NRC FORM 313 (1-84) 10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB 3150-0120
Expires: 5-31-87

APPLICATION FOR MATERIAL LICENSE

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

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

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

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

[ ] A. NEW LICENSE
[X] B. AMENDMENT TO LICENSE NUMBER 13-16347-01
[ ] C. RENEWAL OF LICENSE NUMBER ____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

Calumet Testing Services, Inc.
1945 N. Griffith Boulevard
Griffith, Indiana 46319

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

A. Radiography and Storage: 1945 N. Griffith Blvd. - Griffith, Indiana 46319
B. Radiography: Temporary Job Sites in states subject NRC's Regulatory Authority

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Thomas J. Keilman

TELEPHONE NUMBER: 219-923-9800

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

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

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

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

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 3,O
AMOUNT ENCLOSED $ 230.00

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

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

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

SIGNATURE—CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
	Robert J. Vidimos	President	

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS

[ ]	< $250K	[ ]	$1M–3.5M
[ ]	$250K–500K	[ ]	$3.5M–7M
[ ]	$500K–750K	[ ]	$7M–10M
[ ]	$750K–1M	[ ]	> $10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial—proprietary—information furnished to the agency in confidence)*

[ ] YES [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
amd	oct 8	3O	1) separate amd 19033 / 79875 new amd BwB. Mallett	CP
AMOUNT RECEIVED	CHECK NUMBER			DATE
$230	6513			10/10/85

PRIVACY ACT STATEMENT ON REVERSE

8512050277 851101
REG3 LIC30
13-16347-01 PDR

CONTROL NO. 79875

ITEM 5

RADIOACTIVE MATERIAL

A. System #1 (for radiography)

1. Sealed Source
   Ir-192, Gamma Industries, Inc., Model A-2-A
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Gamma Industries, Inc., Model Century S
3. Source Changer
   Gamma Industries, Inc., Model C-10

B. System #2 (for radiography

1. Sealed Source
   Ir-192, Tech/Ops, Model A-424-9
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Tech/Ops Model 660
3. Source Changer
   Tech/Ops Model 650

C. System #3 (for radiography)

1. Sealed Source
   Ir-192, Gamma Industries, Inc. Model A-2-A
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Gamma Industries, Inc. Model Century S, Modified by removal of standard lockbox assembly and installation of CENT/35 5A lockbox assembly (part no. 8111001107)
3. Source Changer
   Gamma Industries, Inc. Model C-10

D. System #4 (for radiography)

1. Sealed Source
   Ir-192, Source Production & Equipment Co., Model G-1
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Gamma Industries, Inc. Model Century S
3. Source Changer
   Source Production & Equipment Co., Model C-1

E. System #5 (for radiography)

1. Sealed Source
   Ir-192, Source Production & Equipment Co., Model G-3
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Gamma Industries, Inc. Model Century S, Modified by removal of standard lockbox assembly and installation of CENT/35 5A lockbox assembly (part no. 8111001107)
3. Source Changer
   Source Production & Equipment Co., Model C-1

ITEM 5 (continued)

F. System #6 (for radiography)

1. Sealed Source
   Co-60, Gamma Industries, Inc., Model A-8-A
   Maximum Activity Per Source: 100 Curies
2. Exposure Device
   Tech/Ops Model Gammatron 100
3. Source Changer
   Gamma Industries, Inc., Model C-8

G. System #7 (for dosimeter calibration)

1. Sealed Source
   Ce-137, Victoreen Corp., No Model number
   Maximum Activity Per Source: 10 Microcuries
2. Exposure Device
   The source is an integral part of Victoreen Corp.
   Assembly 541-205

ITEM 6

PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

A. Systems #1, #2, #3, #4, #5 and #6 will be used for industrial radiography (source changers will be used for source exchange).

B. System #7 will be used for dosimeter calibration

ITEM 7 INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

ATTACHMENT 6H

7.0 OVERALL ORGANIZATION STRUCTURE

7.1 Calumet Testing Services, Inc. Management Philosophy on the Safe Use of Radiographic Materials in the Radiography Program.

The policy making management of CTS is completely dedicated to the philosophy that the maintenance of a safe radiography program is in the best interest of CTS. We are prepared to follow all NRC regulations that will insure the health and safety of all CTS employees, customer employees, and the general public at all times.

7.2 Below is a description of our organizational structure as it pertains to our radiography program. Included, you will find the names of CTS employees, their titles and qualifications, along with the authority and responsibilities they have been delegated for maintaining a safe radiography program.

7.2.1 Robert J. Vidimos, President of Calumet Testing Services, Inc. assumes complete responsibility and authority over all personnel and functions that relate to the radiography program and its safe implementation. He has the sole responsibility of delegating the authority and responsibility to lower management individuals for maintaining active management control of the radiation protection program and radiography operations.

7.2.2 Thomas J. Keilman is assigned the Title and Responsibility of the RADIATION SAFETY CONTROL DIRECTOR of CTS and will be responsible for maintaining active management control of the safe implementation of the radiography program.
His resume' is attached to this section.

He is completely familiar with all the equipment used and function carried out within the CTS radiography program. He has a thorough knowledge of management policies and CTS's administrative and operating procedures, and has a full understanding of radiation protection and control methods. His specific duties include:

1. Developing and maintaining up-to-date operating and emergency procedures.
2. Establishing and maintaining a personnel monitoring program.
3. Establishing and conducting the training program for radiographers and radiographer assistants.
4. Examining and determining competence of radiographic personnel.
5. Establishing and maintaining the leak testing program.
6. Establishing and maintaining the licensee's record-keeping system.

ITEM 7 (continued)

7. Reviewing and ensuring maintenance of those records kept by others.

8. Assuming control and instituting corrective action in emergency situations.

9. Investigating the cause of incidents and determining necessary preventive action.

10. Establishing a procedure for evaluating and reporting defects and noncompliance pursuant to 10 CFR Part 21.

7.2.3 John Korienek, Nondestructive Testing Manager, is assigned the Title and responsibility of RADIATION SAFETY OFFICER and be answerable to the Radiation Safety Control Director on matters of radiation safety. His resume' is attached to this section.

He is completely familiar with all the equipment used and functions carried out in the CTS radiography program. He has a thorough knowledge of management policies and CTS's administrative and operating procedures and has a full understanding of radiation protection and control methods. In the absense of the Radiation Safety Control Director, he will take over his duties: His specific responsibilities are:

1. Maintaining control of procurement and disposal of licensed material.

2. Procuring and maintaining radiation survey instruments.

3. Establishing and maintaining storage facilities.

4. Maintaining exposure devices, radiography facilities, and associated equipment.

5. Performing source replacement and source tagging operations.

6. Conducting quarterly inventories and maintaining utilization logs.

The responsibility of maintaining records as they pertain to the above functions can be developed to a responsible individual, but the ultimate responsibility that such records are being maintained is that of the Radiation Safety Officer.

7.2.4 Mr. Alan J. Meyer of CTS, will serve as the Internal Auditor of the Radiation Safety Program.

His specific responsibility will be to direct the quarterly internal inspection. He will preside at the quarterly meeting of the Internal Inspection Committee, which will be attended by the President of CTS, Radiation Safety Control Director and the Radiation Safety Officer.

ITEM 7 (continued)

7.2.5 All RADIOGRAPHERS working under CTS's license will be held responsible by CTS management for following established procedures for using, storing and shipping radioactive materials, inspection testing, quality control, record keeping and handling equipment. They will also be held responsible for the tasks performed by assistant radiographers under their supervision.

Evaluation of their performance and adherence to rules concerning radiation safety and record keeping will be evaluated by the Radiation Safety Control Director and Radiation Safety Officer. If corrective counseling is needed a meeting will be set-up between the radiographer and the Radiation Safety Officer. If the problem is not resolved, the matter can be taken to the Radiation Safety Control Director and to the President of Calumet Testing Services, Inc.

CTS

RESUME'

OF

THOMAS J. KEILMAN

4/1982 - Present Calumet Testing Services, Incorporated, Griffith, Indiana

Quality Engineer: Responsible for development of special techniques, monitoring special process procedures associated with technical operations, soil testing, concrete testing and asphalt testing. Duties include assisting the President and Vice-President, auditing internal programs and performing examinations, inspections and tests. Note 1

4/1975 - 4/1982 Midstate Testing Laboratory, Incorporated, Hammond, Indiana

Chief Engineer/Radiation Safety Officer: Responsible for technical activities of a commercial laboratory involved in examination, inspection and testing associated with the construction industry. Duties included scheduling, cost estimates, consulting, purchasing and employment, training, and certifying technical personnel. Experienced with AWS, ASME and ANSI code requirements. Note 2

9/1973 - 4/1975 Westenhoff and Novick Consulting Engineers, Chicago, Illinois

Project Manager: Responsible for supervision of small to medium size projects involving the design of transportation structures. Served as consultant to management in matters related to welding, NDE and fabrication. Duties included development of concepts, costs, specifications and proposals. Experienced with ACI, AASHTO, DOT and state highway codes.

6/1963 - 9/1973 Allied Structural Steel Company, Hammond, Indiana

Chief Designer/Welding Engineer: Responsible for executing structural designs and supervision of associated inspection and detailing activities; also responsible for development ofwelding/NDE procedures related to fabrication of steel structures. Duties included estimating, NDE (UT, PT, MT), training, programming applications and technical interface with clients.

Note 1: Qualified as Radiographer 6-14-82

Note 2: Qualified as Radiographer 1975

EDUCATION

Formal

Northwestern University, Evanston, Illinois
BS/MS Civil Engineering
Purdue University Calumet, Hammond, Indiana
Degree Candidate, Information Systems & Computer Programming

Certifications

Calumet Testing Services Level II
RT, PT, MT, UT, VE Examination Methods
AWS Certified Weld Inspector
Certificate No. 80050171

Professional License

Professional Engineer,
State of Indiana
Registration No. 15738

Continuing Education

Metals and Their Weldability	6 Hrs.	10-63	AWS Chicago Section
Arc Welding Design	40 Hrs.	04-64	Lincoln Electric Company
Application and Reliability of Welding	6 Hrs.	11-64	AWS Chicago Section
Basic Ultrasonic Testing	40 Hrs.		Krautkramer Ultrasonics
Basic Ultrasonic Testing	8 Hrs.	10-65	American Bridge, U.S. Steel
Ultrasonic Weld Inspection	40 Hrs.	10-66	Magnaflux Corporation
Ultrasonics	8 Hrs.	11-67	ASNT Chicago Section
Gas Shielded Welding Processes	8 Hrs.	02-68	AWS School of Welding Technology
Fundamentals of Welding	80 Hrs.	06-68	Ohio State University
Industrial Radiography	40 Hrs.	01-72	Louisiana State University
Radiography Techniques	40 Hrs.	01-72	Louisiana State University
Bridge Maintenance	16 Hrs.	02-75	University of Wisconsin
Magnetic Particle and Penetrant Tests	9 Hrs.	04-77	ASNT Chicago Section
Concrete For Nuclear Containment Vessels	16 Hrs.	1975	ACI/ASME
Radiation Safety	8 Hrs.	03-78	USNRC Region III
Magnetic Particle Testing	8 Hrs.	03-73	Allied Structural Steel Co.
Penetrant Testing	8 Hrs.	03-73	Allied Structural Steel Co.
Ultrasonic Testing	12 Hrs.	05-75	George Kenny, Consultant
Penetrant Testing	6 Hrs.	05-75	George Kenny, Consultant
Magnetic Particle Testing	3 Hrs.	05-75	George Kenny, Consultant

cTs

Calumet Testing Services, Inc.

Mail to: P.O. Box 1510 ... Highland, Indiana 46322
Main Location: 1945 N. Griffith Blvd. ... Griffith, Indiana 46319
(219) 923-9800 ... (312) 474-5860 ... (815) 722-0878

TECHNICAL RESUME

of

JOHN KORIENEK

Calumet Testing Services, Inc.
Griffith, Indiana

4/1983 - Present Nondestructive Testing Manager

Responsible for directing up to 25 laboratory and field technicians and inspectors. Duties include scheduling, cost estimates, customer relations and resolving quality problems. Other responsibilities include training of technicians, developing special testing techniques, maintaining quality assurance and test records.

11/80 - 4/83 - Assistant NDT Manager

Responsible for supervising test technicians on a project basis at nuclear and fossil generating plants and at oil, chemical and steel mill construction sites. Duties included maintaining radiation safety records and equipment as directed by the Radiation Safety Officer. Also responsible for designating particular test methods, techniques and procedure to be used.

9/1976 - 11/80 - NDT Level II Technician

Responsible for setting up and calibrating equipment to perform radiography, ultrasonics, magnetic particle and liquid penetrant test methods. Duties included interpreting and evaluating tests with respect to applicable codes, standards, specifications and reporting the results.

Note: Qualified As Radiographer 11-11-77

EDUCATION

FORMAL

Graduate of Mendel Catholic High School
Chicago, Illinois 1974

CERTIFICATIONS

ASNT, SNT-TC-1A Level II - Radiography, Ultrasonics, Magnetic Particle, Liquid Penetrant and Visual Examinations Methods

FORMAL NDT TRAINING

Spartan School of Aeronautics
Tulsa, Ohlahoma 4/26/76
Industrial Testing & Inspection Technician Course

Subject		Hours
T1-1	Introduction to Nondestructive Testing and Inspection	60
T1-2	Basic Nondestructive Testing Methods	60
T1-3	Radiography	150
T1-4	Electronic Testing Methods	120
T1-5	Evaluation and Critique	60

Magnaflux Corporation
Chicago, Illinois

Basic Ultrasonic Testing — 40

RADIATION SAFETY

Spartan School of Aeronautics, Tulsa, Oklahoma
10CFR 34 Appendix A 4/26/76 — 30

Gamma Industries, Baton Rouge, Louisiana
Isotope Radiography Training 8/12/77 — 40

CONTINUING EDUCATION

Magnetic Particle and Liquid Penetrant	ASNT - Chicago Section 5/78	16
Heat Treating	Exomet Corp., Conneaut, Ohio 2/79	24

PROFESSIONAL SOCIETIES

Member - American Society of Nondestructive Testing

ITEM 8 TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

ATTACHMENT 6F

5. CALUMET TESTING SERVICES, INC. RADIOGRAPHY TRAINING PROGRAM

5.1 CTS Management Philosphy on, and the goals of the Radiography Training Program.

The management of CTS feels that a total in-house radiography training program of their radiographers and assistant radiographers would be a benefit to the Company. It would assure CTS that competent personnel are on hand at all times performing safe and quality work. Because of this desire, CTS management has implemented the radiography training program found in this section.

The goal of the radiography training program is to provide training to radiographer trainees and assistant radiographer trainees on the subjects of radiography techniques, operating procedures, emergency procedures, radiation safety, the use of CTS equipment, and the regulations governing industrial radiography. A system of testing and evaluation has been established where by the trainees have to demonstrate a working knowledge and understanding of the information presented before they can take on the duties of a radiographer or assistant radiographer.

5.2 Radiography Training Program Personnel

The responsibility of carrying out the training program has been given to Thomas J. Keilman Radiation Safety Control Director of CTS. His resume' can be found as an attachment to Section 7.0 of this application (Overall Organization Structure). Under Mr. Keilman's direction radiographers and assistant radiographers will be trained, evaluated, and monitored in compliance with 10 CFR Parts 34.11 B, 34.31, and 34 Appendix A.

The total program will contain the training of radiographers and assistant radiographers, the orientation and testing of newly hired experienced radiographers, and the continuing education and review of all radiography personnel.

The training program faculty will be made up of Thomas J. Keilman, John Korienek, Alan J. Meyer and any other qualified individuals who may be required be required for training personnel.

Only documented outside training programs or training hours which are approved by the Radiation Safety Control Director may be used to meet CTS radiographer training outline requirements.

5.3 Radiography Training Program

5.3.1 Prerequisites for selection as an Assistant Radiographer

The goal of the Assistant Radiographer Training Program is for the individual to observe radiographic procedures and the safe operation of equipment. At no time may the trainee assume the responsibilities or duties of a Radiographer or Assistant Radiographer. The Trainee may assist in roping off areas, posting signs, positioning film, etc. for a period of at least one week.

Individuals considered for Assistant Radiographer shall have sufficient education to ensure and understanding of radiographic principles and procedures. Completion of grammar school (8th grade) shall be considered to meet minimal formal education requirements. In addition, the individual shall receive a far distance vision test to ensure proper surveillance of radiation areas.

5.3.2 Assistant Radiographer Training Program

The goal of the Assistant Radiographer training program will be to train individuals to competently and safely assist the radiographer. To do this the trainee must demonstrate working knowledge gained in the training program through oral and written examinations in these areas listed below.

1. CTS Operating Procedures
2. Emergency Procedures
3. Radiation Safety Procedures
4. The Use and Care of Survey Instruments
5. The Daily Inspection of Exposure Devices
6. The Preparation and Loading of Exposure Devices
7. The Set-up and Operation of Exposure Devices
8. The Unloading of Exposure Devices and the Storage of Sealed Sources
9. Case Histories of Radiography Events

The trainee will aslo have to demonstrate his hands-on working knowledge of CTS equipment and facilities.

5.3.2.1 Classroom Lectures

Sixteen hours of classroom lecture will be required on the nine areas listed in Section 5.3.2 above. See Appendix RAT-A for lecture outline and Appendix RAT-B for an example of the hand outs that the trainee will use.

5.3.2.2 Hands-On Demonstration

Six hours will be devoted to demonstration of the use of facilities along with hands-on experience for the trainee with close supervision in the areas of: the use and care of survey instruments;

5.3 Radiography Training Program (Cont'd)

5.3.2.2 the daily inspection of exposure devices; the preparation and loading of exposure devices; the set-up and operation of exposure devices, and the unloading of exposure devices, and the storing of sealed sources. See Appendix RT-C as an example of the type of handout that will be given the trainee.

5.3.2.3 Testing and Evaluation of Assistant Radiographer Trainee

The trainee will be tested and evaluated after completion of the training program to determine how much knowledge the trainee has acquired and how well he can demonstrate it.

Written Examination A passing mark of 80% will have to be obtained by the trainee on his final exam before being allowed to go on in the testing process. The final test will consist of 35 assorted questions; examplesof which can be found in Appendix RAT-D.

Oral Examination and Operational Examination

After passing the written examination, the trainee will have to demonstrate his knowledge by performing the following work requirements:

1. Daily inspection ofexposure devices.
2. Performing a radiation survey check.
3. Unlock and load exposure devices.
4. Operate an exposure device and terminate an exposure.
5. Prepare a source for storage.

During the practical examination the trainee will be asked questions pertinent to what he is doing, so that the trainee's complete understanding of what he is doing can be evaluated. If a trainee fails to demonstrate competence in performing atask or shows a lack of understandingof what he is doing, the examiner will review the task with the trainee. The examiner will then place a passing or failing mark on the trainee's performance. See Appendix RAT-E for form used during this testing stage.

If the trainee passes all the examinations given, the test scores and evaluations will be reviewed by the management of Cts for final approval before the individual is given the responsibility of assistant radiographer. All examinations and evaluations will be filed in the employee's permanent file for review by NRC Inspectors.

5.4 Radiographer Training Program

5.4.1 Prerequisites for Selection as a Radiographer

In addition to meeting the Assistant Radiographer requirements this individual must have three (3) months on-the-job training as an Assistant Radiographer.

5.4 Radiographer Training Program (Cont'd)

5.4.1 The goal of the radiographer training program will be to train individuals to competently and safely function as radiographers. To do this the trainee must demonstrate the knowledge gained in the training program through oral and written examination in these areas as listed below:

1. CTS Operating Procedures
2. Emergency Procedures
3. Radiation Safety Procedures
4. Radiation Physics and Terminology
5. Radiation Biology
6. Basic Concepts of Industrial Radiography
7. Governmental Regulation of Industrial Radiography

The trainee will aslo have to demonstrate his hands-on working knowledge of CTS equipment and facilities with special attention to the following areas:

(1) The Use and Care of Survey Instruments
(2) The Daily Inspection of Exposure Devices
(3) The Preparation and Loading of Exposure Devices
(4) The Unloading of Exposure Devices and the Storing of Sealed Sources

5.4.1.1 Classroom Lectures

Forty hours of classroom lecture will be required on the seven areas listed in Section 5.4.1. See Appendix RT-A for lecture outline and Appendix RT-B for an example of the handouts that the trainee will use. The 16 hours of training for assistant radiographer trainee may be used to meet the 40 hour radiographer training requirement.

