

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
790 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
☒ B. AMENDMENT TO LICENSE NUMBER 35-01755-02
☐ C. RENEWAL OF LICENSE NUMBER _____

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

Sun Refining and Marketing Co.
PO Box 2039
Tulsa, OK 74102

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

Tulsa Refinery
1700 South Union
Tulsa, OK 74107

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

C. P. Klein

TELEPHONE NUMBER

918-586-7457

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

5. RADIOACTIVE MATERIAL

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

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

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

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

9. FACILITIES AND EQUIPMENT

8604140156 860313
REG4 LIC30
35-01755-02 PDR

10. RADIATION SAFETY PROGRAM

11. WASTE MANAGEMENT

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

FEE CATEGORY 3-L AMOUNT ENCLOSED \$ 110.00

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

C. P. Klein

TYPED/PRINTED NAME

C. P. Klein

TITLE

Instrument Engineer

DATE

12-3-85

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

AMO

FEE LOG

Dec. 31

FEE CATEGORY

3P

COMMENTS

AMOUNT RECEIVED

\$110 (50% refund)

CHECK NUMBER

00592

10

APPROVED BY

G. Jackson

DATE

12/23/85

APPLICATION FOR MATERIAL LICENSE

(35-01755-02)

5. Radioactive Material

- a. Element and Mass Number - Americium 241.
- b. Chemical and/or physical form - Americium-Oxide.
- c. Maximum amount which will be possessed at any one time - 200 mCi.
- d. Sealed Source Manufacturer and Model Number - Gammatron Model AN-HP.

6. Purpose for which licensed material will be used:

As part of the Fisher Controls Type LD2220 portable level detector (see attached device registry TX293D101S)

7. Individual responsible for Radiation Safety Program and their training and experience:

C. P. Klein - Attended level gage training session at Vinson Supply Co., 11-18-85. Attached is training certificate.

Also attended training: Leonard Rivett, Bobby Rhodes, Charles Moore, Marvin Noe, Clarence Smith and Edward VanArsdale.

8. Training for individuals working in or frequenting restricted areas:

Individuals named in Item 7 have received training from the manufacturer.

9. Facilities and equipment:

The device will be kept at: 1700 South Union, Tulsa, OK. The device will be kept in a securable storage area in such a manner to prevent unauthorized removal and use. This area is at least 10 feet from regular work stations.

A diagram of the floor plan showing where the device is stored in relation to other work areas is attached.

10. Radiation Safety Program:

The individual responsible for the radiation safety program will:

- Assure compliance with the applicable provisions of 10CFR Part 19 "Notices, Instructions and Reports to Workers, Inspections" and Part 20 "Standards for Protection Against Radiation" or comparable state regulations.
- Be responsible for maintaining a sealed source inventory and perform or be responsible for performing wipe tests every 6 months.

The individual responsible for the radiation safety program has received training from the manufacturer in the safe handling and operation of the device. The training program offered by the manufacturer, Fisher Controls, includes instruction in the safe handling and operation of the device as well as a presentation on radiation basics. The radiation training covers the principles and practices of radiation protection, radioactivity measurement and monitoring techniques and biological effects of radiation. All trained individuals have received a certificate from the manufacturer stating that they have had the training and that they have an understanding of the principles they have been shown and can safely handle and operate the device. A copy of the certificate is attached.

