURFACE: _____ millirem/h <div style="display: flex; justify-content: space-between; width: 100%;"> ORIGIN DESTINATION </div> </p>	<p>BOX 2 RADIONUCLIDE: IRIIDIUM-192 SHIPPING NAME: RADIOACTIVE MATERIAL SPECIAL FORM, n.o.s., 7, UN2974 TYPE B PACKAGE</p> <p>SOURCE CHANGER MODEL: 650L USA/9269/B(U) WT. <u>85 lbs.</u></p> <p>SOURCE S/N _____ CURIES: _____</p> <p>CHANGER S/N: _____ TI: _____</p> <p>DOSE RATE SURFACE: _____ millirem/h <div style="display: flex; justify-content: space-between; width: 100%;"> ORIGIN DESTINATION </div> </p>
<p>BOX 3 RADIONUCLIDE: COBALT-60 SHIPPING NAME: RADIOACTIVE MATERIAL, SPECIAL FORM, n.o.s., 7, UN 2974 TYPE B PACKAGE</p> <p>DEVICE MODEL 680A/680B USA/9035/B(U) WT. <u>405 lbs.</u></p> <p>SOURCE S/N: _____ CURIES: _____</p> <p>DEVICE S/N: _____ TI: _____</p> <p>DOSE RATE SURFACE: _____ millirem/h <div style="display: flex; justify-content: space-between; width: 100%;"> ORIGIN DESTINATION </div> </p>	<p>BOX 4 RADIONUCLIDE: URANIUM-238, 5 MILLICURES SHIPPING NAME: RADIOACTIVE MATERIAL, L.S.A. n.o.s. 7, UN 2912, SOLID METAL</p> <p>SOURCE CHANGER MODEL: 650L USA/9269/B(U) WT. <u>85 lbs.</u></p> <p style="text-align: center;">OR</p> <p>CHANGER S/N: _____ TI: _____</p> <p>DEVICE MODEL 660A/660B USA/9033/B(U), WT. <u>53 lbs.</u></p> <p>DEVICE S/N: _____ TI: _____</p> <p>DOSE RATE SURFACE: _____ millirem/h <div style="display: flex; justify-content: space-between; width: 100%;"> ORIGIN DESTINATION </div> </p>

Shipper's Certification:

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

EMERGENCY TELEPHONE NUMBER
1-800-992-4589

Radiographer _____

NOTE: SIGNATURE INDICATES THE REQUIREMENTS ON THE REVERSE SIDE OF FORM 1 HAVE BEEN MET.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE****SUBJECT. FORMS**

Form 1
(Back Page)

RADIOACTIVE MATERIAL SHIPPING DOCUMENT
(TVA SOLE USE)

NRC LICENSE NUMBER 041-06832-06

Prior to shipment ensuring the package and its contents meet the following requirements:

- A. The source is secured in the proper shielded position in the shipping package.
- B. The contents are authorized for use in the package.
- C. The package is in good physical condition for transport.
- D. All locks ore required shipping plugs are properly installed and seal wired where required.
- E. If the shipping container is to be packaged inside an outer package, e.g., a crate, the outer packaging must be strong enough to withstand the normal conditions of transport and must not reduce the safety of the package. The shipping container (exposure device) or outer package, as applicable, must be secured and positioned to provide sufficient blocking to prevent shifting during transportation.
- G. Properly complete two radioactive shipping labels indicating the contents (iridium-192 cobalt-60, etc.) the activity of the source in curies or millicuries and the transport index (measured one meter from the package exterior surface).
- H. Ensure that any old radioactive shipping labels have been removed from the package. Apply two properly completed labels to two opposite sides of the package.
- I. Check the RQ box and label the container RQ if the contents are equal to or exceed 10 curies.
- J. If the shipping package is inside a crate or other outer packaging, mark the outside package "INSIDE PACKAGE COMPLIES WITH PRESCRIBED SPECIFICATIONS" and list the appropriate DOT specification number and the word "TYPE B." ("TYPE B" must be in letters at a minimum of ½" high.)

e.g. USA/9033/B(U) - (For 660A/660B Exposure Device)
USA/9035/B(U) - (For 680A/680B Exposure Device)
USA/9269/B(U) - (For 650L Source Changer)

The outer shipping package must be marked with a proper radioactive "Trefoil" symbol.