5.4.1.2 Review of Job Functions

Six hours will be devoted to the review of the use of CTS equipment and facilities, with special attention given to the five areas listed in 5.4.1. See Appendix RT-C as an example of the type of handout that will be given the trainee.

5.4.1.3 Testing and Evaluation of the Radiographer Trainee

The Trainee will be tested and evaluated after completion of the training program to determine how much knowledge the trainee has acquired and how well he can demonstrate it.

Written Examination A passing mark of 80% must be obtained by the trainee. The test will consist of 50 assorted questions, examples of which can be found in Appendix RT-D.

5.4.1.3 Oral Examination Questions will be asked of the trainee on matters of operating procedures, emergency procedures, and radiation safety methods to determine the trainee's complete understanding in these areas. Records will be maintained of all examination scores in the employee's file for NRC inspection. See Appendix RAT-F for form used during this testing stage.

If the candidate passes both examinations, the scores along with evaluations made of the candidate by the teaching faculty will be reviewed by CTS management for final approval before the individual is given the responsibilities of a radiographer.

5.5 Training Program for newly Hired Experienced Radiographers

When an individual is hired with previous experience, as a qualified radiographer, the management of CTS will provide an orientation review and training program. This will assure CTS management that the newly hired radiographer will be as competent and safe with CTS equipment and procedures as the experienced CTS radiographers.

5.5.1 Class room Review Lectures

Information will be presented in six hours of lecture on CTS operating, emergency and radiography procedures. Also a review will be made of radiation protection methods and radiation safety. See Appendix ERT-A for the lecture material outline.

5.5.2 Classroom Review Lectures

The newly hired radiographer will also be given copies of 10 CFR Parts 20, 21 and 34; CTS's NRC License, and the Operating and Emergency Procedures.

5.5.3 On-The-Job Training

The newly hired radiographer will be acquainted by hands-on training, under the supervision of a CTS radiographer with the equipment and facilities of CTS for a two week period.

5.5.4 Testing and Evaluation

Written Examination - A passing mark of 80% must be obtained by the radiographer on a test made up of 25 assorted questions.

The test will primarily concern itself with emergency procedures, operating procedures, and radiation safety. See Appendix ERT-B for examples of questions asked.

5.5.5 After the period of orientation and testing, CTS management will make the final approval on the new radiographer, before the individual is given the responsibilites of a qualified radiographer.

5.6 Continuing Education and Semi-Annual Review of Radiographers and Assistant Radiographers

5.6.1 The management of CTS feels it is their responsibility to provide continuing education to their radiography personnel. Examples of topics which would be presented are: Changes in Operating Procedures, New Regulations; New Radiography Techniques, Review of Emergency Procedures, etc. This information will be provided through posted bulletins, distributed material, in-house lectures or invited lectures. Records will be maintained showing subject material, date and time of presentation, and who was present.

5.6.2 A semi-annual test will be given to all radiographers and assistant radiographers to emphasize CTS management's concern that their personnel keep current. Grades will not be distributed, but the tests will be used to determine what employees need consuling and what areas of continuing education should be covered. See Appendix CE for an example of the type of semi-annual review test to be given to radiographers.

RADIOGRAPHER'S ASSISTANT TRAINING
LECTURE OUTLINE

PART I
(2 hours)

Basic Understanding of Radiaton

I. Radioactivity
   A. Atomic Structure
   B. Radioactive Decay
      1. Half-life
   C. Ionizing Radiation
   D. Units of Measurement (Curie)

II. X-ray Production
   A. Similarity of X-rays and Gamma Rays
   B. X-ray Tubes

PART II
(4 hours)

Radiation Safety Procedures

I. Effect of Radiation on the Body
   A. Units of Measurement
      1. Roentgen
      2. Rad
      3. Rem

II. Radiation Protection
   A. Radiation Protection Guides
   B. Radiation Monitoring
      1. Measuring Radiation Exposure
         a. Survey Meter (G-M type)
         b. Ionization Chamber (Cutie pie)
         c. Survey Techniques and Records
      2. Measuring Personnel Radiation Exposure Doses
         a. Film Badges
         b. TLC Rings
         c. Pocket Dosimeter
         d. Requirements of Wearing Film Badges, TLC Rings and Pocket Dosimeters
         e. Daily and Life-time radiation Dose Records
   C. Radiation Exposure Protection
      1. Internal Exposure Protection
      2. External Exposure Protection
         a. Time
         b. Distance
         c. Shielding

PART III
(7 hours)

Industrial Radiography

I. Introduction to and Elements of Industrial Radiography

II. The Safe Use of Equipment and Facilities of Industrial Radiography
- A. Remote Handling Equipment
- B. Exposure Devices
  1. The Daily Inspection of Exposure Devices
  2. The Preparation and Loading of Exposure Devices
  3. The Set-up and Operation of Exposure Devices
  4. The Unloading of Exposure Devices
- C. Storage Containers

III. Duties and Responsibilities in Assisting the Radiographer

IV. Case Histories of Radiography Events

PART IV
(1 hour)

Governmental Regulation of Radiography

I. Nuclear Regulatory Commission Regulations
- A. 10 CFR Part 19 Notices, Instructions, and Reports to Worker; Inspections
- B. 10 CFR Part 20 Standards for Protection Against Radiation
- C. 10 CFR Part 21 Reporting of Defects and Noncompliance
- D. 10 CFR Part 34 Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations

II. Indiana Regulation for Radiation Control

III. CTS's Nuclear Regulatory Commission License

(Copies of all the above will be handed out and reviewed)

PART V
(2 hours)

CTS Operating and Emergency Procedures

I. Copies of the operating and emergency procedures will be handed out and thoroughly reviewed.

2. Ultraviolet, visible and infrared waves -- are emitted during the transition of electrons among the outer orbits of excited atoms.

3. X-rays -- Bombardment of metals by high speed electrons, excite electrons from inner shells.

4. Gamma rays -- emitted when energy changes occur in the nuclei of atoms

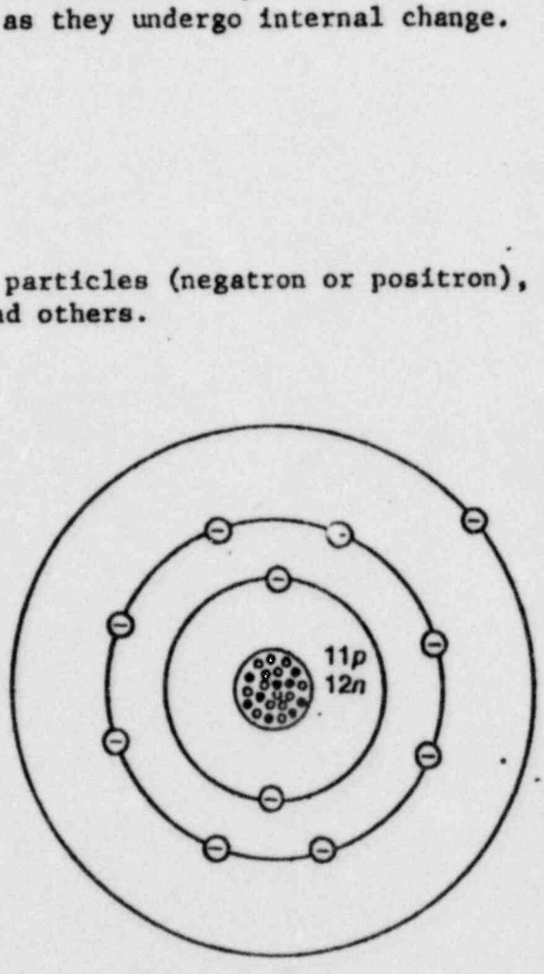
5. Cosmic rays -- are emitted when high speed particles from outer space collide with atoms in our atmosphere.

6. Ionizing vs Non-ionizing radiation -- Some forms of radiation have the ability to remove an electron from an atom as they pass through it or near it. The result of this ionization process is the creation of an ion pair consisting of a negative ion (the electron) and a positive ion (the atom from which the electron was removed).

BASIC CONCEPTS AND TERMINOLOGY INVOLVED WITH FORMS OF RADIATION AND RADIOACTIVITY AND ITS PROPERTIES

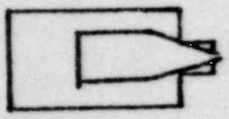
A. RADIATION- The process in which energy in the form of waves or particles is sent out from atoms and molecules as they undergo internal change.

1. Particulate Radiation--Alpha particles, Beta particles (negatron or positron), neutrons, neutrinos and others.



2. Wave Radiation (Photons)

Electromagnetic Waves -- are quantums of energy called photons that travel through space and show characteristics of both wave and particle radiation.



Energy
Machine Gun

Characteristics of electromagnetic radiation:

1. Speed---Always the speed of light (3×10^{10} cm/sec)--(c)

2. Wave Length--The distance it takes for one or the other field to complete an oscillations. (λ) Given in Cm.

3. Frequency--The number of wave length oscillations (cycles) that take place per second. (f).

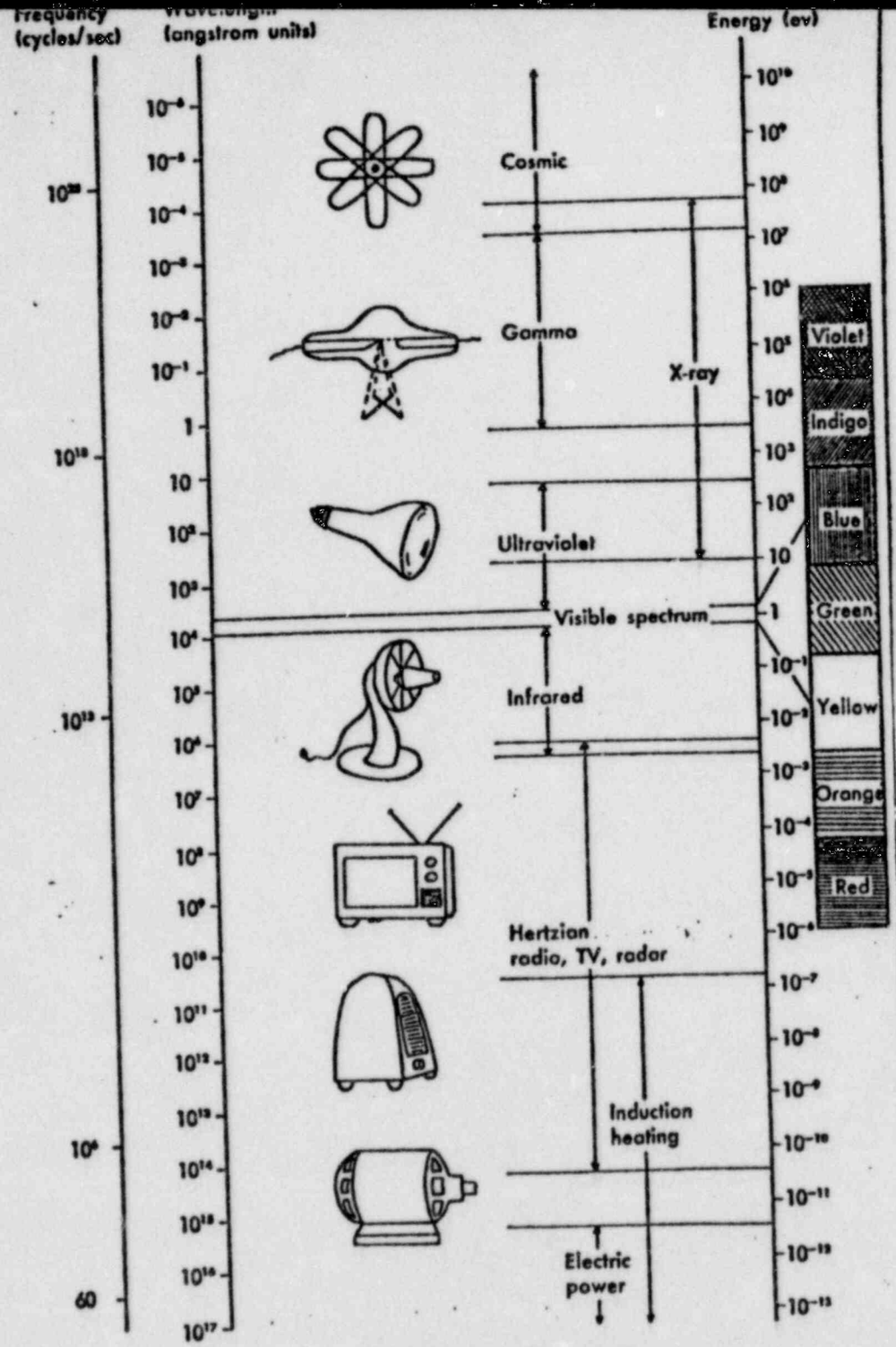


Fig. 3-2. Electromagnetic spectrum.

The energy machine gun can be:

1. Radiowaves and microwaves--Produced in electric circuits in which electrons are made to vibrate at high frequencies.

2. Ultraviolet, visible and infrared waves--are emitted during the transitions of electrons among the outer orbits of excited atoms.

3. X-rays--Bombardment of metals by high speed electrons. excite electrons from inner shells.

4. Gamma rays---emitted when energy changes occur in the nuclei of atoms.

5. Cosmic rays--are emitted when high speed particles from outer space collide with atoms in our atmosphere.

3. Ionizing vs Non-ionizing radiation-- Some forms of radiation have the ability to remove an electron from an atom as they pass through it or near it. The result of this ionization process is the creation of an ion pair consisting of a negative ion (the electron) and a positive ion (the atom from which the electron was removed).

APPENDIX RAT-D

RADIOGRAPHER'S ASSISTANT EXAMINATION

TEST QUESTIONS

Below are examples of the types ofquestions which will be asked of a radiographer's assistant trainee. Tests will be made up of combinations of these types, so that a minimum of thirty-five questions are asked. The point value assigned to the questions will be at the discretion of the examiner. A trainee must obtain a mark of 80% to pass the test.

Test Question Type

I. Definition of Terms

1. Rem --
2. Gamma ray --
3. Survey Meter --
4. Radioactivity --
5. Millicurie --
6. Personnel monitoring --
7. Sealed source --
8. Ionizing radiation --
9. etc.

II. True or False Questions

1. T F One of the hazards from the use of radionuclides in radiography is that the gamma rays induce radioactivity in the objects they strike.
2. T F Several small doses over an extended period of time are equal to one large dose with respect to damage to biological tissue.
3. T F Gamma rays and X-rays primarily differ in their origin.
4. T F The rate of decay of a radionuclide is constantly changing.
5. T F The rem is used to measure radiation absorption in living tissue.
6. T F Humans are able to feel radiation when they are exposed to radioactive material.
7. T F Radiation cannot be directly measured.

II. True or False Questions

8. T F Any vehicle carrying a package containing radioactive material that has a Radioactive Yellow III warning label needs to be placarded on all four sides.

9. T F Anyone who is not a radiographer or radiographer's assistant cannot enter a restricted area.

10. T F You must always survey the camera with a survey meter after every exposure of the source.

11. T F You must survey the boundary of the high radiation area during every exposure of the source.

12. T F If you have a reliable pocket dosimeter, you do not also have to have a film badge.

13. T F You must recharge your pocket dosimeter weekly.

14. T F You can leave a camera unattended in the back of a pickup truck if the source is locked and the key is removed.

III. Multiple Choice Questions

1. By definition in the regulations, a radiographer's assistant is:

   a. A person who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources, or related handling tools, or radiation survey instruments in radiography.
   b. An employee who is certified to ASNT Level I in radiography.
   c. A person who performs or personally supervises radiography operations using sealed radioactive sources, and who is responsible to the licensee for assuring compliance to the applicable regulatory agency regulations and the conditions of our license.
   d. An employee responsible for conducting and supervising the recovery of a lost source.
   e. An X-ray technician.

2. A survey meter is used:

   a. Only in laboratories.
   b. To accurately record personnel surveys.
   c. When an area monitor is not available.
   d. To detect and measure radiation intensities.

3. What is the difference between a Roentgen, Rad, and Rem when dealing with X-rays and gamma rays?

   a. A Rem does not apply to X-rays.
   b. No difference.
   c. A Rad applies only to gamma rays and a Rem applies to X-rays.
   d. A Rem is equivalent to twice as much as a Roentgen or a Rad.

III. Multiple Choice Questions

4. A dosimeter should be charged to zero:

   a. At the end of each job.
   b. Whenever it goes off scale.
   c. At the beginning of each day or job.
   d. Once every day.

5. While performing radiography, you note that your pocket dosimeter reads off scale. Whould should you do?

   a. Recharge your dosimeter and continue working.
   b. Complete your work and record the fact on the daily dosimeter log.
   c. Follow CTS procedures and have your film badge sent out for immediate processing.
   d. Perform a radiation survey to make sure that radiation levels are what you expect.
   e. Both C and D.

6. What is the most important thing you can do to avoid an overexposure to radiation?

   a. Always wear the personal dosimetry provided.
   b. Always make proper radiation surveys.
   c. Request that an alarming dosimeter be provided for use.
   d. Keep a daily log of pocket dosimeter readings.

7. If you arrive at a job and find that your survey meter is not operating properly what should you do?

   a. Complete the job quickly while keeping a close check on your pocket dosimeter.
   b. Use past experience to judge where the restricted area boundary should be and complete the job.
   c. Send an assistant to obtain a new instrument while you complete the first exposure.
   d. Go get a properly operating survey meter.

IV. Complete the Statements

1. Two commonly used radioactive radionuclides in radiography are _____ and _____.

2. The unit of measure of the radioactivity is called a _____.

3. Cobalt-60 has a half-life of _____ years.

4. The unit of measurement for long range penetrating type of external radiation is the _____.

IV. Complete the Statements

5. The relation of distance to radiation exposure is given by _____.

6. Ionizing rates are expressed in terms of _____.

7. etc.

V. Essay Questions.

1. Describe how a film badge works.

2. List several desirable characteristics of survey meters.

3. Describe how X-rays of relatively low voltage (below 400KV) are produced.

4. What is scattered radiation.

5. State several characteristics of gamma radiation.

6. Explain what is meant by "half-life."

7. What is meant by the term "half-value layer?"

8. etc.

ORAL AND OPERATIONAL EXAMINATION OF RADIOGRAPHER'S ASSISTANT

Date: _____ Trainee: _____

Examiner: _____ Overall Grade: _____

Comments: _____

_____

_____

Poor = 1
Good = 2
Excellent = 3

Task	Performance Rating	Response to Questions Asked	Comments
1. The use and care of exposure devices.			
2. The daily inspection of exposure devices.			
3. The preparation and loading of exposure devices.			
4. The set-up and operation of exposure devices.			
5. The unloading of exposure devices.			
6. The storing of sealed sources.			
7. Reporting and Control of an emergency.			
8. The posting & security of the radiation area.			
9.			
10.			

ORAL EXAMINATION OF RADIOGRAPHER

Date _____ Ass't Radiographer _____

Examiner _____ Overall Grade _____

Comments _____

_____ _____

_____

Poor= 1
Good= 2
Excellent= 3

Task	Performance Rating	Response to Questions Asked	Comments
1. The calibration requirements and transportation of survey instruments.			
2. The quarterly inspection of exposure devices.			
3. The leak testing of sealed sources.			
4. The temporary storage of sealed sources.			
5. The transporting of sealed sources.			
6. The control of radiation areas.			
7.			
8.			

RADIOGRAPHER TRAINING

LECTURE OUTLINE

PART I
(4 hours)

Radiation: Concepts and Terminology

I. Basic Understanding of Radioactivity
- A. Radiation
  1. Electromagnetic
  2. Particulate
  3. Ionizing vs. Non-ionizing
- B. Radioactivity
  1. Atomic Structure
  2. Decay Process
     a. Radionuclide (natural and man made)
     b. Types of Decay (transmutation)
  3. Physical Properties
     a. Half-life
     b. Decay Constant
     c. Decay Formula (decay factors)
     d. Energies (MEV, KEV0
     e. Units of Measurement (Curie)
     f. Specific Activity
- C. X-ray Production
  1. Similarity of X-rays and gamma rays
  2. R-rating of X-ray tubes
     a. Milli-amperage
     b. Kilo-voltage
     c. Distance
     d. Time

PART II
(10 hours)

Radiation Biology and Radiation Protection

I. Ionizing Radiation Interaction with Matter
- A. Interaction
  1. Excitation
  2. Ionization
  3. Linear Energy Transfer

RADIOGRAPHER TRAINING

LECTURE OUTLINE

PART II
(10 hours)

Radiation Biology and Radiation Protection

I. Ionizing Radiation Interaction with Matter
   A. Interaction
      1. Excitation
      2. Ionization
      3. Linear Energy Transfer

   B. Radiation Exposure Protection
      1. Internal Contamination Exposure
      2. External Exposure
         a. Time in a Radiation Field
            1. Emmission Constant (dose rate)
            2. Expected Absorbed Dose
            3. Working Time Projections
            4. Absorbed Dose vs Dose Rate X Time
         b. Distance
            1. Emission Constant
            2. Exposure Rate
            3. Calculation of Working Distance
            4. Inverse Square Law and It's Implications
         c. Shielding
            1. Shielding Material
            2. Scattering
            3. Half-value Layer
            4. Radiation Reduction Factor Charts
            5. Shielding Requirement Calculations
         d. Demonstration of the Effect of Shielding, Time, and Distance have on Radiation Exposure.