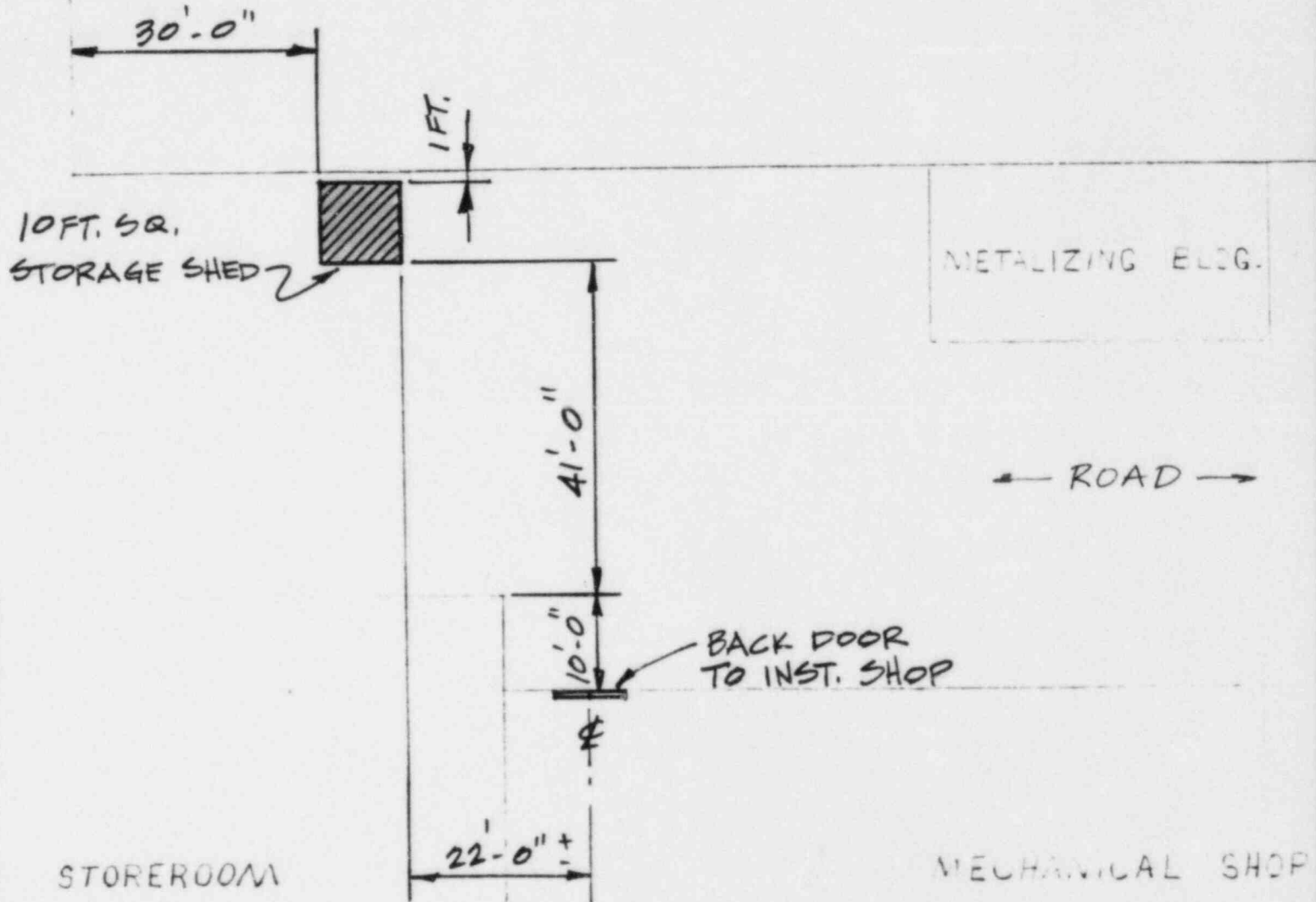
The training materials, the device instruction manual, and the transportation guideline cover the safety and emergency procedures outlined in the license application guide for Item 10. Specifically:

- a. "Safety measures to be used in transporting the device" - See the Instruction Manual, Page 9 and the Transportation Guideline, Page 6.
- b. "Means of preventing unauthorized access, use or removal during use at temporary job sites." See the Instruction Manual, Page 3 and the Transportation Guidelines, Page 5.
- c. "Means of preventing unauthorized use or removal from storage." See Instruction Manual, Page 3.
- d. "Emergency procedures to be followed in case of accidents." See Instruction Manual, Page 9 and the Transportation Guidelines, Page 6.
- e. "Specific instructions to users to not dismantle the source housing." See Instruction Manual, Page 9.

11. Waste Management:

Procedures for returning the device for disposal are on Page 9 of the Instruction Manual and Page 6 of the Transportation Guideline.

WAREHOUSE "B"



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460888

CARPENTER S. CH

MOLDING SHOP

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APERTURE
CARD

Also Available On
Aperture Card

8604140156-01

[illegible]

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT Leonard Lee Rivett HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION. Leonard Lee Rivett IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: M. L. Joman

TITLE: Engineer

DATE: 11-19-85

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT Bobby Joe Rhodes HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION. Bobby Joe Rhodes IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: W. P. Joman

TITLE: Engineer

DATE: 11-18-85

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT Charles Moore HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION. Charles Moore IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: M. S. Joman

TITLE: Engineer

DATE: 11-19-85

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT CYNTHIA P. KLEIN HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION. CYNTHIA P. KLEIN IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: Mark S. Joman

TITLE: Engineer

DATE: 11-19-85

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT MARVIN E, NOE HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION. MARVIN E NOE IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: M. A. Joman

TITLE: Engineer

DATE: 11-19-85

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT Clarence Leroy Smith, Jr HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTATIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES. THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS OF RADIATION Clarence Leroy Smith, Jr IS QUALIFIED TO USE OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: M. L. Joman

TITLE: Engineer

DATE: 11-19-85

460888

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT ^{Edward} Van Ansdale
HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTA-
TIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN
UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE
TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS
ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS
DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES.
THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES
OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT
AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS
OF RADIATION. Edward Van Ansdale IS QUALIFIED TO USE
OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE
LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: M. S. Joman

TITLE: Engineer

DATE: 11-19-85

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

NO: TX D101S

DATE: November 21, 1984

PAGE 1 OF 4

DEVICE TYPE: Neutron Backscatter Level Detector

MODEL: LD2220

MANUFACTURER/DISTRIBUTOR: Fisher Controls
Highway 380 East
P. O. Box 900
McKinney, Texas 75069

SEALED SOURCE MODEL DESIGNATION: Gammatron Inc. Model AN-HP

ISOTOPE: Am-241

MAXIMUM ACTIVITY: 200 mCi.