If the total package weight exceeds 110 pounds, the weight must be marked on the outside of the outer package.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: FORMS

FORM 2

MODEL CAMERA USA/9036/B(U)

Spec Model C-1 Source Changer USA/9036/B(U)
Radioactive Isotopes and Exposure Devices

NRC License Number 041-06832-06

Camera # _____

Source # _____

This document is for TVA sole use transport of radioactive isotopes and exposure devices to and from field locations.

Shipping Name: Radioactive Material, Special Form, n.o.s., 7, UN2974 RQ ☐

Radionuclide: Iridium-192

Exposure Device: Spec Model c-1 - USA/9036/B

Curies _____

Transport Index: _____ Surface Reading _____

Affix Appropriate DOT Label: Radioactive Yellow _____

Shippers Certification:

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

Shipped From: _____
(Origination Point)

Date: _____

To: _____
(Destination Point)

Radiographer: _____

Date: _____

EMERGENCY PHONE NUMBER
1-800-992-4589

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: FORMS

FORM 3

SHIPPER'S DECLARATION FOR DANGEROUS GOODS						
Shipper			Air Waybill No.			
			Page of Pages			
			Shipper's Reference Number			
Consignee						
Two completed - A signed copies of this Declaration must be handed to the operator.			WARNING			
TRANSPORT DETAILS This shipment is within the provisions prescribed for: (Mark one - check only)			Airport of Departure:			
<input type="checkbox"/> PASSENGER AIRCRAFT ONLY <input type="checkbox"/> CARGO AIRCRAFT ONLY			Airport of Destination:			
			Shipment type: (check one - check only) <input type="checkbox"/> DANGEROUS GOODS <input type="checkbox"/> RADIOACTIVE			
NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Description				Quantity and type of packaging	Packing mark	Authorization
Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk			
Additional Handling Information						
I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labelled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations.				Name/Title of Signatory Place and Date Signature (Not necessary when signed)		

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: FORMS

FORM 4

SHIPPING DOCUMENT/RADIOACTIVE SOURCE

(Common Carrier - other than air freight)

NRC License No. _____

Project _____ Date _____ Time _____

Ship To _____ Address _____

Shipping Name _____

Physical and Chemical Form _____

Radionuclide: Iridium-192 F or Cobalt-60 F
(Check One)

RQ ☐

Camera # _____ Source # _____

Activity in Curies _____ Transport Index _____

Appropriate DOT Level:

Container: (Type "B" Package)

a. Radioactive White I	_____	Model 660 Camera USA/9033/B(U)	F
b. Radioactive Yellow II	_____	Model 680 Camera USA/9035/B(U)	F
c. Radioactive Yellow III	_____	Model 616 Camera USA/9039/B(U)	F
		Model 650 Source Changer USA/9032/B(U)	F
		Model C-1 Source Changer USA/9036/B(U)	F

Radiographer _____ Date _____

EMERGENCY PHONE NUMBER
1-800-992-4589

FORM 5

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: FORMS

FORM 6

RADIOACTIVE MATERIAL RECEIVING REPORT

NRC License No. _____

Project _____ Date _____ Time _____

Name of Carrier _____ Shipper _____

Visual Inspection of Container Acceptable _____

Container Survey Dose Rate at surface _____

Dose Rate at one meter from surface _____

Container Contents Projector/Changer Serial Number _____

Source Serial Number _____

Decay Chart and Leak Test Certificate Enclosed _____ Number Curies _____

Leak Test Due _____

I certify the provisions of 10 CFR 20.1906 have been complied with.

Signature _____

Radiographer

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: TABLES

TABLES

TABLE OF CONTENTS

Table #1 - Radiation level/distance from Iridium-192 (unshielded)

Table #2 - Radiation level/distance for cobalt-60 (unshielded)

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING AND EMERGENCY PROCEDURE

SUBJECT: TABLES

RADIATION LEVEL/DISTANCE

Iridium-192 (unshielded)