PART III
(20 hours)

Industrial Radiography

I. Introduction to Radiography

II. Elements of Radiography

III. Equipment and Facilities of Radiography

   A. Remote Handling Equipment

   B. Exposure Devices

   C. Storage Containers

IV. Radiography Equipment Safety
- A. X-ray Tubes
  1. Tube Out-put Measurements
  2. X-ray Tube Safety Devices
  3. Safety Lights
  4. Beam Collimators
  5. Locking devices
  6. Tube Leakage Measurement
  7. Tube Labeling
- B. Radionuclide Sources
  1. Source Intensity Measurements
  2. Source Contamination Evaluation
  3. Source Leakage
- C. Units of Measurement
  1. Roentgen (R)
  2. Rad
  3. Rem
- D. Historical Review of Radiation Effect on Man
  1. Uranium Miners
  2. Luminus Dial Painters
  3. Radiologists
  4. Dentists
  5. Atomic Bomb
  6. Animal Studies
- E. Radiation Chemistry
  1. Ion Pairs
  2. Free Radicals
  3. Direct Effect vs Indirect Effect
  4. Effect on Simple Biological Systems, Macromolecular Structure, Cells and Tissues
  5. Genetic Effects

II. Radiation Protection
- A. Radiation Protection Guides
  1. Permitted Levels in Unrestricted Areas
  2. Permitted Levels in Restricted Areas
- B. Overall Problems Faced by Industrial Radiographers
- C. Radiation Monitoring Instruments
  1. Purpose and Use of Monitoring Instruments
  2. Types
     a. For Measuring Radiation Exposure
        1. Survey Meter (C-M type)
        2. Ionization Chamber (Cutie Pie)
        3. Operational Characteristics
           a. Limitations
           b. Range
           c. Calibration
           d. Care

4. Survey Techniques and Records

b. For Measuring Personnel Radiation Dose
   1. Film Badges
   2. TLC Rings
   3. Pocket Dosimeter
   4. Operational Characteristics
   5. Requirements of Wearing Film Badges, TLC Rings and Pocket Dosimeters
   6. Maintenance of Daily and Life-time Records

D. Camera Safety Devices
   1. Source Handling
   2. Locking
   3. Warning Lights
   4. Container Labeling

E. Transportation of Radioactive Material
   1. Regulations
   2. Containers
   3. Vehicle and Labeling
   4. Vehicle Surveys and Security
   5. Procedure to Follow in Case of Vehicle Accident

V. Radiography Film

VI. Radiography Techniques

VII. Interpretation of Radiographs

VIII. Case Histories of Radiography Events

PART IV
(3 hours)

Governmental Regulation of Radiography

I. Nuclear Regulatory Commission Regulations

A. 10 CFR Part 19 Notices, instruction and Reports to Workers; Inspections

B. 10 CFR Part 20 Standards for Protection Against Radiation

C. 10 CFR Part 34 Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations

II. Indiana Regulation for Radiation Control

III. CTS's Nuclear Regulatory Commission License

(Copies of all the above will be handed out and reviewed)

PART V
(3 hours)

CTS Operating and Emergency Procedures

I. Copies of the operating and emergency procedures will be handed out and thoroughly reviewed.

(An Example of Handouts Used
in Teaching Radiographers)
See Appendix RT-A, Part II-I
of Lecture outline.

3. Ionizing radiation interaction with matter.

Ionizing radiation--Form of radiation which has the ability to remove an electron from an atom as it passes through the atom or near it. The result of this ionization process is the creation of an ion pair consisting of a negative ion (the electron) and a positive ion (the atom from which the electron was removed).

A. Electromagnetic wave (photon) interaction with matter. (Gamma and X-rays)

A gamma ray or X-ray can interact with matter in three ways.

1. Photoelectric effect.
2. Compton effect.
3. Pair Production.

1. Photoelectric effect

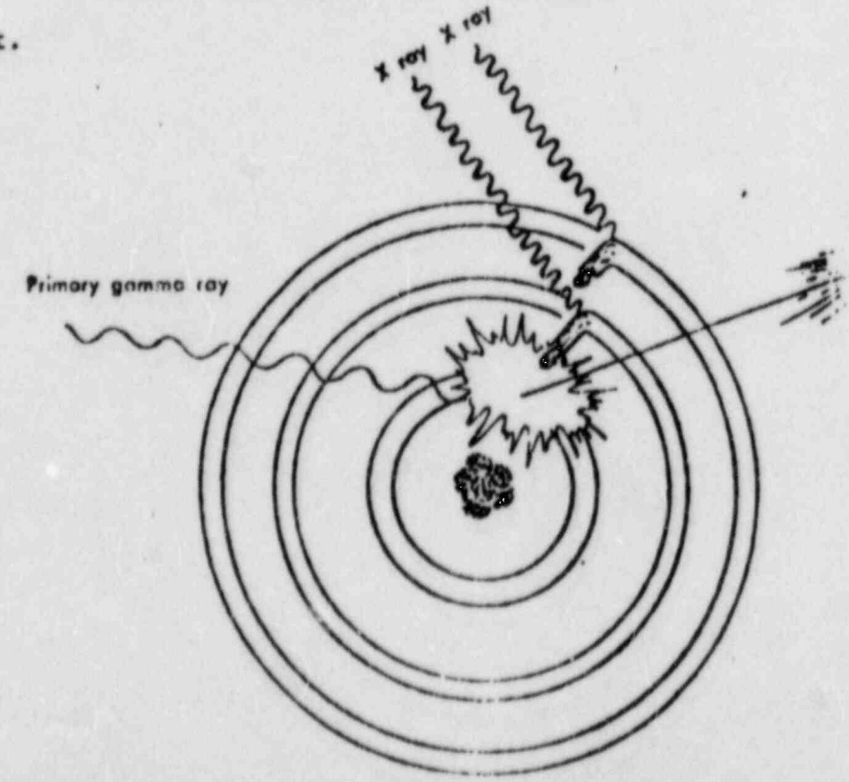


Fig. 4-10. Photoelectric effect. A low-energy gamma photon strikes an inner orbit

3. Pair Production

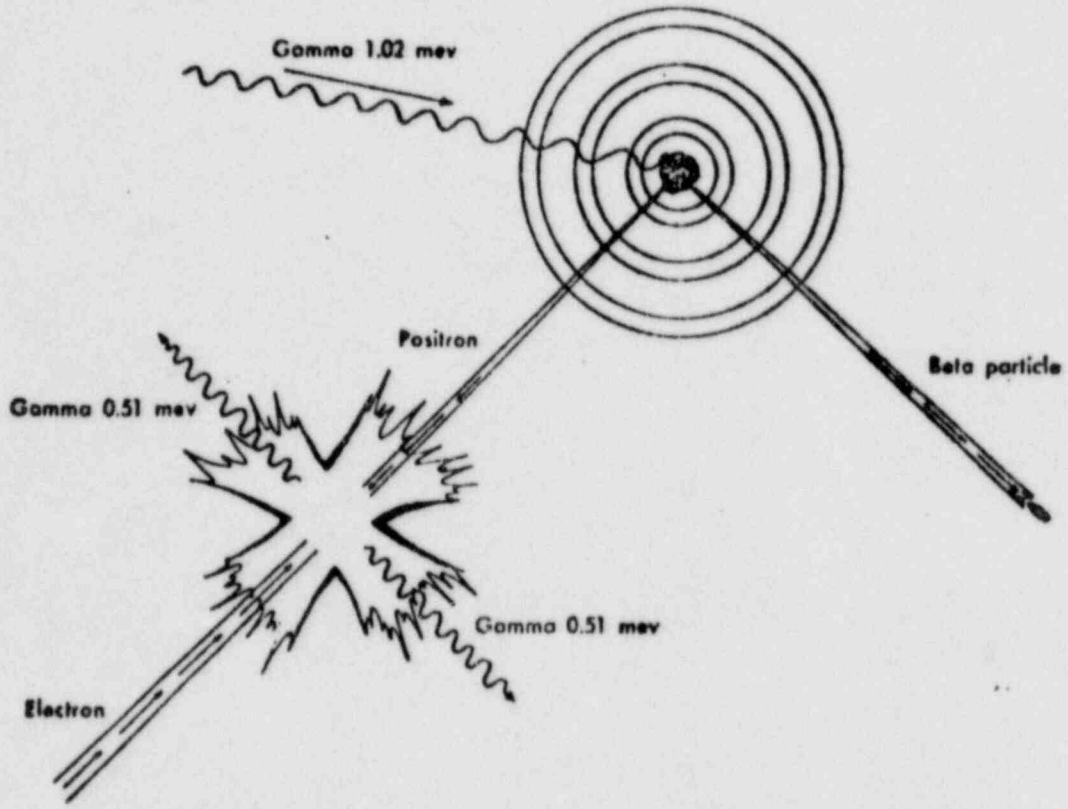


Fig. 4-11. Pair production. A high-energy gamma ray interacts near the nucleus, producing two particles, a beta particle (negatron) and a positron. The positron annihilates almost immediately.

C. Beta Particle interaction with matter.

1. Negatron

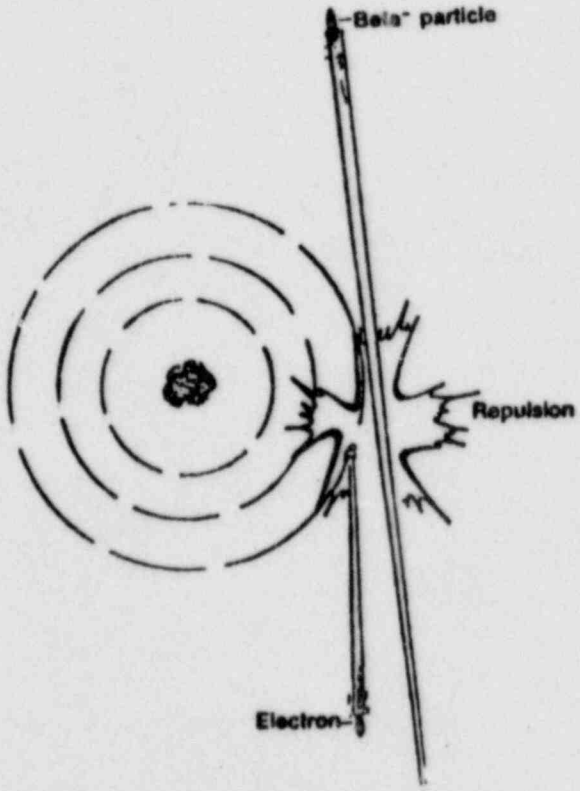


Fig. 4-5. Ionization of matter by a passing beta particle.

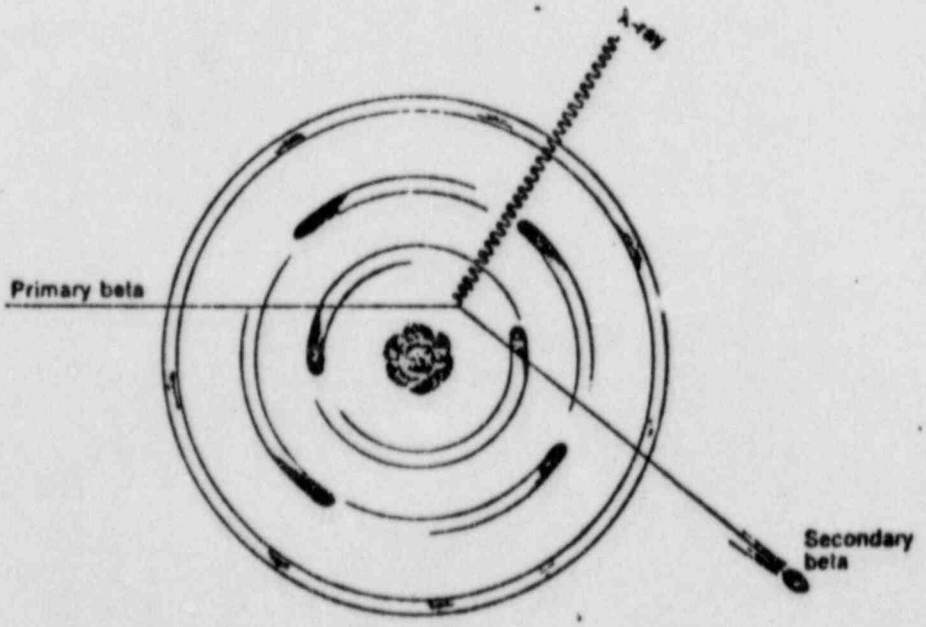


Fig. 4-6. Bremsstrahlung. A beta particle passes near the nucleus of an atom and is attracted to This results in a loss of energy and change in direction. That loss of energy is expressed as x ra or Bremsstrahlung.

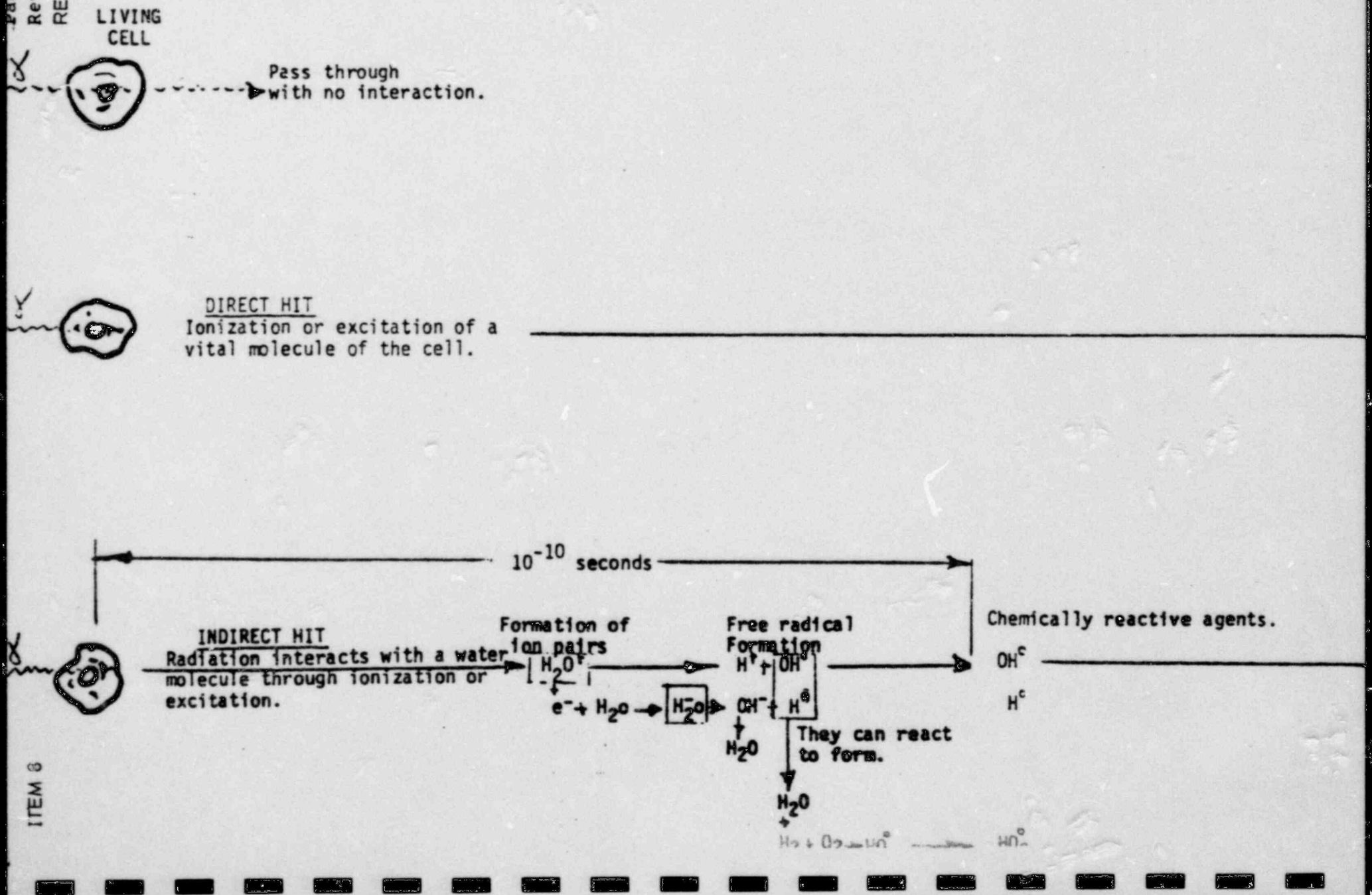
Review: Ionizing radiation and its interaction with matter.

Radiation Chemistry.

A. Ion Pairs.

B. Free Radicals

C. Direct effect vs indirect effect


LIVING CELL
Pass through with no interaction.
DIRECT HIT
Ionization or excitation of a vital molecule of the cell.
10^{-10} seconds
INDIRECT HIT
Radiation interacts with a water molecule through ionization or excitation.
Formation of ion pairs
H_2O^+
$e^- + H_2O \rightarrow H_2O^-$
Free radical Formation
$H^+ + OH^\circ$
$OH^- + H^\circ$
H_2O
They can react to form.
H_2O
Chemically reactive agents.
OH^c
H^c

ITEM 8

b. Most Sensitive Tissues.

1. Hemopoietic Tissue (blood forming tissue)

2. Gonadal Tissue

3. Gastrointestinal Tissue

4. Skin
5. Connective Tissue
6. Bones and Glands
7. Muscle and Nerve Tissue

4. Historical Review of Radiation Damage.

A. Uranium Miners

B. Luminus Dial Painters

C. Radiologists

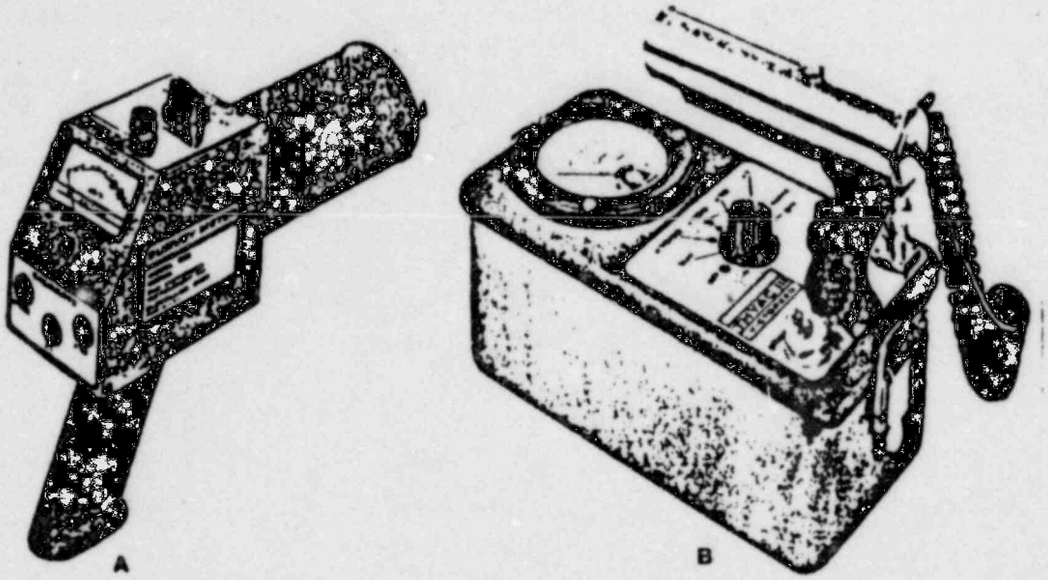
D. Dentists

E. Atomic Bomb

F. Animal Studies

THE USE AND CARE OF RADIATION SURVEY METERS

Since inoizing radiation can not be perceived by any of the human senses, it is necessary to have a detecting device that can detect their presence. Futher more, it is important to quantitate the amount of ionizing radiation present for purposes of radiation protection. There are a number of such detecting devices available to be used in a number of varing situation. In industrial radiography radiation survey detection and monitoring is carried out using a category of detector called "gas detectors."