LEAK TEST FREQUENCY: 6 months

PRINCIPAL USE: General Neutron Source Applications

CUSTOM DEVICE: _____ YES _____ X NO

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

NO: TX D101S

DATE: November 21, 1984

PAGE 2 OF 4

DEVICE TYPE: Neutron Backscatter Level Detector

DESCRIPTION: The Model LD2220 neutron backscatter level detector is composed of a helium-3 neutron detector mounted beside a source holder containing an Am-241 neutron source of 200 millicuries. This assembly is mounted on a five foot long aluminum tube. A Ludlum Measurements Inc. Model 12 rate meter is mounted at the other end of the tube.

LABELING: A label containing the standard "Caution - Radioactive Material" and radiation trefoil is attached to the source-detector assembly. This label also contains the source serial number, radionuclide activity and date of measurement with a "Notify Civil Authorities" on the outside edge of the label. Another label with the company name and serial number of the device is also attached.

DIAGRAM:

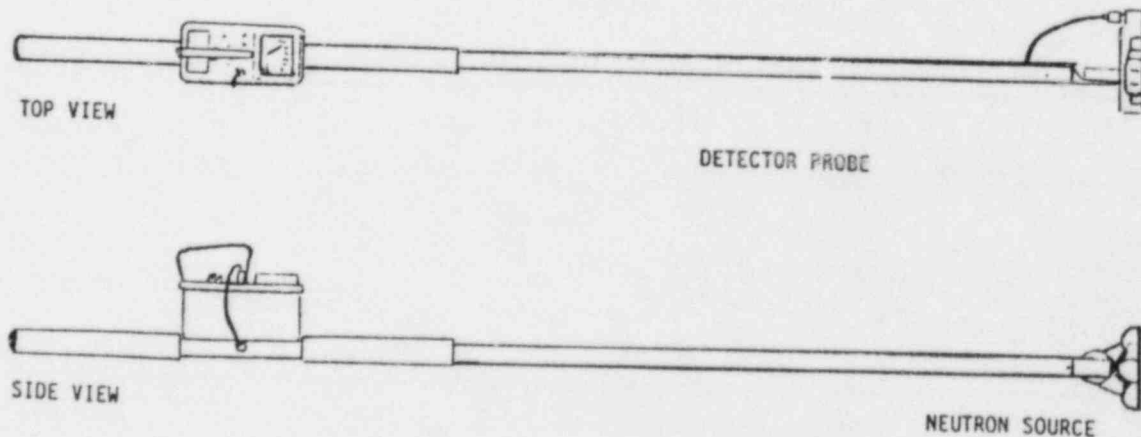


FIG. 1 - Model LD2220 Neutron Backscatter Level Detector

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

NO: TX D101S

DATE: November 21, 1984

PAGE 3 OF 4

DEVICE TYPE: Neutron Backscatter Level Detector

CONDITIONS OF NORMAL USE: The Model LD2220 is intended for use in determining liquid levels inside chemical process equipment. The device is portable and must be used in environments compatible with man. The source-detector assembly is manipulated at the handle end of the device, four and one-half feet from the source-detector assembly. This device will normally be operated using only a 100 millicurie Am(Be) source. However, 200 millicurie sources may be used. This may occur if vessel walls are thick, thick insulation is present around the vessel or materials inside the vessel are low in hydrogen content.

In general, the device will be removed from storage, taken into the plant, and used by trained operating personnel who have been instructed in the safe use and proper handling of the device by the Radiation Safety Officer. The actual period of use expected is 10 minutes to one hour per week. After use, the device is returned to storage.

If severe conditions occur (explosion or fire), the device will likely be destroyed. However, the Am(Be) sources should remain intact since these sources are designed to perform under a pressure of 25,000 pounds per square inch and a temperature of 600 centigrade for one hour.

PROTOTYPE TESTING: Several prototypes were tested. Device construction causes the operator to maintain a safe distance from the source in order to operate the device.

EXTERNAL RADIATION LEVELS: Radiation levels at one foot from the source holder with a 200 millicurie source are 1.28 millirem/hr. of gamma radiation and 8.57 millirem/hr. of neutrons. Each 200 millicurie source is expected to produce 5.74×10^5 neutrons per second.

QUALITY ASSURANCE AND CONTROL: The device is completely assembled and tested before the sealed source(s) is installed. Each sealed source is certified as to specific activity and neutron output. Each device is then tested for proper operation before release.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

NO: TX D101S

DATE: November 21, 1984

PAGE 4 OF 4

DEVICE TYPE: Neutron Backscatter Level Detector

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

1. These devices may be distributed to specifically licensed users only.
2. Leak testing of the sealed source is required at six month intervals.
3. Repair and maintenance will be provided. Any repair involving the source housing will be handled by N.S.S.I. in Houston, Texas.
4. Source exchanges, if necessary, will be performed by N.S.S.I. in Houston, Texas.
5. The device will be returned to N.S.S.I. for disposal.
6. Training to safely use this device is provided to the Radiation Safety Officer. The Radiation Safety Officer may then present a short orientation course to qualify technicians as users.