Table 1

<u>5 curies</u>		<u>10 curies</u>		<u>15 curies</u>		<u>20 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	29500	1.0	59000	1.0	88500	1.0	111800
16.0	100	24.3	100	29.7	100	34.4	100
35.0	24.1	35.0	48.2	35.0	72.2	35.0	96.3
76.8	5	108.6	5	133.0	5	153.6	5
121.5	2	171.8	2	210.4	2	242.9	2
<u>25 curies</u>		<u>30 curies</u>		<u>35 curies</u>		<u>40 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	147500	1.0	177000	1.0	206500	1.0	236000
35.0	120.4	35.0	144.5	35.0	168.6	35.0	192.6
38.4	100	42.0	100	45.4	100	48.6	100
171.7	5	188.1	5	203.2	5	217.2	5
271.6	2	297.5	2	321.3	2	343.5	2
<u>45 curies</u>		<u>50 curies</u>		<u>55 curies</u>		<u>60 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	265500	1.0	295000	1.0	324500	1.0	354000
35.0	216.7	35.0	240.8	35.0	264.7	35.0	289.0
51.5	100	54.3	100	57.0	100	59.5	100
230.4	5	242.8	5	254.7	5	266.1	5
364.3	2	384.0	2	402.8	2	420.7	2
<u>65 curies</u>		<u>70 curies</u>		<u>75 curies</u>		<u>80 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	383500	1.0	413000	1.0	442500	1.0	472000
35.0	313.1	35.0	337.1	35.0	361.2	35.0	385.3
61.9	100	64.3	100	66.5	100	68.7	100
276.9	5	287.4	5	297.5	5	307.2	5
437.9	2	454.4	2	470.4	2	485.8	2
<u>85 curies</u>		<u>90 curies</u>		<u>95 curies</u>		<u>100 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	501500	1.0	531000	1.0	560500	1.0	590000
35.0	409.4	35.0	433.5	35.0	457.5	35.0	481.5
70.8	100	72.8	100	74.9	100	76.8	100
316.7	5	325.9	5	334.8	5	343.5	5
500.7	2	515.3	2	529.4	2	543.1	2
<u>105 curies</u>		<u>110 curies</u>		<u>115 curies</u>		<u>120 curies</u>	
feet	mrem/h	feet	mrem/h	feet	mrem/h	feet	mrem/h
1.0	619500	1.0	649000	1.0	678500	1.0	708000
35.0	505.7	35.0	529.8	35.0	553.9	35.0	557.9
78.7	100	80.6	100	82.4	100	84.1	100
352.0	5	360.3	5	368.4	5	376.3	5
556.5	2	569.6	2	582.4	2	595.0	2

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: TABLES

RADIATION LEVEL/DISTANCE

Cobalt-60 (unshielded)

Table 2

<u>5 curies</u>	
feet	mrem/h
1.0	70000
26.4	100
35.0	57.1
118.3	5
137.0	2

<u>10 curies</u>	
feet	mrem/h
1.0	140000
37.4	100
35.0	114.2
167.3	5
264.6	2

<u>15 curies</u>	
feet	mrem/h
1.0	210000
45.8	100
35.0	171.4
204.9	5
324.0	2

<u>20 curies</u>	
feet	mrem/h
1.0	280000
52.9	100
35.0	228.6
236.6	5
374.1	2

<u>25 curies</u>	
feet	mrem/h
1.0	350000
59.2	100
35.0	285.7
264.6	5
418.3	2

<u>30 curies</u>	
feet	mrem/h
1.0	420000
64.8	100
35.0	342.8
289.8	5
458.2	2

<u>35 curies</u>	
feet	mrem/h
1.0	490000
70.0	100
35.0	400
313.0	5
495.0	2

<u>40 curies</u>	
feet	mrem/h
1.0	560000
74.8	100
35.0	457.1
334.7	5
529.2	2

<u>45 curies</u>	
feet	mrem/h
1.0	630000
79.4	100
35.0	514.3
355.0	5
561.2	2

<u>50 curies</u>	
feet	mrem/h
1.0	700000
83.7	100
35.0	571.4
374.2	5
591.6	2

<u>55 curies</u>	
feet	mrem/h
1.0	770000
87.7	100
35.0	628.6
392.4	5
620.5	2

<u>60 curies</u>	
feet	mrem/h
1.0	840000
91.6	100
35.0	685.7
409.9	5
648.1	2

<u>65 curies</u>	
feet	mrem/h
1.0	910000
95.4	100
35.0	742.8
426.6	5
674.5	2

<u>70 curies</u>	
feet	mrem/h
1.0	980000
99.0	100
35.0	800
442.7	5
700.0	2

<u>75 curies</u>	
feet	mrem/h
1.0	1050000
102.5	100
35.0	857.1
458.2	5
724.6	2

<u>80 curies</u>	
feet	mrem/h
1.0	1120000
105.8	100
35.0	915.3
473.3	5
748.3	2

<u>85 curies</u>	
feet	mrem/h
1.0	1190000
109.9	100
35.0	971.4
487.8	5
771.4	2

<u>90 curies</u>	
feet	mrem/h
1.0	1260000
112.2	100
35.0	1028.6
502.0	5
793.7	2

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: TABLES

RADIATION LEVEL/DISTANCE

Cobalt-60 (unshielded)