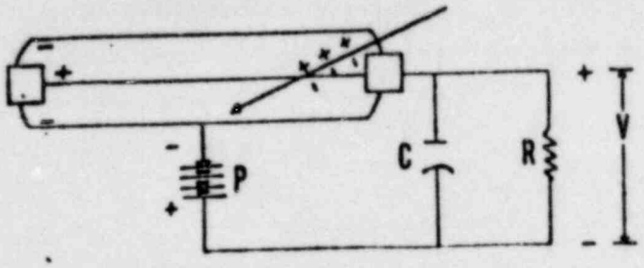


A, Ionization type dose rate survey meter. B, Geiger-Mueller type dose rate survey meter.

Basic Working Principles of a Gas Radiation Detector

If a gas, such as air, helium, argon, etc. is contained in a closed chamber and the concentration and pressure are controlled any ionizing radiation passing into or through this chamber will cause ionization of the gas molecules. The ions formed are a negatively charged electron and a positively charged parent molecule from which the electron has been removed. If the chamber is made electrically polar (anode and cathode) the charged ions can be collected because of electrical attraction to these poles. If enough electrons are collected at the anode, a current will be produced. This current can be amplified to move a needle on a meter. The amount of needle deflection is a result of the amount of current produced at the chamber poles which is a result of the amount of ions formed which is a result of the amont of ionizing radiation which the chamber was exposed to.

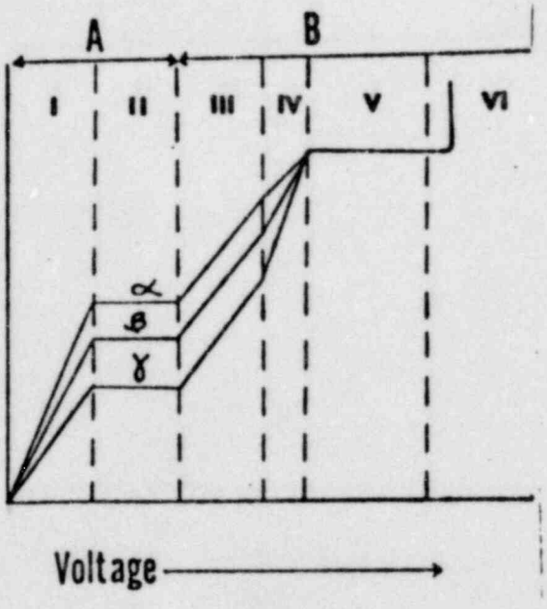
There are many variables to this system which can be considered, but those of primary interest are the variable voltage applied to the chamber for the purpose of collecting ions and the current indicator which should be sensitive and have a wide range.



A gas detector.

A. Variable Voltage Supply

The voltage supplied to the chamber has an important effect on ion formation and collection. This can be demonstrated by what is called regions of response. If a detection chamber is exposed to a constant source of ionizing radiation while increasing voltage is applied across the chamber the current output produced by ionization within the chamber will yield six regions of response.



Number of ion pairs collected.

Region 1. Recombination Region

In this region, the ions produced by the radiation will be under very low voltage gradients and will tend to recombine with each other rather than migrate to the electrodes and be collected. This recombination of ion pairs decreases as the applied voltage is increased and finally becomes negligible. The end of this region is were the voltage supplied will be sufficient to collect all of the ion pairs that are formed. This region is not useful for the operation of radiation detection instruments.

Region 2. Ionization Chamber Region(Saturation Region)

This region begins at the voltage at which all ions formed are collected. These are the primary ions re-

sulting from the action of the radiation, and are comprised of ion pairs. For a substantial increase of voltage above the region of recombination, all ions produced in the gas by radiation are collected. As the voltage is increased within this region, the ions are given more energy and move faster toward the electrodes. However, they do not become energetic enough to produce additional ionization.

Regions 3 and 4. Proportional Region

If the voltage is increased above the ionization chamber region, the number of ions collected by the electrodes is reater than the number produced by the radiation. Under the higher voltage gradient, the primary electrons achieve a high enough velocity to cause secondary ionization in the gas filled chamber. Hence, each primary ion pair produces several additional ions which are also collected (amplification). The number of ions collected is proportional to the number of primary ion pairs formed.

Region 5 Geiger-Mueller Region

In this region the amplification factor is very high because the voltage applied givessuch great energy to even one primary ion that it causes so many secondary electron an avalanche is produced. In this region single ionizing events may be detected.

Region 6 Continuous Discharge Region

This region above the G-M region is a state of continuous discharge.

B. Current Indicator

1. Pulse type indicator. The current produced at the chamber of the detector is seen as pulses separated in time. Each signal represents the interaction of a photon or particle with the detector. The Geiger counter is an example of pulse mode operation. The output is expressed in counts per minute (cpm).

2. Mean-levl indicator. The current produced at the chamber of the detector is seen as an average of many interaction of photons or particles. An ionization chamber is an example of mean-level mode operation. The output is expressed in Roentgen per hour (R/hr).

Operational and Practical Considerations Of Using a Gas Radiation Detector

Although theoretically possible, it is not practical to produce one instrument which can function in all the regions. A radiation detector may be called a laboratory monitor, survey meter or survey instrument. The purpose

of a laboratory monitor or survey instrument is twofold: to keep a constant surveillance over the working environment and to detect the quantity and extent of contamination. Consequently , laboratory monitors are placed in rooms where radionuclides are used. Counters, floors, and other places where spills may have occurred are surveyed daily. In addition, rooms containing x-ray equipment or other sources of radiation are surveyed periodically for amount of leakage and scattered radiation.

Survey instruments must possess the following characteristics: simplicity of construction, ruggedness, reliability, portability, and sensitivity. The most commonly used survey meter used in industrial radiography are:

1. Ionization Meter (Cutie Pie) It operates at a voltage of 60 to 600 volts. It has low sensitivity but high range and is used as a radiation exposure meter to measure exposure levels of radiation. Its read out is in mR/h.

2. Proportional Survey Meter It operates at a voltage of 500 to 5000 volts. It has high sensitivity and high range and is also capable of discriminating between different types of radiation. It is more expensive and is not as rugged as a ionization meter of G-M meter so it is not used as much unless its discriminating properties are needed.

3. G-M Counter It operates at a voltage of 600-3000 volts. It has high sensitivity and low range. It is used to measure low levels of radioactive contaimination. Its read out is in cpm.

Demonstration
The Use of Radiation Survey Meters

NOTES:

The Care of Radiation Survey Meters

A. Storage: Survey instruments should be stored in a relatively dry and safe place. Usually a cabinet or shelf will do. Remember, <u>trun the meter off during storage</u> or the battery will run down. If a new powersupply has to be added the instrument will have to be recalibrated.

B. Handling: Survey instruments are relatively sensitive instruments, so rough treatment can damage the instrument totally or disrupt its surveying accuracy.

C. Calibration: All survey instruments are calibrated by the manufacturer at the time of production. Nevertheless, changes in the characteristics of the individual components of instruments may cause a change in instrument response. It is, therefore, essential that all survey meters be calibrated periodically to ensure proper reading. This calibration is especially important for G-M tubes of their poor energy dependence. It is recommended that G-M type survey meters be calibrated quarterly and after each battery exchange.

APPENDIX RT-D

RADIOGRAPHER EXAMINATION

TEST QUESTIONS

Below, are examples of the types of questions which will be asked of a radiographer trainee. Tests will be made up of combinations of these types, so that a minimum of fifty questions are asked. The point value assigned to the questions will be at the discretion of the examiner. A trainee must obtain a mark of 80% to pass the test.

Test Question Type

I. Definition of Terms.

1. Roentgen (R) --
2. Half-life --
3. Ionizing Radiation --
4. Maximum Permissible Dose --
5. Curie (Ci) --
6. Leak Test --
7. Scatter Radiation --
8. Radioactivity --
9. Effective half-life --
10. Rem --
11. Scatter --
12. Safelight --
13. Fixation --
14. Shrinkage cavities --
15. Cold shuts --
16. Etc.

II. True or False Questions.

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

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

3. T F If your survey meter fails, you must discontinue your radiographic operation.

4. T F The half value of lead is a constant for all energies of ionizing radiation.

5. T F Several small dose over an extended period of time are equal to one large dose with respect to damage to biological tissue.

6. T F Gamma rays and X-rays primarily differ in their origin.

7. T F The rate of decay of a radionuclide is constantly changing.

8. T F Safety practices in nuclear energy industries are set by their insurance companies.

9. T F The inverse square law applies only to "point" sources of radioactivity.

10. T F Cobalt-60 has a half-life of 75 years.

11. T F Etc.

III. Multiple Choice Questions.

1. Are there any times when industrial radiography can be performed, without posting being required?

   a. Any time.
   b. In an exposure room.
   c. Never
   d. On the first exposure.
   e. In an open area, controllable by direct surveillance.

2. Which of the following is used to determine if a source has been properly returned to the safe position in an exposure device.

   a. Survey meter.
   b. Counter attached to the controls.
   c. Dosimeter
   d. Signal lights.

3. At what interval is a source to be leak tested?

   a. At least once every 3 months.
   b. At least once every 6 months.
   c. At least once a year.
   d. Only when specifically directed by the radiation safety officer.

4. What is the acceptable limits for radiation intensities when performing a vehicle survey?

   a. 200mR/hr at the surface and 10mR/hr at 3 feet from the surface.
   b. 10mR/hr or less.
   c. 2mR/hr or less.
   d. 5mR/hr or less provided the individual cannot receive a dose in excess of 2 mR in any one hour's time.

5. Circle the items a radiographer is responsible to fill out on the utilization log each time he checks a source out and returns it.

   a. Date/Time - In/Out
   b. Source material and serial number.
   c. Location of Use.
   d. Responsible radiographer.
   e. Exposure device and serial numbers.
   f. Inspection maintenance.

6. Etc.

IV. Complete the Statements.

1. Emergency radiological assistance may be obtained from the _____.

2. _____ screens decrease exposure time by emitting electrons.

3. The sharpness of a radiation shadow depends upon _____, _____ and _____.

4. Differences in density from one area to another on a radiograph are called _____.

5. The _____ cells are the most sensitive to radiation.

6. Etc.

V. Essay Questions.

1. What is the difference between dose and dose-rate as applied to radiation?
2. Why are dose-rate constants of interest to the radiogrpher?
3. What are the causes of low radiographic contrast?
4. What causes fog?
5. What is "percent sensitivity?"
6. What are the exposure limits permitted radiography personnel working in restricted areas?
7. Describe the color and markings of the radiation symbol?
8. Etc.

VI. Problem Solving Questions.

1. What is the radiation intensity 30 feet from 90 Ci of Ir 192?
2. How many half-value layers are required to shield a radiation beam from 16,384 mR/hr down to 128 mR/hr?
3. An aluminum specimen is 3" thick, 4" wide, and 15" long. Sketch the radiographic arrangement and calculate the exposure time.
4. Suppose it is determined that a 2.1 curie source of C0-60 is available. How far from the source should a meter be placed in order to check the meter at the 500 mR/hr point?
5. Suppose the emission rate of a source of radiation is 81 roentgens per hour at 1 foot. What is the emission rate at 3 feet?

APPENDIX ERT-A

EXPERIENCED RADIOGRAPHER ORIENTATION AND TRAINING LECTURE OUTLINE

PART I
(4 hours)

Orientation to CTS Procedures

I. CTS Operating Procedures

II. Emergency Procedures

III. Radiography Procedures and Equipment

PART II
(4 hours)

General Review

I. Radiation Protection and Safety

- A. Radiation Protection Guides
- B. Radiation Monitoring
  1. Measuring Radiation Exposure
     - a. Survey Meter (G-M type)
     - b. Ionization Chamber (Cutie Pie)
     - c. Survey Techniques and Records
  2. Measuring Personnel Radiation Exposure Doses
     - a. Film Badges
     - b. TLC Rings
     - c. Pocket Dosimeter
     - d. Requirements of Wearing Film Badges, TLC Rings and Pocket Dosimeters
     - e. Daily and Life-time radiation Dose Records

II. Governmental Regulation of Radiography

- A. Nuclear Regulatory Commission Regulations
  1. 10 CFR Part 19 Notices, Instructions, and Reports to Workers; Inspections
  2. 10 CFR Part 20 Standards for Protection Against Radiation
  3. 10 CFR Part 21 Reporting of Defects and Noncompliance
  4. 10 CFR Part 34 Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations
- B. Indiana Regulation for Radiation Control
- C. CTS's Nuclear Regulatory Commission License

APPENDIX ERT-B

EXPERIENCED RADIOGRAPHER EXAMINATION

TEST QUESTIONS

Below, are examples of the types of questions which will be asked of an experienced radiographer after the orientation and training period. Tests will be made up of combinations of these types, so that a minimum of twenty-five questions are asked. The point value assigned to the questions will be at the discretion of the examiner. A trainee must obtain a mark of 80% to pass the test.

Test Question Type

I. Definition of Terms.

1. Maximum permissible Dose --
2. Transport Index --
3. Radiation Area --
4. Calendar quarter --
5. Dose rate --
6. Etc.

II. True or False Questions.

1. T F Radiographers bear direct responsibility for compliance with regulations wherever they do radiography work.
2. T F A 0-1R dosimeter may be used instead of a 0-200mR dosimeter for radiographic operations.
3. T F If your survey meter fails, you must discontinue your radiographic operation.
4. T F Reduction factor depends only upon the thickness of the shield.
5. T F When distance is tripled the amount of radiation received is decreased six times.
6. Etc.

III. Multiple Choice Questions.

1. In the following situation, what should the responsible radiographer do? The situation is that one of our client's employees has walked unauthorized into the radiation area and close to an exposed source. The employee was not wearing any monitoring equipment and it is not immediately known how much exposure he received.

   a. Do nothing.
   b. Send the man to the hospital for a series of blood tests and an examination by a radiologist.
   c. Reprimand the employee and tell him not to do it again.
   d. Immediately notify the radiation safety director of the company and follow their instructions.

2. Number the answers below in the correct order that radiographer is to follow in an emergency situation when a gamma exposure device malfunctions and the source is stuck in an exposed position.

   a. Immediately cease all radiographic operations and remove all personnel from the area where the radiation is greater than 2mR/hr.
   b. After surveillance of the area has started, have the radiation safety director or other person on the RSC personnel list immediately notified of the emergency. Notify applicable personnel of the client.
   c. Post the perimeter of the restricted area with "Radiation Area" signs and erect a barricade when possible. Survey the perimeter of the posted area to assure the radiation level outside the area is 2mR/hr or less. Adjust the barricades and signs if necessary.
   d. Have the area under constant surveillance and do not allow unauthorized personnel to enter the areas.
   e. Maintain control of the area until relieved of the responsibility by the radiation safety monitor or his designate.

3. What is the acceptable limits for radiation intensities when performing a vehicle survey?

   a. 200mR/hr at the surface and 10mR/hr at 3 feet from the surface.
   b. 10mR/hr or less.
   c. 2mR/hr or less.
   d. 5mR/hr or less provided the individual cannot receive a dose in excess of 2 mr in any one hour's time.

4. A dosimeter should be charged to zero:

   a. At the end of each job.
   b. Whenever it goes off scale.
   c. At the beginning of each day or job.
   d. Once every day.

5. Select the answers that show when an exposure device containing a radioactive source must be surveyed.

   a. During the last exposure.
   b. When removing the exposure device from storage.
   c. After each exposure.
   d. Immediately before the first exposure.
   e. As soon as you arrive at the job site.
   f. When returning the exposure device to storage.

6. Etc.

IV. Complete the statement.

1. _____ is one of the best ways of sealing capsules containing gamma ray sources.
2. The _____ cells are the most sensitive to radiation.
3. Ionization chamber instruments are _____ level instruments.
4. Radiation measuring instruments provide either a measurement of _____ or of _____.
5. The absorption formula applies to _____ radiation.
6. Etc.

V. Essay Questions.

1. What are the range and characteristics of survey meters acceptable for radiography?
2. Explain why radiation surveys are required in connection with radiographic operations.
3. How does radiation affect the living organism?
4. Describe how a film badge works.
5. Explain very generally how radiation may be measured.
6. Etc.

VI. Problem Solving Questions.

1. An Iridium-192 source was exposed to a pocket dosimeter for 15 minutes at a distance of 10 feet and the dosimeter read 177 mR. What is the activity of the Iridium-192 source?
2. Suppose it is determined that a 2.1 curie source of C0-60 is available. How far from the source should a meter be placed in order to check the meter at the 500 mR/hr point?
3. A 20 curie source of C0-60 is to be used 15 feet from a group of workmen. How thick an iron shield would be needed to reduce the dose-rate received by the workmen to 5 mR/hr?
4. Etc.

NAME: _____ APPENDIX-CE

DATE: _____

SCORE: _____

C T S SEMI-ANNUAL RADIOGRAPHER REVIEW TEST

1. What is the HVL of lead for Iridium 192?

   a. .19
   b. .12
   c. .50
   d. .35

2. When performing radiography using radioisotopes in a licensed exposure room with permanent installed radiation monitoring devices and alarm systems, it is not necessary to use a survey meter.

   a. True
   b. False

3. A survey meter is capable of measuring:

   a. Dose
   b. Dose Rate
   c. a and b
   d. None of the above

4. What federal document regulates the transportation of radioactive materials on public highways?

   a. Title 10 Code of Federal Regulations
   b. Title 29 Code of Federal Regulations
   c. Title 49 Code of Federal Regulations
   d. None of the above

5. When must the physical condition of all radiographic devices be checked?

   a. Before each use.
   b. At the end of each calendar quarter.
   c. After the equipment has been subjected to unusual stress.
   d. All of the above.

6. When is it permissible to allow untrained personnel to operate an exposure device?

   a. Only with written approval of the Radiation Safety Director.
   b. Only under direct surveillance of a Radiographer.
   c. Untrained personnel are never allowed to operate an exposure device.
   d. Only when the individual is supplied with personnel monitoring devices and a survey meter.

7. At what interval is a source to be leak tested?

   a. Once a year.
   b. Once every 90 days.
   c. Once every 6 months.
   d. Once every month.

8. At what interval is a survey meter to be calibrated?

   a. Once a year.
   b. Once every 90 days.
   c. Once every 90 days and after servicing.
   d. Once every 6 months and after servicing.

9. Which of the following devices is used to record exposure?

   a. A Densitometer
   b. A Dosimeter
   c. A Penetrometer
   d. A Survey Meter

10. The supervision of an Assistant Radiographer is not a duty of the Radiographer?

   a. True
   b. False

11. Which item below can best cause a Radiographer to cease his operation completely until corrective action is taken?

   a. Wrong type of film.
   b. Run out of masking tape.
   c. Survey meter malfunction.
   d. Too short exposure times.

12. What part of the company license must always be with the Radiographer?

   a. Section showing lab location.
   b. Operating and Emergency Procedures Section.
   c. Section showing who owns stock in the company.

13. Why must all Radiographers be tested periodically?

   a. Make sure they remember shooting techniques.
   b. Aware of any changes in the Operating and Emergency Procedures and so they do not forget pertinent information in regards to their duties.
   c. So they can put out more work per shift.

14. Name the three concepts a Radiographer uses to protect himself and others from radiation.

   a. _____

   b. _____

   c. _____

15. What item below should be a prime concern of all Radiographers?

   a. Get his jobs completed as quickly as possible.
   b. Use all radiographic devices in the safest manner possible, to receive as little radiation as possible, and to protect all personnel from exposure to radiation.
   c. Never buy coffee for USNRC Inspectors.

ATTACHMENT - 6A

1.0 DESCRIPTION OF RADIOGRAPHIC FACILITIES

1.1 CALUMET TESTING SERVICES, INC. (CTS) of Griffith, Indiana is a privately owned Company.

1.2 CTS is located at 1945 North Griffith Blvd., Griffith, Indiana. The building is located on a 270' x 290' lot in the Brant Business Center.

2.0 The building consists of offices and shop area. Three sketches are included with Attachment 6A to show building location, shop layout, source storage, and radiographic exposure areas.

2.1 The source storage area is a locked room constructed of solid concrete block, on the east side of the building.

2.1.1 The storage area may be lined on the inner surfaces with sufficient lead and/or other material so that there shall be no radiation detected on the outer surfaces in excess of 2 MR per hour.

2.2 A pit is available on the southeast corner of the building for shop radiography. This radiographic exposure area measures approximately 30' long, 14' wide and 7' deep from the shop floor. Construction is 8" thick poured concrete walls and floor, with access provided by a steel staircase. A 2' thick poured concrete wall separates the stairway from the exposure area.