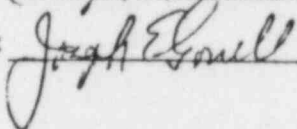
SAFETY ANALYSIS SUMMARY: This device can be operated safely by trained personnel. However, the possibility of misuse exists and only trained and competent personnel should be allowed to have access.

REFERENCES: Application dated November 5, 1984 with procedures, accompanying data and drawings.

DATE: November 21, 1984

REVIEWED BY: 

DATE: December 4, 1984

REVIEWED BY: 

ISSUING AGENCY: Texas Department of Health

bcc: File/Insp. File/Board/FRH
FRH:da

Fisher Controls

Instruction Manual

Type LD2220 Level Detector**FISHER®**

June 1985

Form 5604

Contents

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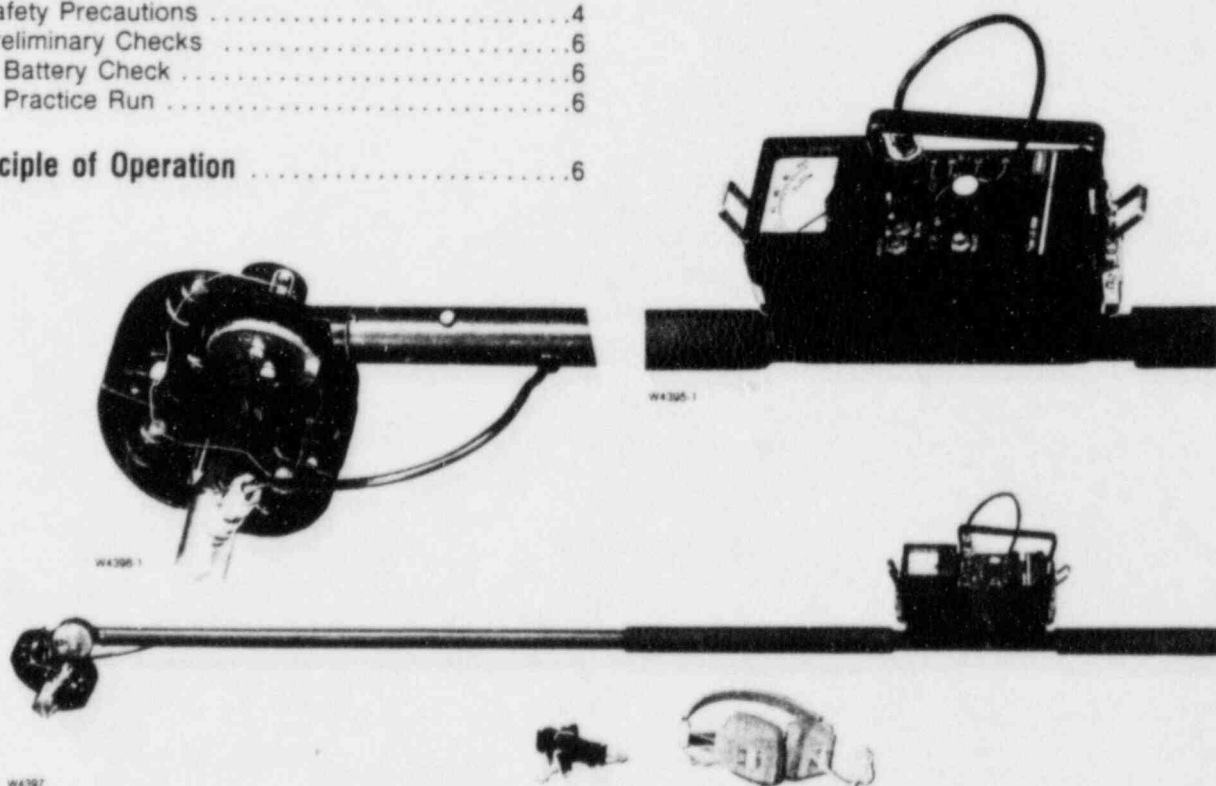


Figure 1. Type LD2220 Level Detector

Table 1. Specifications

RADIOACTIVE SOURCE	Americium 241-Beryllium, 200 millicuries (N.S.S.I. Model AN-HP)	MAXIMUM ALLOWABLE VESSEL WALL THICKNESS⁽¹⁾	6 inches (152 mm)
RADIATION LEVEL AT OPERATOR END OF DEVICE	0.47 mRem/hr	MINIMUM ALLOWABLE VESSEL DIAMETER	2 inches (51 mm)
METER LINEARITY	± 5 percent of full scale	VESSEL WALL TEMPERATURE LIMITS	− 112 to 500°F (− 80 to 260°C)
METER POWER SUPPLY	Two D-cell batteries (approximately 100 hours of operation)	OPERATIVE AMBIENT TEMPERATURE LIMITS⁽²⁾	− 112 to 221°F (− 80 to 105°C)
METER RESPONSE TIME	3 or 11 seconds	APPROXIMATE WEIGHT	7 pounds (3.2 kg)
MEASUREMENT ACCURACY	± 0.5 inches (13 mm)	ADDITIONAL SPECIFICATIONS	For construction materials, see the parts list section

1. Total wall thickness includes insulation, jackets, etc. For more information on total wall thickness, contact your Fisher sales office or sales representative.