Table 2 (Continued)

<u>95 curies</u>		<u>100 curies</u>	
<u>feet</u>	<u>mrem/h</u>	<u>feet</u>	<u>mrem/h</u>
1.0	1330000	1.0	1400000
115.3	100	118.3	100
35.0	1085.7	35.0	1142.8
515.8	5	529.2	5
815.5	2	836.7	2

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: CHARTS

CHARTS

TABLE OF CONTENTS

Chart #1 - Radioactive Labeling

Chart #2 - Radioactive Placard

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: CHARTS

Chart #1

MAXIMUM RADIATION LEVELS

	Surface	One Meter
RADIOACTIVE-WHITE I	0.5mR/hr	None
RADIOACTIVE-YELLOW II	50mR/hr	1.0mR/hr
RADIOACTIVE-YELLOW III	200mR/hr	10mR/hr

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: CHARTS

Chart #2

RADIOACTIVE PLACARD



The radioactive placard must have the top portion yellow with the symbol black. The lower portion must be white and the inscription black.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

17.0 ATTACHMENT 1

RADIATION SAFETY TRAINING PROGRAM

TABLE OF CONTENTS

1. Radiographer Initial Training
2. Radiographer Assistant's Initial Training
3. Periodic Training
4. Previously Qualified Personnel
5. Record of Qualification
6. Training Material Outline
 - a. Radiographer Initial Training
 - b. Assistants Radiographer Periodic Testing
 - c. Radiographer Assistant Initial Training
 - d. Radiographer Assistant Periodic Training

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

1.0 Radiographer's Initial Training

- 1.1 Personnel qualifying as radiographers shall have at least three months on-the-job training. All field training shall be conducted under the personal supervision of a radiographer. At the conclusion of the field training period, the radiographer will certify, in writing, to the Radiation Safety Officer that the person under consideration has demonstrated competency and knowledge in the safe and proficient use of TVA's exposure devices and Industrial Radiography Manual.
- 1.2 Candidates are required to successfully complete a forty (40) hour course in industrial radiation safety. This course, as a minimum, shall cover the items specified in Radiographers Training Outline. This course may be administered by TVA or by an outside organization that has been granted approval by the RSO. A written examination (50 questions minimum) shall be administered and a passing grade of 75 must be attained by the individual under consideration.
- 1.3 In addition to paragraphs 1.2.1 and 1.2.2 the candidates shall successfully complete the following test to be designated a "radiographer":
 - a. A field examination (minimum of ten (10) checkpoints) will be evaluated of the candidate operating TVA's radiographic equipment (actual conditions) by observation and under the direct supervision of the RSO or RSCs.
 - b. Copies of the written examination, field examination and final evaluation results shall be retained by the RSO. Candidates that have demonstrated competency to the satisfaction of the RSO or RSCs will be designated as "radiographer."

2.0 Radiographer Assistant's Initial Training

- 2.1 Candidates will be required to complete a minimum of 8 hours of training as provided by TVA or by an outside organization that has been granted approval by the RSO. The training shall consist of:
 - a. 4 hours of instructions on TVA's Industrial Radiography Manual and
 - b. 4 hours of instruction on the practical aspects of the use and handling of specific equipment.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

**FIELD EXAMINATION (PRACTICAL) FOR
RADIOGRAPHER/RADIOGRAPHER ASSISTANTS**

Date _____

Name _____ Social Security No. _____

	<u>Unsatisfactory</u>	<u>Satisfactory</u>
1. Restricted Area Set up	_____	_____
2. Attitude	_____	_____
3. Survey Meter Usage	_____	_____
4. Radiation Surveying	_____	_____
5. a. TLD Usage	_____	_____
b. Dosimeter Usage	_____	_____
c. Ratemeter Usage	_____	_____
6. Familiarization with Emergency Procedure	_____	_____
7. Equipment Operation	_____	_____
8. Familiarization and Use of Company Forms	_____	_____
9. Daily Maintenance Check Procedure	_____	_____
10. Transporting Sources	_____	_____
11. ALARA Performance	_____	_____

A field examination (practical) was conducted this date _____

and _____ is/is not qualified as a radiographer/radiographer assistant.