2.2.1 The top outer edge of the pit is surrounded by a wall of solid concrete block 48" high and stacked 2 to 4 rows deep. Access is provided only at the stairway.

2.2.2 Six solid concrete slabs approximately 10" thick can be positioned across the top of the pit. These slabs are movable and provide access for large parts to be lowered into the radiographic exposure area from an overhead 10 ton crane.

2.3 The radiographic exposure area is equipped with radiation monitors to prevent unauthorized entrance into the high radiation area of the pit.

2.3.1 A Tech/Ops Model 492D Gammalarm visible indication monitor shall be located in the radiographic exposure area and connected to a Model 492E Dual light flasher positioned at the outside of the entrance door.

2.3.2 A Model 492J monitor circuit arrangement is connected to a horn which gives an audible alarm signal if the entrance door is opened by an unauthorized person during a radiographic exposure.

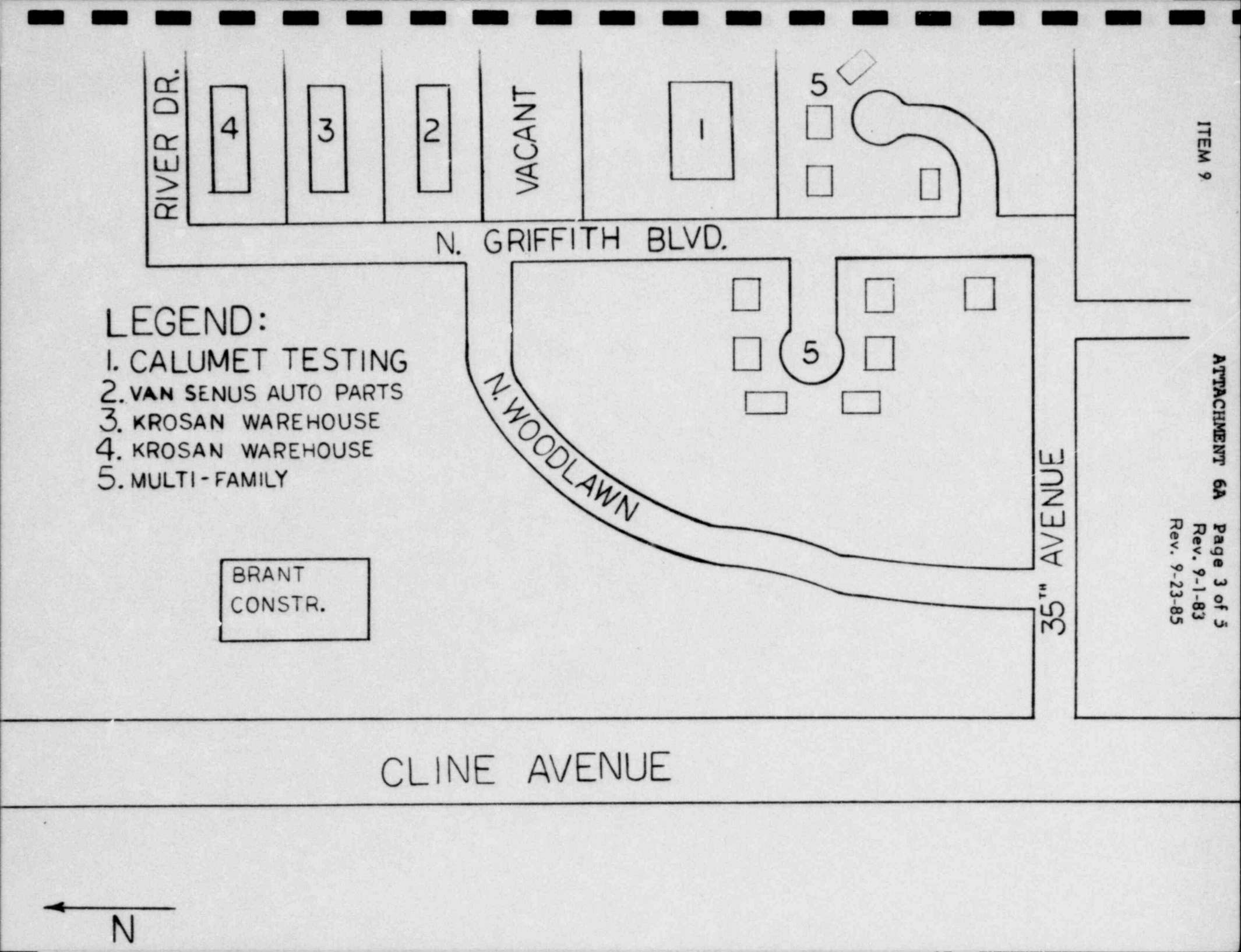
3.0 Field storage of radioactive materials.

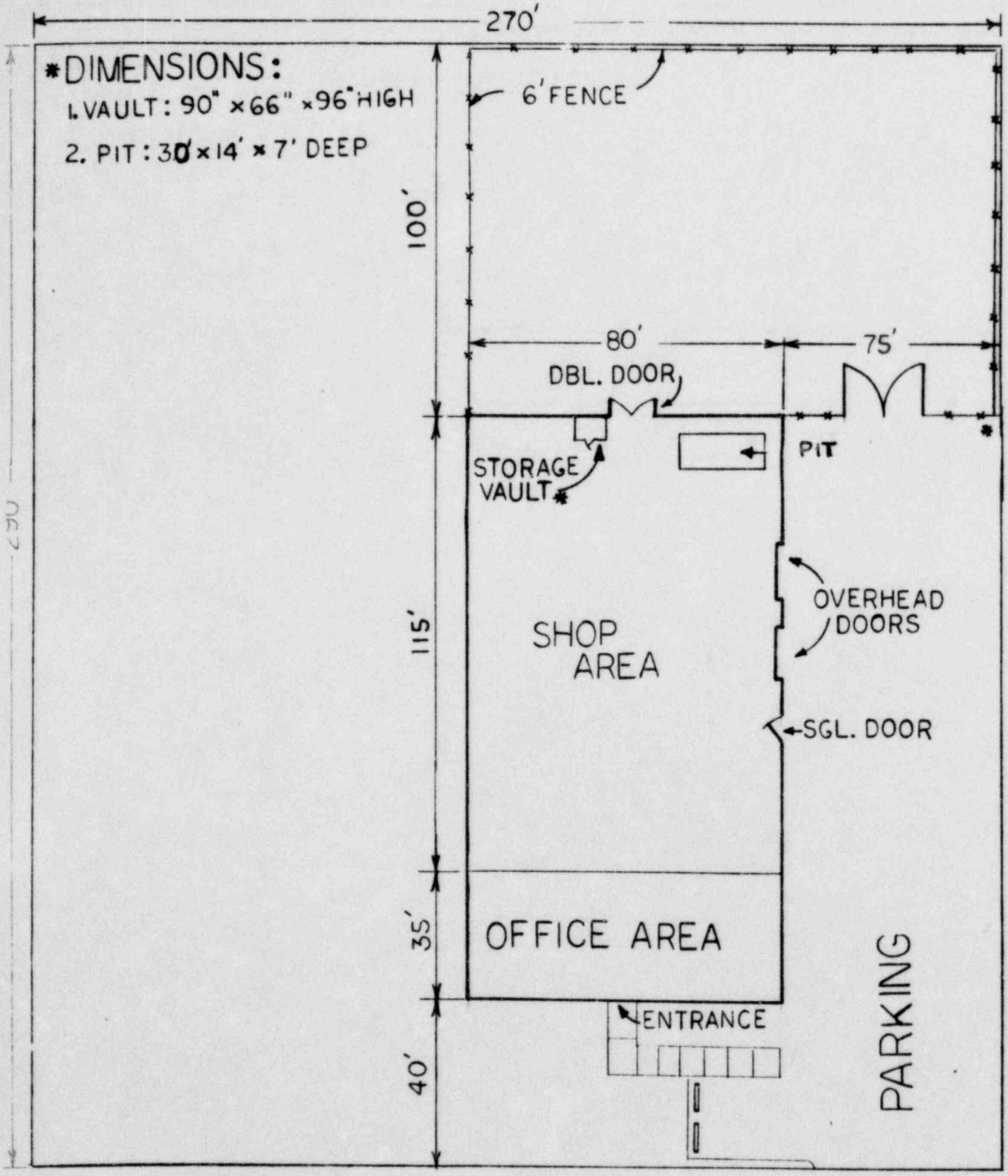
3.1 If radioactive material is stored at a jobsite or radiography location, it must be secured and identified.

3.1.1 When stored in a locked enclosure, there shall be no radiation detected at the outer surface in excess of 1 MR per hour.

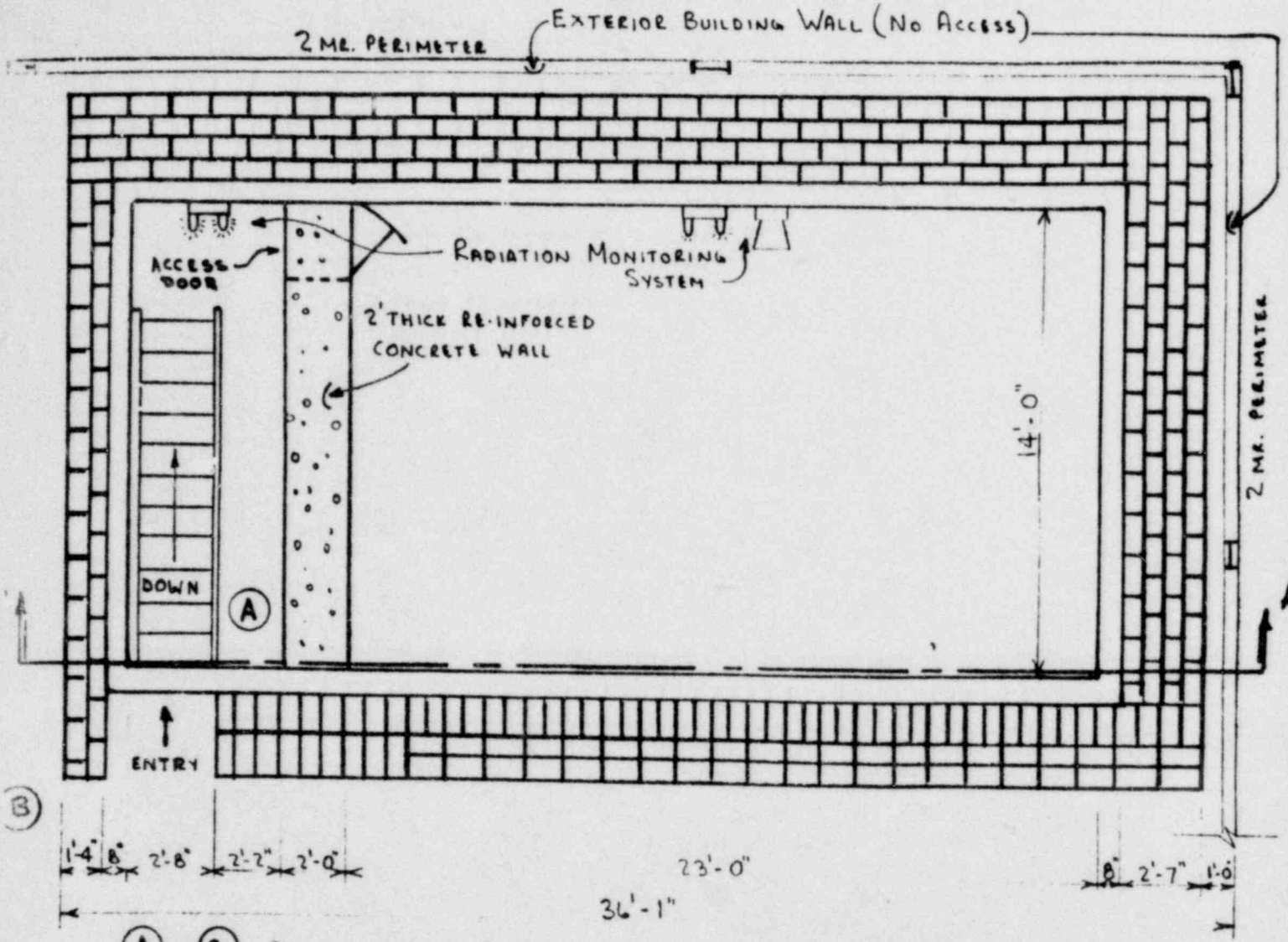
3.1.2 When stored in an open area, the material must be changed and locked. The storage area must be roped and posted with appropriate signs at the 1 MR per hour perimeter.

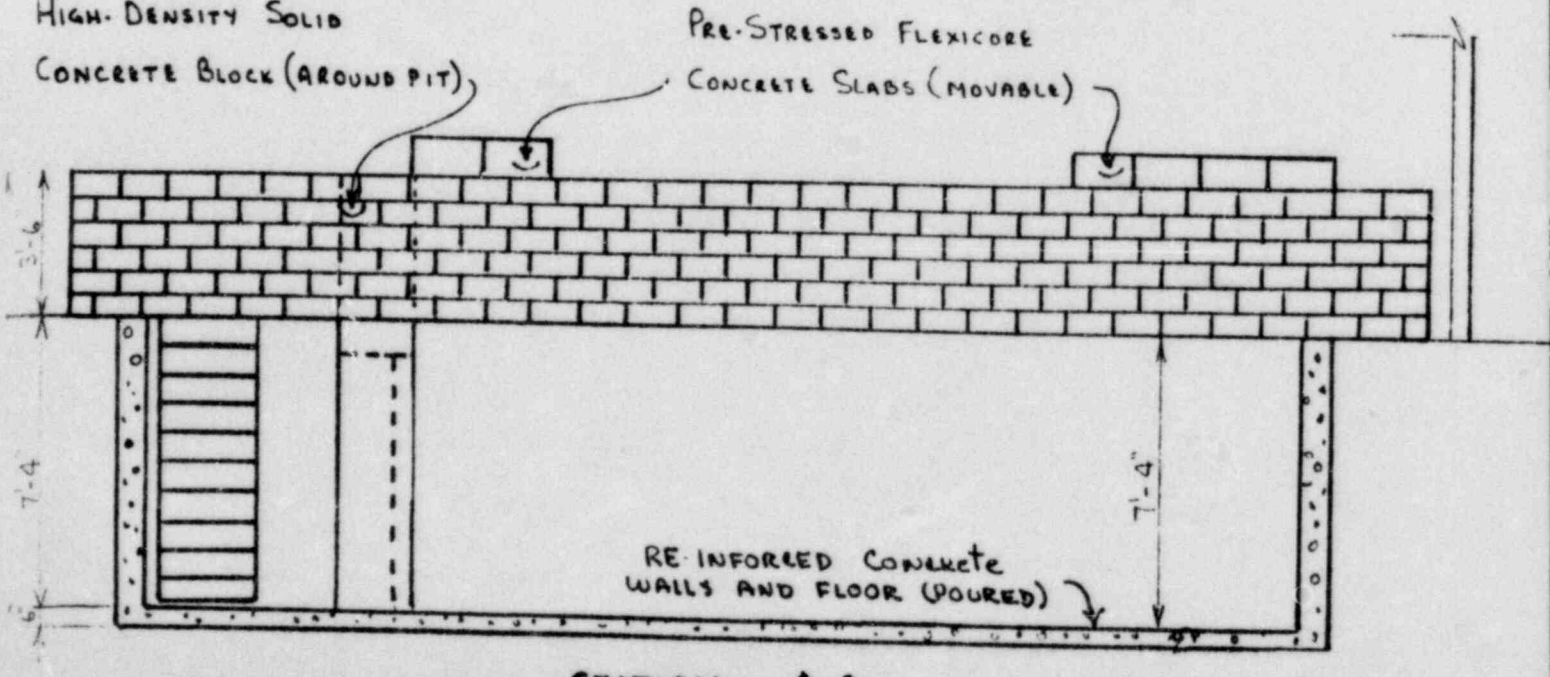
3.2 The customer, or person in charge of a field location where CTS is doing work shall be notified by CTS when it intends to store material at the jobsite. CTS Shall give the person in charge adequate instructions concerning the stored material, including persons to notify at CTS in case of an emergency or unauthorized removal of the stored material.


RIVER DR.
4
3
2
VACANT
1
5
N. GRIFFITH BLVD.
5
N. WOODLAWN
35TH AVENUE
LEGEND:
1. CALUMET TESTING
2. VAN SENUS AUTO PARTS
3. KROSAN WAREHOUSE
4. KROSAN WAREHOUSE
5. MULTI-FAMILY
BRANT CONSTR.
CLINE AVENUE
N


VACANT
270'
*DIMENSIONS:
1. VAULT: 90" x 66" x 96" HIGH
2. PIT: 30' x 14' x 7' DEEP
6' FENCE
100'
80'
75'
DBL. DOOR
PIT
STORAGE VAULT
OVERHEAD DOORS
SHOP AREA
115'
SGL. DOOR
35'
OFFICE AREA
ENTRANCE
40'
PARKING
N. GRIFFITH BLVD.

RADIOGRAPHIC PIT ARRANGEMENT





SECTION AA

ATTACHMENT 6D

4.0 PERSONNEL MONITORING EQUIPMENT

4.1 The following listed company shall supply film badge service for Calumet Testing Services, Inc.

4.1.1 The R. S. Landauer, Jr. & Company
Glenwood Science Park
Glenwood, Illinois 60425
Phone (312) 755-7000

4.2 Dosimeters - Make - Model

4.2.1 Victoreen pocket dosimeters, Model No. 541/A, Dosimeter Corporation of America, Model No. 862 or comparable equipment will be used, having energy dependence maximum within plus or minus 10% of true dose from 55KEV to 2 MEV. Range is 0 to 0.2R (200 MR).

4.2.2 Victoreen dosimeter charger Model No. 2000/A or Dosimeter Corporation of America charger Model #909 will be used.

Note: Required personnel monitoring equipment, including 0- to 200- milliroentgen dosimeters will be used by radiographic personnel.

Maximum time period for film badge exchange is one month.

ATTACHMENT 6-B

2.0 DESCRIPTION OF RADIATION DETECTION INSTRUMENTS

2.1 One or more operable and calibrated survey meters shall be used for all radiographic procedures.

2.1.1 Survey meters shall be capable of detecting x-rays and gamma rays in the range 2 milliroentgens per hour through one roentgen per hour.

2.1.2 Survey meters will be calibrated so that readings are accurate within ± 20% of the scale range in use.

2.1.3 Meter calibration documentation will include a graph or chart showing the results of the calibration, the calibration date and the due date of the the next calibration.

2.1.4 Labels will be affixed to calibrated meters, identifying the meter, listing the date of calibration and listing the due date of the next calibration.

2.1.5 Meters will be calibrated every three months or after each servicing. Calibration records will be kept for a minimum of two years.

ATTACHMENT 6C

3.0 INSTRUMENT CALIBRATION PROCEDURES

3.1 All radiation survey instruments will be calibrated by an outside service organization which is licensed by the United States Nuclear Regulatory Commission, or an agreement state.

3.1.1 (a) HEALTH PHYSICS ASSOCIATES LTD.
3304 Commercial Avenue
Northbrook, Illinois 60062
NRC License No. 12-09160-01
Phone (312) 273-2525

(b) GAMMA INDUSTRIES, A Division of
Nuclear Systems, Incorporated
2255 Ted Dunham Avenue
Baton Rouge, Louisiana 70821
Louisiana License LA-0006-L01
Phone (800) 535-8132

(c) TECHNICAL OPERATIONS, INCORPORATED
40 South Avenue
Burlington, Massachusetts 01803
NRC License No. 20-00277-03
Phone (617) 272-2000

(d) SOURCE PRODUCTION AND EQUIPMENT COMPANY, INC.
625 Oxley Street
Kenner, Louisiana 70062
Louisiana License LA-2966-L01
Phone (504) 464-9471

3.1.2 The above companies will perform calibration and/or repair work radiation survey equipment.

3.2 Handling and procedures for calibration of radiation survey instruments are as follows:

3.2.1 All survey meters shall be calibrated at periodic intervals not to exceed 90 days.

3.2.2 If a survey meter becomes inoperative, or is suspected to operate incorrectly, the meter shall be returned immediately to an approved source for meter repair and/or calibration.

3.2.3 Survey meters shall be sent for calibration on a schedule so as not to deplete CTS of the necessary quantities needed to operate safely.