2. This term is defined in ISA Standard 51.1-1979.

Introduction

Scope of Manual

This instruction manual provides storage, operation, maintenance, and parts ordering information for the Type LD2220 level detector. Only qualified personnel should operate or maintain this level detector. If there are any questions concerning the instructions in this manual, contact your Fisher sales office or sales representative before proceeding.

Description

The Type LD2220 Level Detector (figure 1) is a lightweight, hand-held, portable device that enables the user to determine levels of foams, liquids, solids, and other substances without intrusion into the vessel. The Type LD2220 Level Detector gives accurate measurements for all common substances which contain hydrogen, such as water, hydrocarbons, acids, bases, and most organic liquids⁽¹⁾. By use of the neutron backscatter measurement principle (see the Principle of Operation section), this level detector can penetrate even heavy-walled vessels with fast neutrons to determine the levels of liquids and solids. The level can normally be located to one-half inch (13 mm) on most vessels.

Specifications

Specifications for the Type LD2220 Level Detector are listed in table 1. Specifications for the radioactive source



Figure 2. Warning Nameplate Used on a Type LD2220 Level Detector

are also listed on the warning nameplate as shown in figure 2. The warning nameplate (key 24, figure 8) is permanently attached to the head assembly that houses the radiation source. Fisher Controls serial tags (key 30, figure 8) are attached separately to the head assembly and to the count rate meter.

Storage

WARNING

Only qualified individuals should handle or operate the Type LD2220 Level Detector. This device contains a radioactive source which can cause personal injury if mishandled in any way. To help prevent the possibility of personal injury, never handle the head assembly directly in the immediate vicinity of the radiation source (key 26, figure 8).

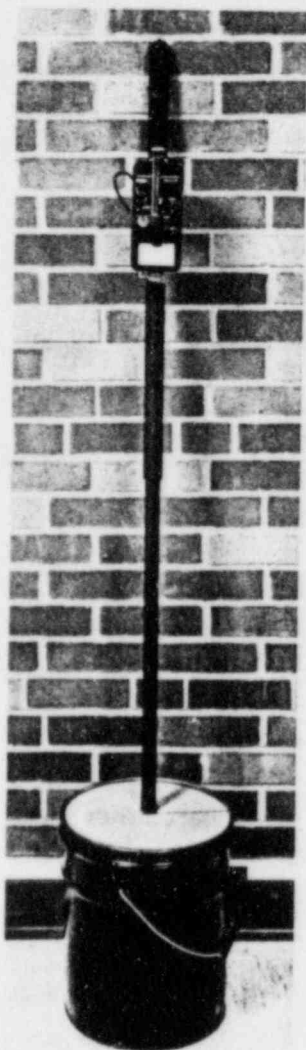
When shipped, the head assembly of the Type LD2220 Level Detector is packaged inside of a U.S. D.O.T.-7A container. This container is also used for storing the level detector when the device is not in use. In storage, the level detector should be kept in a secure area, such as inside a locked closet or cabinet, to prevent unauthorized access.

The Type LD2220 Level Detector can be stored in one of two ways. For most storage purposes, the head assembly of the level detector can be stored inside of the storage container with the pole assembly end of the device extending out of the container and propped against a wall or other solid surface as shown in figure 3. The meter end of the level detector should be supported firmly by the wall or solid surface to prevent the device from tipping over while in storage. In this manner, the level detector can be kept inside of a locked room or closet to prevent unauthorized access.

For long term storage, the head assembly of the level detector can be disconnected from the pole assembly as shown in figure 3 and stored separately. The head assembly can be disconnected from the pole assembly by disconnecting the MHV connector (key 7, figure 8) from the detector tube (key 29, figure 9) and disengaging the lock assembly (key 15, figure 9). The head assembly is then stored inside of the storage container with the foam padding inserted and the storage lid attached securely to the container. If the head and pole assemblies are stored separately, refer to the initial assembly portion of the operation section to reassemble the level detector for field operation.