Date: _____ Examiner: _____

Date: _____ RSO: _____

Circle One

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

- 2.2 Candidates shall successfully complete the following examinations to be designated a "Radiographer's Assistant."
- a. 25 questions minimum examination concerning TVA's Industrial Radiography Manual and the utilization of radiographic equipment.
 - b. A field examination (minimum of 10 point checklist) conducted under actual conditions as observed under the direct supervision of the radiographer as a minimum. The practical examination is administered to ensure management and the candidate that the candidate has a thorough understanding of TVA Industrial Radiography Byproduct Materials Operating and Emergency Procedure and he/she has demonstrated competence to use the radiographic equipment under the direct supervision of a radiographer.
 - c. Upon satisfactory completion of a & b above, the RSO or ARSO shall designate the candidate as a Radiographer Assistant." He/she may then proceed to on-the-job training.
 - d. The written examination and final field evaluation shall be forwarded to the RSO for placement in the employee's file.

3.0 Periodic Training

- 3.1 All radiographers and radiographers assistants will receive periodic radiation safety training. The subject material covered during this training (either by main-out or by actual classroom) will include the following:
- a. Changes in policy, procedures or equipment
 - b. New regulations
 - c. Emergency and Operating Procedures
 - d. Record keeping requirements
 - e. Radiological safety practices
 - f. Review of selected incident case histories
 - g. Actual demonstration of equipment
 - h. Written examination containing a minimum of 25 questions (75% is passing). Those that fail will receive additional training and reexaminations before performing their prior duties.

NOTE: Periodic shall be viewed as annual plus or minus 45 days.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

4.0 Previously Qualified Personnel

- 4.1 Previously qualified radiographer - Radiographers previously qualified by another organization may be qualified directly as a radiographer provided the candidate has previously met the OJT and classroom training of paragraphs 1.1 and 1.2 respectively. He must additionally receive a minimum of (4) hours training on TVA's Industrial Radiography Manual. Also, the requirements of paragraph 1.3a. and b. shall be met.
- 4.2 Previously qualified assistants - Personnel previously qualified as radiographer assistant with another organization must comply with the requirements of 2.0 above (radiographer assistant initial training) in its entirety.

5.0 Record of Qualification

- 5.1 A qualification record for each radiographer and radiographer's assistant will be maintained by the RSO and/or ARSO. The file on the individuals will include a copy of the written test results, performance in oral or practical exams and the overall evaluation of the individual's qualification. If any part of the 11 part criteria (attached) is deemed unsatisfactory, the candidate shall not be granted qualification. The qualification may be gained when the unsatisfactory portion is corrected and becomes satisfactory. The RSO has the ultimate responsibility for granting qualifications of radiographers and radiographer's assistants.
- 5.2 A passing grade of 75 is required on all written examinations.
- 5.3 All examinations are reviewed with the trainee with particular emphasis on questions he/she missed.

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

**TRAINING MATERIAL OUTLINE
RADIOGRAPHER INITIAL TRAINING**

- | | | |
|-----|---|-----------------------------|
| 1.0 | <u>FUNDAMENTALS OF RADIATION SAFETY</u> | <u>Suggested</u>
8 hours |
| 1.1 | Characteristics of Gamma Radiation | |
| 1.2 | Units of Radiation Dose (mrem) and Quantity (curie) | |
| 1.3 | Hazards of Exposure to Radiation | |
| 1.4 | Levels of Radiation from Licensed Materials | |
| 1.5 | Methods of Controlling Radiation Dose | |
| | a. Working time | |
| | b. Working distance | |
| | c. Shielding | |
| 2.0 | <u>RADIATION DETECTION INSTRUMENTATION TO BE USED</u> | 6 hours |
| 2.1 | Use of Radiation Survey Instruments | |
| | a. Operation | |
| | b. Calibration | |
| | c. Limitations | |
| 2.2 | Survey Techniques | |
| 2.3 | Use of Personnel Monitoring Equipment | |
| | a. Film badges and thermoluminescent dosimeters (TLDs) | |
| | b. Direct reading pocket dosimeters and alarm rate meters | |
| 3.0 | <u>RADIOGRAPHIC EQUIPMENT TO BE USED</u> | 6 hours |
| 3.1 | Remote Handling Equipment | |
| 3.2 | Radiographic Exposure Devices | |
| 3.3 | Storage Containers | |

TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

TRAINING MATERIAL OUTLINE
RADIOGRAPHER INITIAL TRAINING

	<u>Suggested</u>
4.0 <u>INSPECTION AND MAINTENANCE PERFORMED BY RADIOGRAPHERS</u>	6 hours
4.1 Survey Records	
4.2 Daily Inspections	
4.3 Quarterly Inspections	
4.4 Leak Test	
5.0 <u>CASE HISTORIES OF RADIOGRAPHY ACCIDENTS</u>	4 hours
6.0 <u>TVA'S INDUSTRIAL RADIOGRAPHY MANUAL</u>	4 hours
7.0 <u>10 CFR, PARTS 19, 20, 21, 30 and 34</u>	4 hours
8.0 <u>SHIPPING OF SEALED SOURCES</u>	2 hours
8.1 Marking	
8.2 Packaging	
8.3 Labeling	
8.4 Posting	
8.5 Documentation	
	<hr/> Total 40 hours

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

TRAINING MATERIAL OUTLINE
RADIOGRAPHER ASSISTANT INITIAL TRAINING

Suggested
Hours/Minutes

- | | | |
|-----|---|---------------|
| 1.0 | <u>ACCIDENT NOTIFICATION PROCEDURES</u> | 20-30 minutes |
| 1.1 | Events to follow | |
| a. | Names of emergency personnel | |
| 2.0 | <u>EMERGENCY CONTROLS FOR MINIMIZING PERSONNEL RADIATION EXPOSURE</u> | |
| 2.1 | Conditions under which an accident might occur | 30-45 minutes |
| 2.2 | Procedures for emergency situations | |
| a. | Survey | |
| b. | Restricting access | |
| c. | Posting | |
| d. | Maintain surveillance | |
| e. | Notification | |
| 3.0 | <u>PERSONNEL MONITORING</u> | 30-45 minutes |
| 3.1 | TLD badges | |
| a. | Proper wearing | |
| 3.2 | Dosimeters and alarm rate meters | |
| a. | Recharged/Procedure Requirements | |
| b. | Proper wearing | |
| 3.3 | Calibration | |
| 3.4 | Film badge processing and replacement | |
| 3.5 | Over exposure | |
| 3.6 | Controlling access to a restricted area | |
| 3.7 | Storage for TLD badges and pocket dosimeters | |
| 3.8 | Emergency processing for TLD badges | |

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

**TRAINING MATERIAL OUTLINE
RADIOGRAPHER ASSISTANT INITIAL TRAINING**

Suggested
Hours/Minutes

4.0 CONTROLLING ACCESS TO RADIATION AREAS

- | | | |
|-------|-----------------------------|---------------|
| 4.1 | Procedure | 20-30 minutes |
| 4.1.1 | Before exposure | |
| 4.1.2 | Security | |
| 4.1.3 | Posting restricted area | |
| 4.1.4 | Responsibility | |
| 4.1.5 | Posting high radiation area | |
| a. | Show the different signs | |

5.0 RADIATION SURVEYING PROCEDURE

- | | | |
|-------|------------------------------------|---------------|
| 5.1 | Occasions | 30-45 minutes |
| 5.2 | Radiation Survey Instruments | |
| a. | Describe different types used | |
| b. | Demonstrate usage and scales | |
| c. | Usage of correct batteries | |
| 5.3 | Instrument Field Operational Check | |
| a. | Purpose | |
| b. | Form for recording | |
| 5.4 | Radiation Survey Procedure | |
| 5.4.1 | Demonstrate a survey | |

**TITLE : TVA INDUSTRIAL RADIOGRAPHY BY PRODUCT MATERIAL OPERATING
AND EMERGENCY PROCEDURE**

SUBJECT: RADIATION SAFETY TRAINING PROGRAM

**TRAINING MATERIAL OUTLINE
RADIOGRAPHER ASSISTANT INITIAL TRAINING**

Suggested
Hours/Minutes

**6.0 HANDLING AND USE OF SEALED SOURCES AND RADIOGRAPHIC EXPOSURE
DEVICES**

6.1 Equipment Type

- a. Explain the different devices and their quantities

6.2 Operational Procedure

- a. Demonstrate method of monitoring exposure devices
- b. Explain in detail the hook-up and disconnect procedure

6.3 Source Changes

6.3.1 Surveying of Shipping Container

- a. Demonstrate a survey
- b. Explain the radiation levels
- c. Describe in detail the source change

7.0 STORAGE OF SEALED SOURCES

7.1 Storage

20-30 minutes

7.2 Responsibility

7.3 Labeling

7.4 Storage locations labeled

- a. Demonstrate proper signs and labeling

8.0 SHIPPING OF SEALED SOURCES

8.1 Marking

8.2 Packaging

8.3 Labeling

8.4 Posting

8.5 Documentation

9.0 TVA INDUSTRIAL RADIOGRAPHY MANUAL

30-45 minutes

TOTAL 4- 6 hours