3.2.4 The Radiation Safety Officer shall be responsible for shipment and receipt of survey meters.

3.2.5 Survey meters will be transported in protective containers designed to minimize damage.

3.2.6 The RSC Director shall approve procedures used for calibration and repair of survey meters.

3.2.7 Each survey meter shall have a calibration sticker affixed showing the model, serial number, the date of calibration, the next due date for calibration and the name of the calibration personnel. A calibration certificate shall also be kept on file.

3.2.8 In the event a survey meter is not in continuous use, after the last due calibration date, the time of inactivity shall be noted on the Instrument Calibration Log.

3.2.9 Should a survey meter become inoperable during radiographic operations, the radiographer shall immediately cease operations and report the situation to the Radiation Safety Officer.

3.3 Dosimeter Calibration

3.3.1 All Pocket Dosimeter calibrations will be performed by the Radiation Safety Officer. Pocket Dosimeters will be checked for accuracy at intervals not to exceed one year. This check will be performed using the Victoreen Model 541-205 Dosimeter Calibrator.

3.3.2 Each Pocket Dosimeter will be exposed to a minimum of 50 MR. If the reading of the Pocket Dosimeter varies by more than ± 30% it will be repaired or replaced.

3.3.3 Records of Pocket Dosimeter calibrations will be maintained by the Radiation Safety Officer.

ATTACHMENT 6G

6.0 INTERNAL INSPECTION SYSTEM

6.1 The President of Calumet Testing Services, Inc., Robert J. Vidimos, having complete responsibility and authority over the radiography program delegates the responsibility of performing an internal inspection on matters of radiation safety and NRC compliance to an internal auditor, Mr. Alan J. Meyer. He will conduct the internal inspection every three months.

The purpose of the internal inspection will be to assure management that there is control of the receipt, possession and disposal of radioactive materials, and that these radioactive materials are being used in a safe manner. Furthermore, the internal inspection will ensure that NRC license conditions, commission regulations, and operating and emergency procedures are followed by radiographers and radiographer's assistants.

The results of the internal inspection will be presented and discussed at a meeting of the Internal Inspection Committee, which consists of the President of CTS, the Internal Auditor, Radiation Safety Control Director, and the Radiation Safety Officer. Any and all deficiencies found in the program or the performance of individual radiographers or radiographer's assistants will be considered and corrective measures will be formulated. Minutes of these meetings will be taken and filed for a two (2) year period. The Radiation Safety Officer will then be given the responsibility with complete backing of the Internal Inspection Committee to correct the deficiencies through warnings to personnel or through educational methods.

Below is listed the specific areas and records of the radiography program that will be inspected, the individual responsible, and the method of inspection or review. All forms listed are found at the back of this section.

6.1.1 The Receipt, Inventory and Disposition of Radioactive Sources.

The Radiation Safety Officer is responsible for maintaining radioactive sealed sources. Specifically, he will place orders, document receipt of the sources, keep up-to-date inventory records and supervise the return of spent sources. The internal records he is required to keep, or supervise the keeping of are: Control Form #4, Source Replacement Schedule, Control Form #9, Special Purchase Order for Radioactive Source Material Only, and Control From #5, Quarterly Inventory Record and Log - Radioactive Sources. During the internal inspection these records will be reviewed to determine if these records are being maintained and are accurate.

6.1.2 Daily Source Utilization and Radiographic Application

The radiographer is required to record the use of any sealed source. This is done by completing Control Form #1, Daily Utilization Log. These reports are then filed for inspection by The Radiation Safety Officer, or his designee.

6.1.3 Wipe Test Records of Sealed Sources

In accordance with NRC regulations, radioactive sealed sources will be wipe tested for contamination and leaks upon receipt and every six months. The maintenance of Control Form #6, Wipe Test Records of Radioactive Sealed Sources, will be the responsibility of the Radiation Safety Officer, although he may delegate the actual wipe function to a radiographer who is properly trained. Control Form #6 is then filed along with the results of the wipe test, as submitted by an outside service. See Section 8.1.2 for name of testing service. During the internal inspection these reports will be reviewed for completeness and accuracy.

6.1.4 Radiographic Equipment Inspection Check List

As part of the internal inspection, responsibility will be given to the Radiation Safety Officer of his designee to inspect all radiographic equipment and Control Form #8, Radiographic Equipment Check List, will be completed. These reports are then reviewed by the Radiation Safety Control Director along with the records of equipment maintenance.

6.1.5 Survey Instruments: Records of Use and Calibration

In accordance with NRC regulations, survey instruments will be calibrated every 90 days, after possible damage and after repair and servicing. The survey instruments are calibrated by an outside service, see Section 3.1.1 of this application. Control Form #3, Survey Instruments - Log and Calibration Records, and Control Forms #1 and #2 will be reviewed during the internal inspection by the Radiation Safety Officer.

6.1.6 Personnel Exposure Records

The records of personnel radiation exposure are maintained by film badge readings and daily dosimeter readings. Film badge service is supplied by and outside service, see Section 4.1.1. Their monthly reports are reviewed, filed and maintained by the Radiation Safety Officer. If exposure levels warrant the attention of the Internal Inspection Committee, they will be discussed and proper action taken to determine the reason for the higher dose readings along with a way to eliminate the problem.

In addition to the monthly film badge readings, daily dosimeter readings are maintained by the radiographer's assistant. Control From #7, Daily Dosimeter Readings, are maintained by each individual.

All radiation exposure records are reviewed by the Radiation Safety Officer to determine if they are being maintained properly.

6.1.7 Radiographer Evaluation/Radiographer's Assistant Evaluation

Once every three months each radiographer and radiographer's assistant will be observed in the performance of his duties to determine if he is performing in a safe manner. This observation will be made by the Radiation Safety Officer or his designee and a report filed for review by the Internal Inspection Committee. At this time any unsatisfactory performance will be discussed with the individual and corrective measures will be implemented.

6.2 As part of the Internal Inspection, particular attention will be given to the emergency procedures. Personnel will be questioned to determine their knowledge of emergency procedures. If satisfactory response are not given the emergency procedures will be reviewed with the individual by the Radiation Safety Officer.

6.3 The Radiation Safety Control Director or the Radiation Safety Officer will perform as a partof this internal inspection system.

6.3.1 The Radiation Safety Control Director and the Radiation Safety Officer shall be qualified by outside training, past technical training of experience, and present knowledge of all the articles in this license. Any one of these reasons will qualify Radiation Safety Control Director or Radiation Safety Officer to operate as a monitor of the radiographic operation.

6.4 The "Control Forms" currently used will be as follows:

(1) Daily Utilization Log

(2) Daily Utilization Log operation sheet

(3) Survey Instrument - Log and Calibration Record

(4) Source Replacement Schedule - Shipment - Receipt - Disposal

(5) Quarterly Inventory and Out of State Log - Radioactive Sources

(6) Wipe Test Records - of Radioactive Sealed Sources

(7) Record of Daily Dosimeter Readings - Monthly

(8) Radiographic Equipment Inspection Check List

(9) Special Purchase Order For Radioactive Source Material Only

6.4.1 Additional forms, reports, or records may also be used in conjunction with the above Control Forms, if needed.

ITEM 10 (continued)

CONTROL FORM #1

Calumet Testing Services, Inc.

Mail to: P.O. Box 1510 ... Highland, Indiana 46322
Main Location: 1945 N. Griffith Blvd. ... Griffith, Indiana 46319
(219) 923-9800 ... (312) 474-5860 ... (815) 722-0878 ... (219) 269-6442 (Warsaw, IN)

DAILY UTILIZATION LOG

Date _____

Radiographer: _____ Initial Dosimeter Reading _____ mR

Radiographer's Ass't _____ Initial Dosimeter Reading _____ mR

Survey Meter: _____ S/N _____ Date of Calibration _____

Gamma Ray Projector:
Model: _____ S/N _____
Maximum Radiation Level: _____

Radioactive Source:
Isotope: _____ S/N _____ Activity _____ Ci

Daily Inspection: (Initial all Entries)

Condition of Guide Tubes _____
Condition of Control Cables _____
Condition of Swaged Fittings _____
Condition of Source Stop _____
Condition of Projector Labeling _____
Condition of Control Crank _____
Condition of Locking Mechanism _____

Storage of Gamma Ray Projector:

Projector Locked _____
Maximum Surface Radiation Level _____
Storage Box Locked _____

Final Dosimeter Reading: Name: _____

Remarks:

Signature of Radiographer _____

SHIPPERS CERTIFICATION FOR RADIOACTIVE MATERIALS

NATURE AND QUANTITY OF CONTENT					PACKAGE	
Proper Shipping Name	Radionuclide	Group	Form	Activity	Transport Index	Container
Radioactive Material Special Form N. O. S. NA 9182	Ir-192	III	Special Form	100 Curies Maximum	1.1	D.O.T. 6717/B

Destination _____

Sheet___of___

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 Dept. of Transportation.

CTS

CONTROL FORM #2

Calumet Testing Services, Inc.

Mail to: P.O. Box 1510 ... Highland, Indiana 46322
Main Location: 1945 N. Griffith Blvd. ... Griffith, Indiana 46319
(219) 923-9800 ... (312) 474-5860 ... (815) 722-0878 ... (219) 269-6442 (Warsaw, IN)

DAILY UTILIZATION LOG

OPERATION SHEET

Date_____

Location_____ Time___:_____

Duration of Exposure_____

Distance to High Radiation Area Boundary_____Ft.

Distance to Radiation Area Boundary_____Ft.

Gamma Ray Projector Surface Radiation Level Prior to Exposure_____mr/H

Radiation Level at Boundary of Restricted Area_____mr/Hr.

Gamma Ray Projector Surface Radiation After Exposure_____mr/Hr.

Dosimeter Reading After Exposure_____

Vehicle Surveyed _____ Yes _____ No

Radiation Level at Driver's Seat _____

Survey Meter S/N _____

Out of State Log Completed _____ Yes _____ No

Sheet ___ of ___

CONTROL NO. 79875

ITEM 10 (continued)

SURVEY INSTRUMENTS - Log and Calibration record - Year of ____________

In Accordance with NRC Regulations, Survey Instruments will be checked for calibration every 90 days.

CONTROL FORM #3

Manufacturer-Model Number	Serial Number	Date of last Calibration	Location	Date Returned	Report No.	Next Date Due Calibration	Lost, Destroyed etc.

YEAR OF: _____

SHIPMENT - RECEIPT AND DISPOSAL

CONTROL FORM #4

PURCHASE ORDER		DATE NEW SOURCE REC'D		DATE INSTALLED IN CAMERA								RETURN OF SPENT SOURCE		
NUMBER	DATE	SOURCE SERIAL NO.	CONT'D SERIAL NO.	Ir-192 1871	Ir-192 1843	Ir-192 2063	Ir-192 2336	Ir-192 2367			Co-60 100-47	Serial No.	Cont'd No.'s	DATE

ITEM 10

Calumet Testing Services, Inc.
1945 N. Griffith Blvd.
Griffith, Indiana 46319
(219) 923-9800 — (312) 474-5860

QUARTERLY INVENTORY RECORD & LOG - RADIOACTIVE SOURCES Year of _____

Also Note Date & Location When Source is Used Outside of Indiana

CONTROL FORM #5

DATE	Quarterly X	CO-60 UNIT SN 1135	Curies	IR-192 UNIT SN 2063	Curies	IR-192 UNIT SN 1871	Curies	IR-192 UNIT SN 1843S	Curies	IR-192 UNIT SN 2336	Curies	IR-192 UNIT SN 2367	Curies	IR-192 UNIT SN 2396	Curies	Out of State Job Location	Used & Returned By: _____

TEM 10

WIPE TEST RECORDS OF RADIOACTIVE SEALED SOURCES - Year of ________

In accordance with NRC regulations, radioactive sealed sources shall be tested for leaks every (6) months

CONTROL FORM #6

CONTROL NO. 79875

Source Description	Serial No. of Source	Date Wiping Performed	Location	Date Wiping Sent For Analysis	Report No.	Next Wiping Due Date

ITEM 10 (continued)

DAILY DOSIMETER READINGS

FOR EXPOSURE PERIOD / /8 TO / /8

DOSAGE IN MILLIREMS

CONTROL FORM #7

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

DAY	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Fill Page

ITEM 10 (continued)

RADIOGRAPHIC EQUIPMENT INSPECTION CHECK LIST

TYPE OF INSPECTION	MAKE	MODEL	SERIAL NUMBER	DATE INSPECTED
Periodic				
Special				

	COMPONENT	CHECK FOR:	S	U
	EXPOSURE DEVICE	COMPLETENESS AND GENERAL CONDITION		
1	Handle	attached and secured - ripped - torn		
2	Handle Studs	looseness - must be tight		
3	Handle pins	wear - bent - rust		
4	Source outlet nipple	wear - dents - cracks		
5	Case shield	dents - cracks - proper labeling		
6	Lock and lock plunger	freedom of operation-must turn by hand		
7	Lock box	dents - cracks		
8	Lock insert	wear-broken internal threads-cracks		
9	Top and bottom saddle plate	dents-cracks		
10	Source pigtail connector	alignment - wear - frayed cable strands		
11	Safety plug	wear - dirt - frayed cable strands		
	SOURCE TUBE	COMPLETENESS AND GENERAL CONDITION		
12	Quick disconnect	locking-freedom of operation-must swivel		
13	Nipple	looseness - wear - cracks		
14	Sleeve	wear - dents - cracks		
15	Flexible source tube	cuts - kinks - dirt build-up inside the tube		
16	Male coupler	looseness wear - cracks		
17	Adapter	looseness wear - cracks		
18	Source tube end piece	dents - wear - cracks		
	CONTROL GRIP ASSEMBLY	COMPLETENESS AND GENERAL CONDITION		
19	Hand crank mechanism	freedom in operation - must turn freely		
20	Drive gear box	wear - lubrication		
21	Control conduit	cuts - damage - dents - kinks		
22	Drive control cable	dirt - wear - cuts - kinks - frayed cable		
23	Drive cable and connector	alignment - wear - frayed cable		

24 **IF DISCREPANCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION:**

Inspected by: _____
Radiographer/Supervisor

CTS

Calumet Testing Services, Inc.

Mail to: P.O. Box 1510 ... Highland, Indiana 46322
Main Location: 1945 N. Griffith Blvd. ... Griffith, Indiana 46319
(219) 923-9800 ... (312) 474-5860 ... (815) 722-0878 ... (219) 269-6442 (Warsaw, IN)

CONTROL FORM #9

SPECIAL PURCHASE ORDER
FOR
RADIOACTIVE SOURCE MATERIAL ONLY

PART I - ORDER

1. **Purchase Order No:**
2. **Vendor:**
3. **Location:**
4. **Date:**
5. **Material Ordered:**
6. **Amount:**
7. **Maximum Amount Allowable By CTS License:**
8. **Shipping Instructions:**
9. **Remarks:**

PART II - RECEIPT OF ORDER

1. **Vendor - Ship Date:**
2. **Date Received By CTS:**
3. **How Shipped:**
4. **Material Shipped:**
5. **Amount:**
6. **Wipe Test:**
7. **Container Reading MR:**
8. **Material Used in Exposure Device, S/N:**
9. **Contact Reading of Exposure Device MR:**
10. **Remarks:**

CTS

Calumet Testing Services, Inc.

Mail to: P.O. Box 1510 ... Highland, Indiana 46322
Main Location: 1945 N. Griffith Blvd. ... Griffith, Indiana 46319
(219) 923-9800 ... (312) 474-5860 ... (815) 722-0878 ... (219) 269-6442 (Warsaw, IN)

SPECIAL PURCHASE ORDER
FOR
RADIOACTIVE SOURCE MATERIAL ONLY

NOTES:

1. **Part I must be filled out completely upon placement of order.**
2. **Part II must be filled out completely upon receipt of order.**
3. **Radiation Safety Director to review completed Purchase Order and retain on file.**

CONTROL NO. 79875

ATTACHMENT 6E

5.0 OPERATING AND EMERGENCY PROCEDURES

5.1 Operating Personnel Performing Radiography

5.1.1 All radiographic operations shall be done by a qualified radiographer or qualified assistant radiographer under the direct supervision of a qualified radiographer. The radiographer shall be physically present if the work is being done by an assistant radiographer.

5.1.2 CTS may use an individual described as a helper or observer in its radiographic operations. This individual will be badged and monitored the same as assistant radiographers, however, he will not perform their duties. He may assist in setting up equipment, film and to act as a monitor of the radiation area. He will have received satisfactory instructions prior to carrying out these duties from the radiographer in charge of the radiographic operation.

5.1.3 The primary concern of all qualified personnel performing radiography will be to see that he does not endanger himself or any other person with radiation in excess of the limits set forth by the Nuclear Regulatory Commission.

5.1.4 Any personnel who do not perform their work in a safe manner, or in violation of any Nuclear Regulatory Commission Regulations, or in violation of practices set forth in this license, shall be dismissed from the nondestructive testing department of CALUMET TESTING SERVICES. The Radiation Safety Control Director will see that this article is enforced and maintained.

5.2 Film Badge Procedures

5.2.1 All radiographers, assistant radiographers, X-ray technicians and X-ray operators shall be required to wear a film badge while performing radiography. The film badge is the official recording monitoring device of the CTS Testing Department.

5.2.2 A film badge will be worn for all X-ray and gamma radiography functions performed. Any person working as a helper on a radiographic project will be required to wear a film badge. No person shall be permitted to perform radiography or be present in a controlled radiation area without a proper film badge.

5.2.3 In the event a film badge is lost or destroyed it shall be the responsibility of the individual assigned to immediately report such loss or damage to the Radiation Safety Control Director. The Radiation Safety Control Director shall establish an estimated radiation dose for the lost film badge and shall request the film badge supplier to show such on the film badge report.

5.2.4 For new employees with previous experience as radiographers, an exposure history shall be requested from his previous employer. The Radiation Safety Control Director shall request the prior film badge supplier to show the actual or calculated dose for the period from the first of the calendar year to that time of employment with CALUMET TESTING SERVICES, INC. This request shall be included with the film badge start notice for the new employer.

5.2.5 Film Badges shall be exchanged at least once per month. Film Badge reports are furnished by the supplier for each badge period. This report shall be kept on file by the Radiation Safety Officer.

5.2.6 Film badge reports may be posted for viewing by personnel to whom film badges are issued. Film badge records shall be made available for reference to any personnel whose name may appear thereon.

5.3 Dosimeter - Use and Procedures

5.3.1 Each radiographer and assistant radiographer and other personnel with access to the radiation area shall wear pocket dosimeters. A dosimeter shall be worn at all times by the radiographer and assistant radiographer while performing gamma radiography.

5.3.2 Each radiographer and assistant radiographer shall be instructed in the proper use of the dosimeter and dosimeter charger. The dosimeter shall be assigned by serial number and the Radiation Safety Officer will record these numbers. The dosimeter will be carried in the breast pocket while being used.

5.3.3 In the event of suspected or actual damage to a dosimeter, the Radiation Safety Officer shall be notified immediately. Dosimeters should be protected from dropping, jarring and excessive humidity. The use and maintenance of dosimeters shall be in accordance with written instructions of the manufacturer. The manufacturer's instructions shall be required reading for all persons using a dosimeter.

5.3.4 Dosimeters, when used, shall be charged daily, or at the beginning of each work shift. One or more operable dosimeter charges shall be available for this purpose. Daily dosimeter readings will be recorded on Control Form #7.

5.4 Radiographic Operations Area

5.4.1 Radiography performed by CALUMET TESTING SERVICES, INC. will be shop radiography, field radiography, or temporary jobsite radiography.

5.4.2 Field or temporary jobsite radiography shall be posted with appropriate radiation caution signs.

5.4.3 The controlled radiation area shall be an area that is under the direct visual surveillance and control of the radiographer or assistant radiographer, and will be further defined by the use of a rope barricade, and "Caution Radiation Area" signs where the level of radiation with the source in an exposed position, will not exceed a reading of 2 MR per hour. The sign, "Caution High Radiation Area", must also be posted around the area where radiation is in excess of 100 MR per hour.

5.4.4 The controlled area will be determined by the use of radiation survey instruments and/or the inverse square law formula, by the radiographer. If the inverse square law is used, the perimeter must be checked by an actual physical survey.

5.4.5 Personnel will not be allowed to enter a controlled radiation area. Should access to a controlled radiation area be required, a person must wear a film badge anda dosimeter, and have permission from the radiographer in charge. Under no circumstances shall other than a nondestructive testing employee of CALUMET TESTING SERVICES, INC. be permitted to enter a controlled radiation area.

5.4.6 Should a controlled radiation area be entered by unauthorized personnel, the radiographer in charge shall immediately request the person to withdraw. Should and authorized person refuse to withdraw, or a situation occur where it is impossible to remove persons from the area; the source shall be retracted to the stored position, and the unit be secured until such time as normal procedures may be followed.