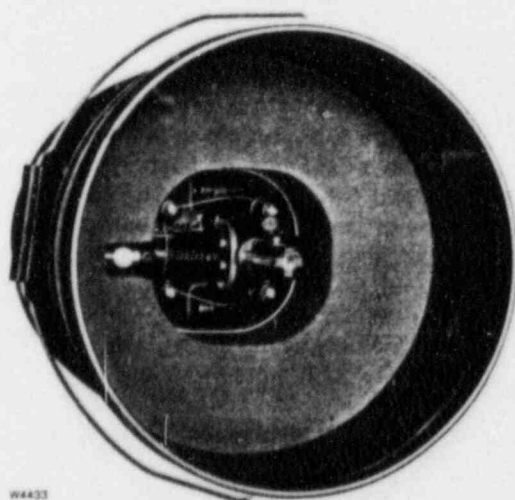
WARNING

Personal injury can result due to overexposed exposure to the radiation source (key 26, figure 8) at very close proximity. To prevent the possibility of such injury, always perform the following precautions when the device is not in use:



W4432

LEVEL DETECTOR WITH POLE ASSEMBLY EXTENDING OUT OF CONTAINER FOR STORAGE INSIDE OF A SECURE AND LOCKED AREA



W4433

HEAD ASSEMBLY DISCONNECTED FROM POLE ASSEMBLY FOR SEPARATE STORAGE

Figure 3. Storage Container for Type LD2220 Level Detector

- Store the level detector in a secure area and at least 18 inches (0.46 meters) from personnel,
- Use locks when storing the level detector to prevent removal by unauthorized personnel, and
- Post an NRC Form 3 in clear view outside the storage area.

For more information on the NRC Form 3, or any of these storage procedures, contact your Fisher sales office or sales representative.

Operation

WARNING

Only qualified individuals should handle or operate the Type LD2220 Level Detector. This device contains a radioactive source which can cause personal injury if mishandled in any way. To help eliminate the possibility of personal injury, never handle the head assembly directly in the immediate vicinity of the radiation source (key 26, figure 8).

Initial Assembly

The Type LD2220 Level Detector is ready for immediate operation as received. To complete initial assembly, perform the following steps. This procedure can also be performed to reassemble a level detector that was disassembled for storage or shipping purposes. Key numbers referenced in the following procedure are shown in either figure 8 or 9 as indicated.

1. Remove the lid and the top piece of foam packing from the storage container (key 31, shown in figure 3) to expose the head assembly.
2. Connect the head assembly to the pole assembly by engaging the lock assembly (key 15, figure 9) into the appropriate opening in the pole assembly. The middle of the three holes in the pole is used for most applications. The outer two holes are used for applications where the operator must stand very close to the tank wall, such as on a tank with a winding staircase.
3. To complete the assembly, attach the MHV connector (key 7, figure 8) to the detector tube (key 29, figure 9). The level detector is now ready for use.

License Requirements

A specific materials license is required to possess or use the Type LD2220 Level Detector. Licensing information and applications for this license can be obtained from your Fisher sales office or sales representative or from your local regulatory agency.

Orientation

Operation of the Type LD2220 Level Detector is restricted to trained personnel who are instructed in the safe use and proper handling of the device. Fisher Controls provides a training program for Radiation Safety Officers and designated personnel. A representative from Fisher Controls is available to provide a field demonstration of the device.

Fisher Controls also offers:

- Training accessories that depict proper operation of the level detector,
- Training accessories that present basics in radiation safety, and
- A training manual that outlines basic radiation characteristics as well as safety and regulatory considerations.

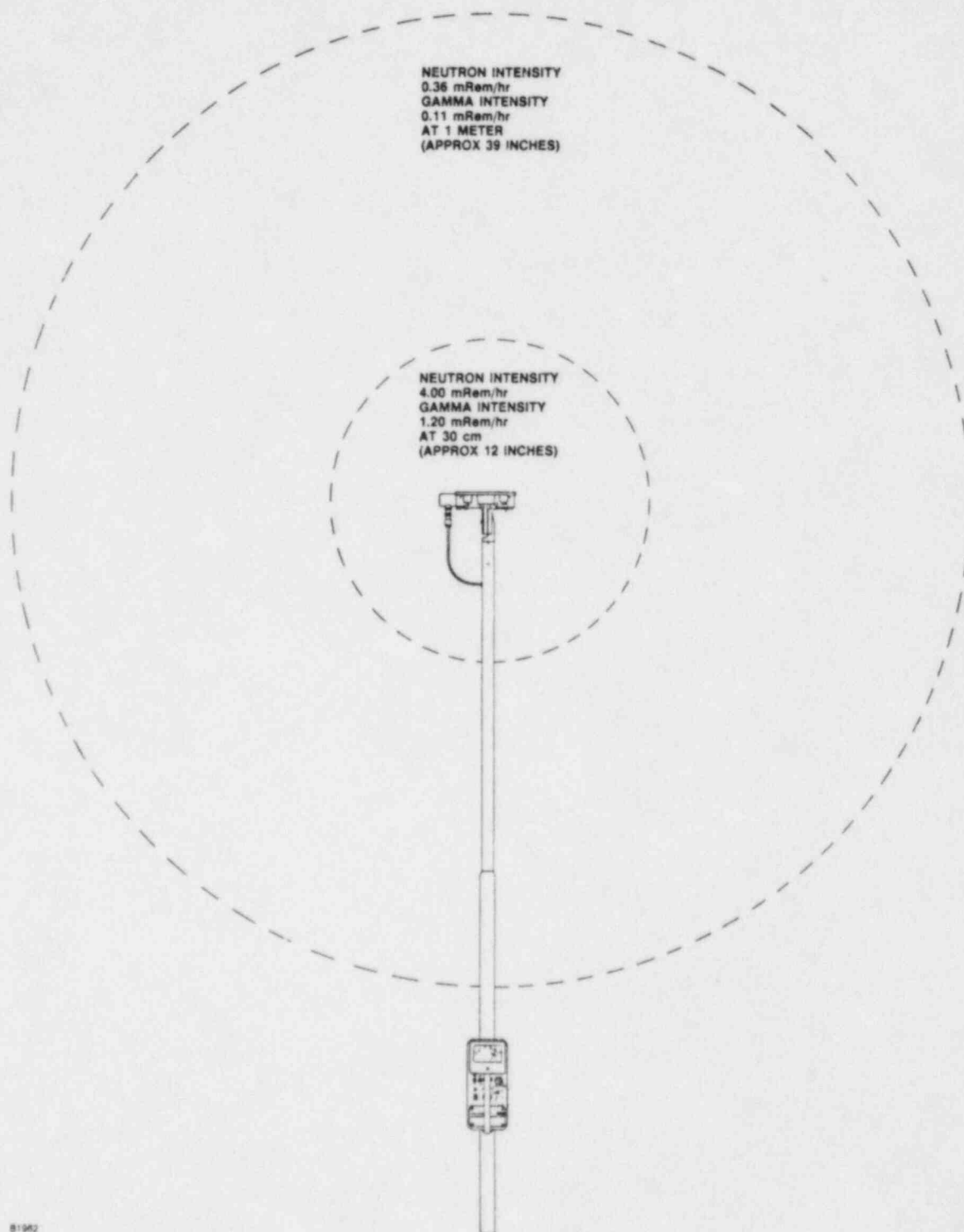
Users of the Type LD2220 Level Detector are encouraged to refer to these training materials. This instruction manual must be read thoroughly before attempting to operate the device.

Safety Precautions

WARNING

Personal injury can result due to overextended exposure to the radiation source (key 26, figure 8) at very close proximity. To prevent the possibility of such injury, be sure to read this section carefully and to take note of these safety precautions before attempting to operate the device.

During normal operation, the Type LD2220 Level Detector is to be handled only by the hand grips (keys 5 and 6, figure 8) that are located at the meter end of the device. Under these conditions, the operator is exposed to a 0.47 mRem/hr radiation level which is well below the 2.0 mRem/hr radiation limit established by the Nuclear Regulatory Commission for unrestricted areas. Therefore, by NRC regulation, no film badges, dosimeters, or other safety related equipment are required by the user when operating the level detector.



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Figure 4. Typical Isodose Curve for Type LD2220 Level Detector

The Americium 241-Beryllium source used in the Type LD2220 Level Detector is a relatively small source and it is not considered hazardous during normal use of the device. It is possible, however, to receive radiation exposure in excess of permissible levels if the operator remains in close proximity to the source for extended periods of time. This is especially true if the operator

spends long periods of time within 18 inches (0.46 meters) of the capsule that contains the radiation source.

It should be noted that the Type LD2220 level detector is not a shielded device. Isodose curves (figure 4) for the Type LD2220 Level Detector indicate that at a distance

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of 39 inches (1 meter) from the radiation source, the radiation level is 0.47 mRem/hr while at one foot (0.3 meters) the radiation level is 5.20 mRem/hr. Therefore, keeping a maximum distance between the operator and the radiation source is an extremely effective method for reducing radiation exposure. Fisher Controls recommends that any intended users of the device, as well as any other applicable personnel, remain at least 18 inches (0.46 meters) from the radiation source (key 26, figure 8) whenever possible.

Preliminary Checks

Battery Check

Before attempting to operate the Type LD2220 Level Detector, the batteries should be checked for adequate operation. First turn the selector switch on the count rate meter (key 1, figure 8) to the battery test position as shown in figure 5. Note the meter reading. If the meter reads below the BAT TEST zone on the scale, the batteries are low and should be replaced. If the meter reading is within the BAT TEST zone on the scale, the batteries are adequate for normal operation. Most alkaline battery cells have an average operating life of about 100 hours.

Practice Run

The best way to learn the relationship between detector response and a process level position is by making a practice run. Fill a test vessel about 2/3 full of water. The vessel should be open at the top or transparent enough so that the liquid level in the container can be observed. A bucket, waste basket, glass bottle, or beaker are all suitable for this purpose.

To prepare the level detector for operation, turn the selector switch on the count rate meter (key 1, figure 8) to the range B position that is shown in figure 5. Turn the audio switch to the ON position and the time constant switch to the SLOW position. In free air, a meter reading of less than 6 divisions will be observed and a slow audio rate will be heard.