5.4.7 The Radiation Safety Control Director shall be informed if any such situation occurs, as described in the above article, so that he may take corrective action.

5.5 Field Radiography procedures

5.5.1 The following procedures, as outlined, shall apply to all radiographic operations conducted by CALUMET TESTING SERVICES, INC. NDT Department, in its own shop, at a customer's plant or temporary jobsite.

5.5.2 The Radiation Safety Officer shall determine which sources and equipment will be used for radiographic projects, and the personnel to be responsible for their operation. Each radioactive source to be used for radiography shall be logged out, by filling in the required information on the Control Form #1, by the operator. The radiographer shall survey the source storage area prior to removal of sources, and upon return of sources to the storage area to assure that radiation levels for unrestricted areas are not exceeded; the results of the survey shall also be recorded on Control Form #1.

NOTE: THE EMERGENCY AND OPERATING INSTRUCTIONS, as well as the Control Forms shall be in the operator's possession while performing his duties.

5.5.3 The radiographer or the Radiation Safety Officer shall record the date and the time the source was removed from the source storage area, the customer's plant or jobsite where the source is to be used, and the responsible person's name. If a source is to be used on two or more jobs, then the source location record shall show each job location. When the source is returned to the source storage area, after job completion, the date and time shall be indicated on the form by the radiographer or Radiation Safety Officer.

5.5.4 The radiographer and/or assistant radiographer shall now prepare the gamma ray equipment for radiographic procedures, after the area and job requirements have been determined.

5.6 Shop Radiography Procedures

5.6.1 The Radiation Safety Officer shall determine which source and equipment is to be used for shop radiography.

5.6.2 All shop radiography shall be done in the radiographic exposure pit.

5.6.3 Prior to entering radiographic pit, visually verify that the radiation monitoring device is in operation. Failure of any signaling element either turns on the red warning light or turns off both lights to alert the radiographer. The green light, therefore, not only shows the radiation level is safe, but shows the system circuitry to be functioning normally.

5.6.4 Set up exposure equipment following equipment operating procedures outlined in paragraph 5.9 of attachment 6E.

5.6.5 Close high radiation access door which completes the audible alarm circuit.

5.6.6 While operating the exposure device, the radiographer must be positioned behind the concrete wall next to the stairway or at the shop floor level at the top of the stairway.

5.6.7 Survey the perimeter of the pit at the shop level. If any readings exceed 2 MR per hour, immediately retract the source into a safe position and change the radiographic arrangement, select a smaller source, add shielding or use a combination of these actions to reduce the perimeter to 2 MR per hour or less.

5.6.8 Enter the radiographic area of the pit between exposures only if the green light is on and the audible alarm does not sound when opening the access door.

5.6.9 The survey instrument must be taken into the radiographic exposure area between each exposure. The guide tube and exposure device must be surveyed to determine if the source has returned to a safe position.

5.7 Personnel Operating Procedures

5.7.1 All radiographers and assistant radiographers shall have a copy of the ATTACHMENT (6E) "OPERATING AND EMERGENCY PROCEDURES", and all required Control Forms in their immediate possession at all times, while performing any radiographic operations.

5.7.2 Above personnel must also have copies of all applicable Nuclear Regulatory Commission Instructions and Safety Regulation which apply to their radiographic work with them at all times.

5.7.3 Above personnel must be wearing film badges and using pocket dosimeters on the clothing of their chests before they can begin radiographic operations, and during all operations.

5.7.4 Above personnel must always have an operable and calibrated survey meter in their possession and use before, during and upon completion of the radiographic operation.

5.7.5 The radiographer or assistant radiographer may now remove the source storage container from the vault or storage area; he may place the source container on a dolly or cart, if necessary and move it to the controlled area of the plant where radiography is to be performed.

5.7.6 If the use of a vehicle is necessary to reach a jobsite, the above personnel must follow procedure set forth in the article "Shipment and Transporting Radioactive Materials", included in this Attachment 6E.

5.7.7 Upon arrival at a jobsite, the radiographer shall notify the customer of the presence of radioactive material or other penetrating radiation producing equipment, and the procedures that are to be followed while on their premises, or in their area.

5.7.8 The customer shall be responsible for the notification of their personnel that radiography is to be performed. The radiographer may assist in this practice.

5.7.9 The radiographer or the Radiation Safety Officer shall advise the customer of the availability of this published procedure to them for their information, and to advise them of the CTS radiation safety and control procedures to be used.

5.8 Equipment Inspection and Maintenance

5.8.1 Prior to performing any radiography; Radiographers shall inspect all components of radiographic exposure device and related support equipment, following the items listed on the "Daily Utilization Log" Control Form #1 which is attached to these instructions.

5.8.2 A detailed inspection of all radiographic equipment will be performed by the radiographer to check for any equipment deterioration thru normal use and wear, physical abuse, or corrosion, prior to performing any radiography.

5.8.3 Daily Utilization Log Control Form #1 shall be used for records and must be filled out and turned in upon completion of the days work, by the radiographer

5.8.4 The radiographer must cease further use of all radiographic equipment anytime radiographic equipment is involved in any fire, vehicle accident or severe stresses, such as dropping from a high place and submersion in water, and any major discrepancies found during daily inspections, which would make the exposure device unsafe for operational use. Radiographers shall report device defects as required by 10 CFR, Part 21, a copy of which shall be posted at the Calumet Testing Services, Inc. main office. Failure to report device defects shall be cause for immediate dismissal of the individual from the radiographic operation.

5.8.5 A copy of the suggested inspection and maintenance of exposure devices by the manufacturer will serve as a guideline for all inspection of radiographic equipment. This information will be available to all personnel and will be attached to these OPERATING & EMERGENCY PROCEDURE INSTRUCTIONS.

5.9 Equipment Operating Procedures

5.9.1 Always have an operating and properly calibrated radiation survey meter at hand and use it, before, during and upon completion of radiographic operations, following the numbered operations:

(1) Remove the protector cap from the lockbox, thereby exposing the pigtail connector.

(2) Crank the control cable to a length of approximately six inches.

(3) Connect control cable to pigtail.

(4) Crank control cable in, so that male connecting thread can be screwed into lock box.

(5) Screw control cable into lock box.

(6) Remove safety plug from protruding nipple located approximately 1" from top of unit.

(7) Connect source tube.

(8) Place free end of source tube in desired position trying to keep it in a straight line without kinks.

(9) Stretch control cable away from exposure device in as straight a line as possible.

(10) Unlock the unit by turning the handle back (counter-clockwise) which will permit the key to be turned.

(11) Crank the source out as smoothly as possible. When you feel that source is approaching end of source tube, slow turning speed so that pigtail does not strike the end of the source tube with undue force.

(12) Survey to see that radiation levels do not exceed 2 MR per one hour at the perimeters of controlled radiation area.

(13) At the end of exposure, retract source into unit.

(14) Now for the most important step of all: Survey the guide tube and exposure device carefully to be sure that source has returned to a safe position into the unit. Record the results of the survey after the final exposure, on the daily utilization log.

(15) Turn crank back (counter-clockwise) and depress lock plunger.

(16) Disconnect cable.

(17) Screw safety cap into place.

(18) Disconnect source tube.

(19) Insert safety plug.

5.10 Emergency Operating Procedures

5.10.1 An emergency situation consists of any events which may occur during radiographic operations which are not covered or provided for in normal operating conditions. It shall be the responsibility of the radiographer, assistant radiographer, Radiation Safety Control Director and any other CALUMET TESTING SERVICES personnel to follow explicity the following and any other emergency procedures which may apply. A copy of these emergency procedures must be with radiographic personnel whenever radiographic operations are being done.

5.10.2 In the event the radiographer thinks he has an emergency situation, he will immediately notify one of the following persons: One or more of these persons will be available (on call) whenever there are radiographic operations being done and wherever they are being done.

(1) Mr. John Korienek
9620 S. Central Park
Evergreen Park, Illinois 60642
Phone: Home (312) 424-0401
Office (219) 923-9800
CTS Radiation Safety Officer

(2) Mr. Thomas Keilman
2323 Ridgewood Avenue
Highland, Indiana 46322
Phone: Home (219) 972-0759
Office (219) 923-9800
CTS Radiation Safety Control Director

(3) Mr. Robert J. Vidimos
8802 Woodward Avenue
Highland, Indiana 46322
Phone: Home (219) 923-3407
Office (219) 923-9800
CTS President

(4) Mr. Alan J. Meyer
660 East Margaret
Monee, Illinois 60449
Phone: Home (312) 534-1163
Office (219) 923-9800
CTS Internal Auditor

(5) Health Physics Associates Ltd.
3304 Commercial Avenue
Northbrook, Illinois 60062
Attention: Mr. Bill Rivkin
Phone: (312) 433-3330

NOTE: This company's source - recovery service - may be utilized by CTS

5.10.3 The above personnel will have thorough knowledge of emergency situations which may occur during radiographic operations. Upon being contacted by the radiographer, they will determine if an emegency exists and if so will assume the responsibility for further action in regards to the emergency. The Radiation Safety Control Director of CALUMET TESTING SERVICES, INC. will have the ultimate responsibility for all necessary corrections, reporting and notifying management of all emergency situations. The Radiation Safety Control Director shall handle all necessary correspondence with the Nuclear Regulatory Commission in regards to emergency situations.

5.10.4 The CTS nondestructive testing person in charge of radiographic operations, when an emergency condition exists, shall exercise control over the radiation area and shall not leave the area unattended. The radiation area or inoperative equipment shall not be left unattended. Recruit assistants from other personnel to make phone calls and act as surveillance or go to help.

5.10.5 It is the responsibility of the radiographer and assistant radiographers to keep on hand at all times the phone numbers and location of the Radiation Safety Control Director and other Radiation Safety Control Personnel. A list of Radiation Safety Control personnel is included in this section

5.10.6 Situations or other normal events shall be reported to the Radiation Safety Officer by the radiographer, assistant radiographer, or other CTS NDT personnel regarding the following:

(A) Actual or suspected over-exposure to any person.

(B) Actual or suspected malfunction of a radiation exposure device.

(C) Actual or suspected malfunction of radiation monitoring devices.

5.10.7 Should an emergency arise due to a malfunction of a gamma exposure device (source connection failure, drive cable malfunction, etc.) where the source is left in an exposed position, radiographic operations shall cease immediately and the following action taken:

(A) Remove all personnel from the radiation area, that area where the radiation level is greater than 2 MR hour.

(B) Post radiation signs and erect a barricade (rope) when possible.

(C) Inform responsible personnel of the customer or other persons with a-need-to-know.

(D) Determine to the extent possible, without excess exposure, the position of the source and what caused the malfunction.

5.10.8 Immediately notify the Radiation Safety Officer or other Radiation Safety Control Personnel of the situation and await instructions from either the Radiation Safety Officer or the Radiation Safety Control Personnel.

5.10.9 Should a fire occur in a customer's plant or on a jobsite, radiographic operations should immediately be stopped, by retracting the source or shutting off the X-ray unit, the equipment dismantled and removed to a safe area. Radiation signs and barricades are to be removed when time permits. If conditions exist that make source retraction, unit shutdown and equipment removal impossible, it will be the radiographer's responsibility to notify the fire and police departments on their arrival at the scene.

5.10.10 Should an automobile accident occur involving a CTS vehicle carrying radioactive material, the following procedures should be followed.

(A) Give assistance to any persons requiring it.

(B) Secure all gamma exposure equipment.

5.10.11 Each CTS vehicle used to transport radioactive material shall have posted, in a conspicuous location, a sign stating that the vehicle may contain radioactive material and that a possible radiation hazard may exist. This notice shall list the CTS address, telephone number, the Radiation Safety Control Director's name and show home telephone numbers that may be called in emergencies. This notice is required in the event that the vehicle or driver is unable to follow these procedures or give assistance.

5.10.12 If gamma exposure device is suspected of becoming unsafe, either as a result of an automobile or other accident, the equipment shall be surveyed with a survey meter to determine its condition. Immediately notify the cognizant authorities when possible, and follow emergency procedures.

5.10.13 A radiographer or assistant radiographer shall not resume radiographic operations, after an emergency, without the authorization or approval of the Radiation Safety Control Director.

5.10.14 In cases where the radiographer or assistant radiographer receives, or is suspected of receiving an excessive dose of radiation, the Radiation Safety Control Director shall determine and direct the return of such persons to radiographic functions.

5.10.15 Radiation equipment involved in an accident or incurring a malfunction shall not be returned to service until such time as its operation has been thoroughly checked and approved by the Radiation Safety Control Director.

5.10.16 Procedures for an over-exposure or suspected over-exposure to any person, as a result of X-ray or gamma ray radiation shall be done by the Radiation Safety Control Director as follows:

(A) Film badges belonging to the persons involved shall be immediately sent to the film badge supplier for processing. The film badge supplier shall be notified of such actions and that badge results are to be telephoned as soon as possible.

(B) Notify CTS Management immediately by telephone and follow up with a complete detailed written report.

(C) The Radiation Safety Control Director shall determine if medical examinations are to be made and if additional requirements are necessary.

(D) In the event a dosimeter is found to be off scale, points (A), (B), and (C) above shall be followed. The radiographer who experiences an off scale dosimeter reading should notify the Radiation Safety Officer of an off scale reading on his dosimeter, and submit this film badge to him for immediate processing by the film badge supplier. The radiographer will not be re-assigned to radiographic work until the film badge results return to CTS for appraisal by the Radiation Safety Control Director.

5.10.17 At the conclusion of an emergency situation, and after corrective action has been taken all personnel involved shall submit a written detailed report to the Radiation Safety Control Director. The Radiation Safety Control Director, in addition to this report shall also indicate what action has been, or will be taken to prevent reoccurence.

5.10.18 Should radiation producing equipment be lost or stolen, the Radiation Safety Control Director shall immediately notify the authorities. The authorities shall be given descriptive details of the lost or stolen equipment, and in the case of gamma exposure devices, advised that unauthorized use may result in radiation hazard.

5.11 Shipment and Transportation of Radioactive Material

5.11.1 Shipment of sources and radiographic devices, to and from source and equipment suppliers, shall be made by a commercial carrier or by CTS personnel. Shipment of sources and equipment shall be done in a container specifically made for such a purpose. Shipping containers shall be securely fastened so as to make entry difficult, except to authorized personnel.

5.11.2 All shipping containers shall be marked with a Radioactive Yellow III Label, showing that the contents are radioactive. The labels shall contain information as to the radioactive content, Iridium 192, Cobalt 60, etc. and the activity (curie strength). The radiation level 3 feet from the external surface of the container shall not exceed 10 millirem per hour, and 200 millirem per hour on the container surface.

5.11.3 The outside surface of the shipping container shall be monitored with a survey meter to determine that the level of radiation does not exceed 200 millirem per hour on the surface, and 10 millirem per hour 3 feet from the container surface. If levels in excess of those above are found, notify the Radiation Safety Control Director, who will immediately notify the Radiation Safety Control Director, who will immediately notify the appropriate U.S.N.R.C. regional office. The shipping container shall be clearly marked as to the shipper and receiver.

5.11.4 Radioactive material (sealed source) contained in a Type B exposure device may be transported in CTS vehicles without shipping containers, when going to and from a jobsite.

5.11.5 Gamma cameras shall be placed as far away from the driver as possible when transporting in a truck or automobile.

5.11.6 The radiation level at the driver's location should not exceed 2 MR hour. A survey meter shall be used to monitor this reading. If the driver's location exceeds a level in excess of 2 MR hour, shielding shall be provided to reduce the level to 2 MR hour. The outside surfaces of a vehicle transporting radioactive material shall not exceed 2 MR hour. A properly operating and calibrated survey meter shall be used to determine this level.

5.11.7 Gamma equipment carried in CTS vehicles shall be tied or braced against movements and to avoid over turning or damage.

5.11.8 All vehicles used by CTS for transporting radioactive materials must be posted with signs as called for in accordance with Department of Transportation Regulations which apply.

5.11.9 Each vehicle used for transportation of sources shall be posted with placards on all four sides. These placards will read: "RADIOACTIVE", and shall meet the requirements set forth in U.S.N.R.C. and D.O.T. Regulations.

5.11.10 The internal compartment of the vehicle were the source is contained shall be posted with a standard radiation caution signs: "CAUTION: RADIOACTIVE MATERIALS." All signs to be used for posting of vehicles shall be approved by the Radiation Safety Control Director.

5.11.11 Vehicles used for transporting radioactive material shall be kept locked at all times when not in direct attendance of the driver, except when radioactive material has been removed.

5.11.12 The radiographer shall be responsible for keeping certain records whenever using the radioactive equipment. These records are: Control Form #1. They should be turned into his supervisor upon completion of each days work. Examples of these forms are attached to these procedures for the radiographer's information.

5.11.14 Radioactive materials in an unrestricted area and not in storage shall be tended under the constant surveillance and immediate control of radiography personnel.

ATTACHMENT 6I

8.0 LEAK TESTING PROCEDURES

8.1 Leak testing requirements will be met by the use of a Leak Test Kit supplied by an outside company, with an NRC or Agreement State License to perform the service.

8.1.1 This kit will be used in strict accordance with the instructions provided by the service companies.

8.1.2 The Leak Test Kits will be supplied by:

(a) HEALTH PHYSICS ASSOCIATES LTD.
3304 Commercial Avenue
Northbrook, Illinois 60062
NRC License No. 12-09160-01
Phone (312) 273-2525

Kit HPC - 14 or Kit HPC - 1

(b) SOURCE PRODUCTION AND EQUIPMENT COMPANY, INC.
625 Oxley Street
Kenner, Louisiana 70062
Louisiana License No. LA-2966-L01
Phone (504) 464-9471

Kit Model 1

8.1.3 Sample instructions are attached to this section.

8.2 The Radiation Safety Control Director, Radiation Safety Officer or a designated Radiographer under their direction shall perform all leak tests.

8.3 All source disposal will be done by the manufacturer.

8.3.1 Any source changing will be done by CALUMET TESTING SERVICES, INC., following the manufacturer's instructions (Procedure Enclosed). They will be changed by the Radiation Safety Control Director, Radiation Safety Officer, or a radiographer under their direct supervision.

8.4 A leak test shall be performed for each sealed source of radioactive material under the following condition:

(1) Upon receipt of a new source by Calumet Testing Services, Inc. if leak test records were not furnished by the manufacturer or a leak test was not performed within 6 months of transfer.

(2) Subsequent intervals not to exceed six months.

ATTACHMENT 6I (continued)

8.5 Each leak test shall be monitored after the wipe and before packaging. Any test showing a reading of 2 MR/hr. or greater shall be immediately reported to the service company. No leak test with a reading of 2 MR/hr. or over shall be mailed or disposedof without permission from the Radiation Safety Control Director.

8.6 Leak test wipes will be performed at one or more positions on the gamma equipment as follows:

8.6.1 On disposal of a source - at the gamma projector port, and on the source drive cable connector. The same swab shall be used on both locations. This procedure shall be followed after the source has been put into the source changer. This same procedure shall be followed indisposing of a source when shipping in a gamma projector.

8.6.2 At intervals not to exceed six months - At the gamma projector port with the source retracted to the stored position.

8.7 CALUMET TESTING SERVICES, INC. upon receiving notice that suspicion exists of a leaking source, shall cease radiographic procedures immediately, and all gamma equipment shall be returned to the lab and secured. Suspected gamma equipment will not be used until released by the Radiation Safety Control Director.

8.8 Records ofleak tests results shall be kept on file by the Radiation Safety Officer for two years.

LEAK TEST KIT #HP-C14
LEAK TEST INSTRUCTIONS FOR

GAMMA INDUSTRIES, INC. "CENTURY" GAMMA RAY PROJECTORS

HEALTH PHYSICS ASSOCIATES LTD. CONSULTANTS IN RADIATION SAFETY

3304 COMMERCIAL AVENUE / NORTHBROOK, IL 60062 / PHONES: 312/564-3330 / CHICAGO #: 273-2626

MATERIALS:
3 - swab sticks in tubes
1 - vial with detergent (Turco)
1 - pair plastic gloves in bag
1 - set of wipe test instructions
1 - information sheet

RADIATION SAFETY PRECAUTIONS:

The operator shall wear a film badge and/or dosimeter and the disposible gloves provided while taking the wipes. The gloves are removed after the wipes are placed into the test tubes by a sterile technique (i.e., by grasping inner surface at wrist). The gloves are placed in the bag provid and returned to HEALTH PHYSICS ASSOCIATES. Wash hands when through.

LEAK TESTING PROCEDURES:

1. Add water to test tube containing detergent until it is approximately half full. It will be used to wet swab sticks before making wipes.
2. Be certain the source is fully retracted into source housing by checki for normal radiation levels with a survey meter.
3. Remove source tube or safety plug from protrudinb nipple approximately 1" from top of shield.
4. Wet swab stick #1 with detergent furnished; squeeze off excess and wip the interior of the hole thoroughly. Replace swab stick into test tub
5. Wet swab stick #2 in detergent furnished, and wipe thoroughly inside source cable, as far as the swab stick will reach, at end that connect to the shield. Replace swab stick into test tube.
6. Wet swab stick #3 with detergent furnished, and wipe all external surfaces of projector cable connections. Point of entry into shield, nozzle connector and any other joints in projector cable. Replace swa stick #3 into test tube.
7. Place all swab stick tubes in returnable mailing container, remove gloves per instructions above and place in bag provided for return to HEALTH PHYSICS ASSOCIATES.
8. Set survey meter to its most sensitive range in a low background area. Bring container with swabs to meter and note maximum deflection of meter above background.
9. If meter indication is 0.4 mR/hr or less, above background, place the return label provided on container and return to HEALTH PHYSICS ASSOCI ATES, with completed information sheet enclosed.
10. If available survey meter is not a Geiger counter type (e.g., ion cham and cannot read down to 0.4 mR/hr, determinine that reading is less th 2.0 mR/hr on contact. Return container to HEALTH PHYSICS ASSOCIATES v REA express. Do not ship if indicated surface activity is greater tha 2.0 mR/hr, and call HEALTH PHYSICS ASSOCIATES for further instruction

Wipe Test Instructions for
Medical Teletherapy Users
Kit HPC-1

HEALTH PHYSICS ASSOCIATES LTD. CONSULTANTS IN RADIATION SAFETY

2356 SKOKIE VALLEY ROAD HIGHLAND PARK, ILL. / PHONE: AREA (312) 433-3330

00035

Materials:

1	- Tube containing wetting agent
1 Pair	- Polyethylene gloves in bag
3 Sets	- Wipe sticks in plastic test tubes
1 Set	- Wipe test instructions and information sheet
1	- Returnable shipping container

Radiation Safety Precautions:

The operator should wear a film badge or dosimeter and the disposable gloves provided while taking the wipes. The gloves are removed after the wipes are placed into the test tubes by a sterile technique (i.e. by grasping inner surface at wrist). The gloves are placed in the bag provided and returned to Health Physics Associates. Wash hands when through.

Always ascertain that the source is in "OFF" and shielded position before beginning test.

Wipe procedure:

1. Pour several cc of water into test tube containing a wetting agent. Each wipe stick is to be moistened in this solution prior to making each wipe.

2. Moisten #1 stick, squeeze off excess and wipe inside of source head on collimating leaves, or inside of collimating cone holder, or outside of plastic window on collimator, whichever of above is available without dismantling unit. Insert wipe into #1 tube and attach cap to tube.

3. Moisten #2 wipe stick, squeeze off excess and wipe area around opening through which source has been inserted into the housing (loading screw).

4. Moisten #3 wipe stick, squeeze off excess and wipe crevices and cracks about exterior surface of source housing. If extra collimating cones are used, wipe inside of all cones with same wipe stick. Insert wipe into #3 tube and attach cap to tube.

5. Insert all tubes and gloves into shipping container with completed information sheet for return to Health Physics Associates using shipping label enclosed.

6. Use Survey meter to determine that level of radiation on external surface of shipping container is less than 0.4 mr/hr. If survey meter is unavailable, contact Health Physics Associates. If reading is greater, do not send wipes and phone Health Physics Associates immediately for further instructions.

IMPORTANT - READ CAREFULLY BEFORE CHANGING SOURCE

SOURCE CHANGING INSTRUCTIONS

FOR C-10 SHIPPING CONTAINER
Revised 4/23/74

Attached is a cross-sectional view of the shipping container used for transporting your pigtail source. The container has two lock boxes--one on each side. The upper lock box is labeled "NEW SOURCE" and the upper tube contains the new source. The lower lock box and tube contain a safety plug when shipped to you. The lower tube will be used to return the decayed source to Gamma Industries.

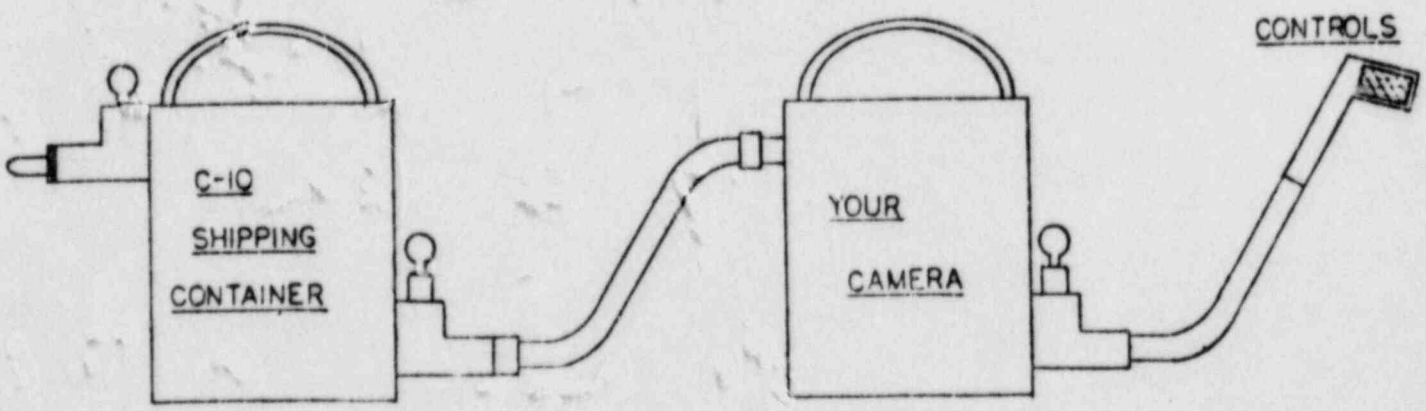
The following procedure should always be followed in the source changing operation:

ALWAYS HAVE A PROPERLY OPERATING SURVEY METER AT HAND WHEN CHANGING SOURCES!

1. Survey the C-10 shipping container with meter. The radiation intensity should not exceed 10 mr/hr at 1 meter from any surface of the C-10.

2. Open the lower lock of the C-10 shipping container. Remove the safety plug.

3. Connect one end of short exchange tube (provided in the shipping barrel) to the lower lock box of the C-10 shipping container. Attach the other end of the short exchange tube to your camera.



4. Crank your old source into the C-10 shipping container until it reaches a definite stop.

5. Survey to assure that the old source has reached a safe position.

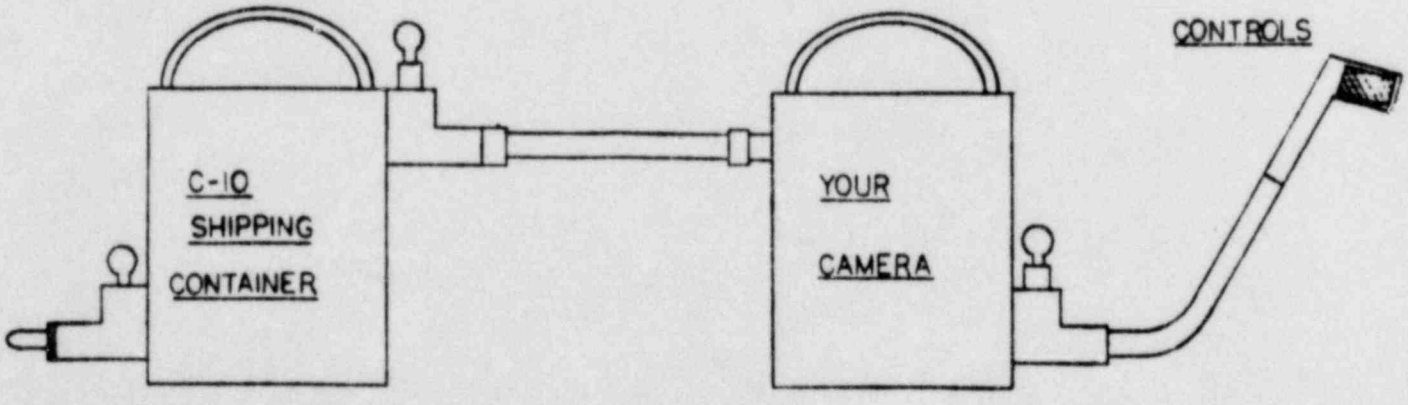
6. Lock the lower lock of the C-10 shipping container onto the old pigtail locking ball. You must be aware that the source could be removed from the open end of the lock box if the lower lock is not locked.

7. Remove the short exchange tube from the C-10 shipping container. Disconnect the control cable from the old pigtail. (Attempt to move the pigtail into and out of the C-10 shipping container to assure the lock is depressed upon the pigtail locking ball. If the pigtail can be moved, then open the lower lock, carefully move the pigtail, and lock the lock upon the pigtail locking ball. This will assure that the old source will remain properly locked and shielded during the return shipment.)

8. Remove the source protector cap from the upper lock box and attach the source protector cap over the old source pigtail in the lower lock box.

9. Attach the control cable to the new pigtail which is in the upper lock box.

10. Attach short exchange tube to the C-10 shipping container upper lock box.



11. Unlock the upper lock from the new source.

12. Standing as far away as possible, crank the new source from the C-10 shipping container into your camera.

13. Survey.

14. Lock your camera lock.

15. Remove the short exchange tube from your camera. Remove the short exchange tube from the C-10 shipping container.

16. Insert the safety plug into the upper tube of the C-10 shipping container. Lock the upper lock of the C-10 shipping container.

17. Survey.

18. Place the C-10 into the barrel in the same orientation which it was received. Place the short exchange tube into the barrel. Place the top on the barrel and secure with the locking ring.

19. Insert a safety seal into the barrel locking ring.

20. Survey. (The radiation intensity should not exceed 200 mr/hr at any barrel surface or 10 mr/hr at one meter from any barrel surface.)

END OF SOURCE INTERCHANGE INSTRUCTIONS

Be sure that you:

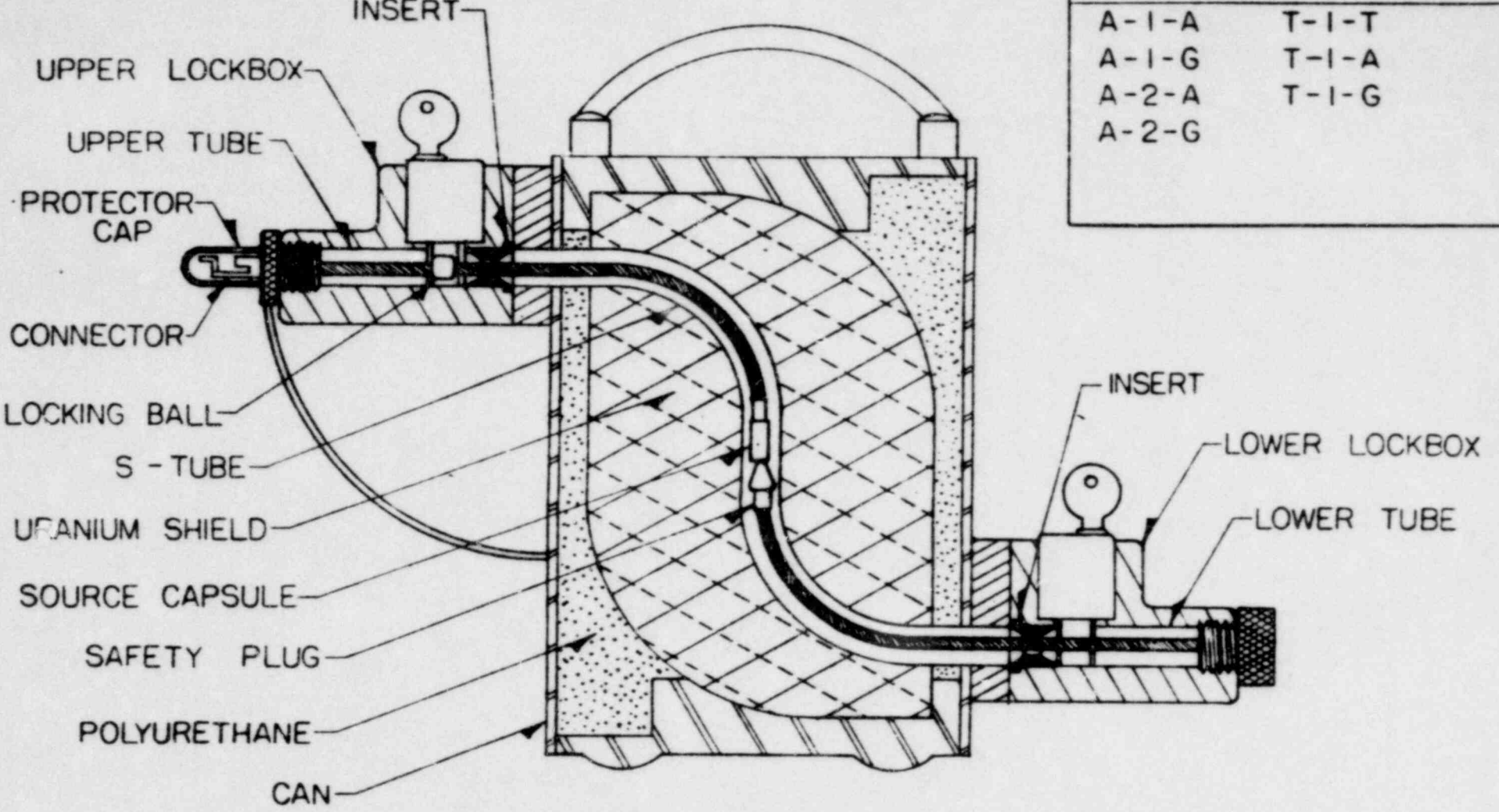
1. Attach two "Radioactive Yellow-III" labels to the barrel.

2. Measure and write the transport index upon the affixed labels.

3. Properly fill out all shipping documents.

SOURCES SHIPPED IN C-10	
A-1-A	T-1-T
A-1-G	T-1-A
A-2-A	T-1-G
A-2-G	

CONTROL NO. 70875



GAMMA INDUSTRIES, B. R., LA.		
SCALE: NONE	APPROVED BY:	DRAWN BY WDL
DATE: 9-20-74		REVISED
C-10 SHIPPING CONTAINER		
REVISIONS TO DRAWING NO. 323		DRAWING NUMBER 323-02

SOURCE PRODUCTION & EQUIPMENT CO., INC.

OPERATION INSTRUCTIONS

SPEC MODEL C-1 SOURCE EXCHANGER

DESCRIPTION:

The SPEC Model C-1 Source Changer is for the exchange of "pigtail type" radiography sources. It is designed with safety as the prime consideration, and if you follow these procedures carefully you should be able to change a source with virtually no exposure to yourself or others. Please read the following instructions carefully before operating or shipping the unit. You will note that there are three separate closures, the plunger lock, the protector cap and the lid of the container, incorporated in the device to assure that the source is maintained in an absolutely safe position during the source exchanging, while the device is being secured, and during all phases of shipment.

A. Upon opening the container you will note that the interior is painted in two colors, one half red and the other half blue. The tube in the red side has the "HOT" source in it and the tube on the blue side is the one in which you will place your "COLD" or decayed source for return to supplier. Each side is appropriately labeled "NEW SOURCE" and "OLD SOURCE"

On the side wall of the container are two spring loaded plungers. These plungers project into the source tubes and act as locks to hold the pigtail in place during shipment and during connecting for exchange. Unfortunately locks can lock things OUT as well as IN, so be sure to follow the instructions very carefully in this regard. Now proceed with the directions below.

ALWAYS USE A CALIBRATED SURVEY METER IN PROPER WORKING ORDER WHILE CHANGING SOURCES AND PRIOR TO SHIPPING.

1. Upon receipt of shipment, survey to determine if surface reading is greater than 200 mr/hr. If significantly greater, notify shipper and proper authority within your company and regulatory agency, after barricading container or isolating it in some way to minimize dosage to yourself and others. Do not proceed until your company RSO authorizes.

2. If radiation levels are less than 200 mr/hr., break tamper seal and open padlock using key or combination provided.

3. Open both top and side doors to their fully extended positions exposing the outlet tubes on top and the lock plungers on the side.

4. Pull the lock plunger on the blue side and turn to the left. This unlocks the plunger by holding it in the retracted position.

5. Connect one end of the source exchange tube provided in the container to the uncapped outlet tube in the top of the container. Connect the other end of the exchange tube to the outlet of the exposure device.

6. Properly connect drive cable to the depleted source in the "camera" and hook up controls to the exposure device.

7. With a correctly functioning survey meter in view, next to the source exchange tube, crank the depleted source into the C-1 changer until the source reaches a definite stop and the survey meter indicates that the source has reached a shielded position.

8. Carefully survey the container to ascertain that the source is in a safe position.

9. Lock the container by turning the lock plunger 1/4 turn to the right and release. The plunger will lock down on the source. The knurled knob of the plunger has to seat on the barrel of the plunger housing. If it doesn't, jiggle the source with the control cable crank, until it does seat.

10. Detach the source exchange tube from the container tube.

11. Gently pull the pigtail to be sure it is locked in.

12. CAUTION-- If you can withdraw the pigtail more than 1½ inches, it probably is not locked in. In this case, pull the lock plunger out and shove the pigtail down into the tube and reseat the plunger.

13. Disconnect control cable from pigtail.

14. Remove protector outlet cap from outlet tube on the red side of container.

15. Place protector cap on tube on blue side.

16. Secure source exchange tube to camera and crank control cable thru it until approximately 8 inches of cable protrudes from loose end of source exchange tube. Connect drive cable to new source.

17. Attach loose end of source exchange tube to shipping container outlet on the red side.

18. Pull the lock plunger on the new source side of the container and turn 1/4 turn to the left. This unlocks the plunger and the new source is free to be extracted from the container.

19. With a correctly functioning survey meter in view next to the source exchange tube, and while standing as far away as possible, retract the source into the exposure device.

20. Carefully survey the exposure device to ascertain that the source is in the safe position. Lock exposure device.

21. Remove source exchange tube from both exposure devices and outlet tube.

22. Turn the lock plunger in the empty red tube 1/4 turn and release. This allows the side door to be closed.

23. If side door is prevented from closing by either lock plunger, the plunger is not properly seated.

24. Place source exchange tube in top of container.

25. Close the top door and affix lock.

26. Survey container to determine if D.O.T. requirements are met. Radiation level should not exceed 200 mr/hr, at surface of container.

SUMMARY OF SHIPPING INSTRUCTION

It is imperative that all Department of Transportation requirements be met. To assist you in properly preparing the container for shipment, we have enclosed a packet of return shipping labels and a tamper seal. We hope the following check list will be helpful.

1. Survey Container - Do not ship if container reads greater than 200 mr/hr on the surface.
2. Determine the transport index by surveying 3 feet away from all accessible surfaces of the container including the bottom. (When shipping a depleted source, the index will usually be less than 1). The transport index is the highest reading obtained, rounded off to the nearest 1/10 mr.
3. Write this transport index in the square on the radioactive III label. Also indicate the isotope (IR 192) and the number of curies.
4. Attach two radioactive III labels to the shipping package, one on each side.
5. Make sure the container is locked and affix a tamper seal.
6. Attach the address tag (consignee) to the tamper seal or in a conspicious location on the container.
7. Attach a complete "shippers certification" to the freight bill. Iridium 192 falls in Group III, is in Special Form and is Type B if more than 20 curies, (type A if less than 20 curies).

SPEC MODEL I LEAK TEST KIT
WIPE TEST INSTRUCTIONS

Crank Out Models:

1) Fill out identification form. Put original in plastic envelope and keep duplicate copy.
2) Remove lock cap and safety plug from camera.
3) Insert swab 1" and wipe inside tube.
4) Seal swab in plastic envelope.

Pipeliner Models:

1) Fill out identification form. Put original in plastic envelope and keep duplicate copy.
2) Wipe shaft of control knob(s).
3) Wipe joint between camera housing and base plate.
4) Seal swab in plastic envelope.

NOTE: Survey envelope with survey meter. If meter detects radiation do not mail envelope. Call SPEC for instructions.

Phone 504/464-9471

ITEM 11

WASTE MANAGEMENT

Licensed material will be disposed of by transfer to the original supplier.