For normal operation, the Type LD2220 Level Detector should be handled only at the meter end of the device. The level detector has two foam rubber hand grips (keys 5 and 6, figure 8) at the meter end for easy handling. Practice holding the level detector by the hand grips. Use the handle on the top side of the count rate meter to adjust the position of the head assembly so that the flat surface of the head assembly moves smoothly against the wall of the practice container.

Slowly move the head assembly up and down around the surface level on the outside wall of the practice container. Carefully note the position of the head assembly relative to the liquid surface level when the meter signal changes. Normally the arrow on the source/detector housing will be at the process level when the count rate meter signal increases rapidly as the detector is moving from above to below the surface level. The signal will rise to an even higher meter reading as the head assembly is lowered further beneath the surface level. The liquid surface level is located at the point where a sharp increase in the meter signal reading is observed. If the meter reads 100 percent of full scale it can be brought back onto the scale by turning the selector switch to the range A position. If greater resolution is desired, the selector switch can be turned to the range C or D position.

Practice moving the detector head assembly up and down along the outside wall of the container until the relationship between the meter signal and process level is readily apparent. Further testing can be performed by altering the liquid level and covering the container so that the liquid surface cannot be seen. Locate the liquid level several different times and mark each measurement. Compare each of the markings with the true levels as observed visually. Develop increased confidence and ability before proceeding to an actual application.

Once full confidence is developed using the device, actual process measurements can be performed. For actual applications, the selector switch on the count rate meter can be positioned to either range A, B, C, or D depending on the type of process material that is measured. Continued experience with the device makes such selections more apparent. Once level measurement is completed, the level detector should be immediately returned to its storage container (key 31, shown in figure 3). Refer to the storage section for instructions on how to store the level detector.

Principle of Operation

The Type LD2220 level detector (shown in figure 6) consists of a sealed radioactive source mounted as an assembly next to a helium-3 neutron detector tube. The source-detector assembly is located at one end of a 5 foot (1.5 m) aluminum pole assembly; the count rate meter and the operator hand grips are located at the opposite end.

The radioactive source of the level detector emits fast neutrons which can penetrate the wall of an enclosed vessel. When the source-detector assembly is moved along the outside wall of a vessel, the fast neutrons

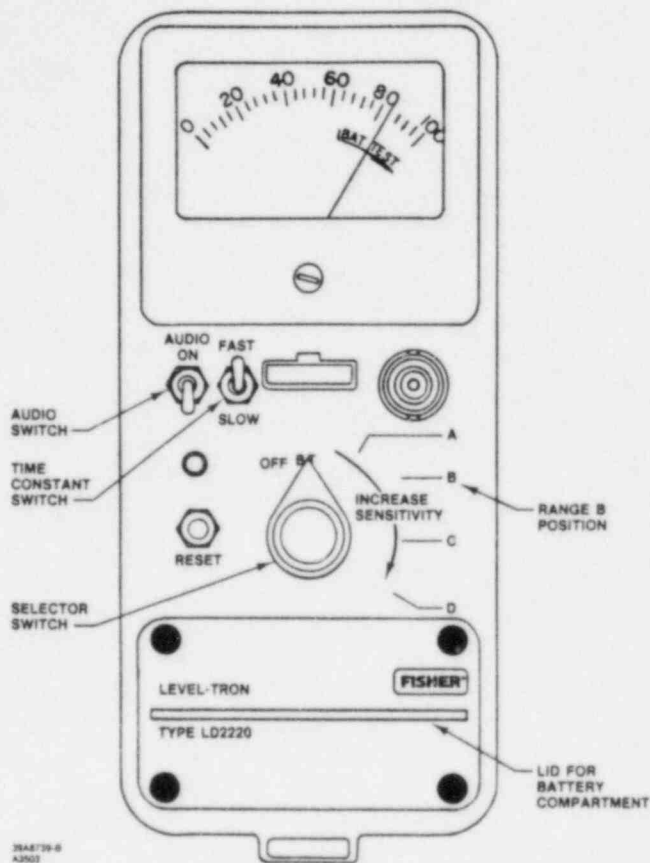


Figure 5. Count Rate Meter Used with Type LD2220 Level Detector

penetrate the vessel wall and enter the vessel. When the source is moved below the level of a hydrogen-containing substance (the liquid level), the fast neutrons interact with the hydrogen atoms in the liquid and lose energy. During this process some of the neutrons are reflected back (or backscattered) out of the vessel as slow neutrons to which the detector is highly sensitive.

The number of slow neutrons backscattered to the level detector gives a signal which is directly related to the hydrogen density of the substances contained inside the vessel. Substances having different hydrogen densities give different signals; therefore an abrupt signal change occurs when a level is passed. Electrical impulses corresponding to the rate of slow neutrons passing through the detector tube are relayed from the detector tube to the battery-powered count rate meter. These impulses give both an analog and audio signal indication of the count rate, therefore they indicate level. The level can normally be determined to within one-half inch (12.7 mm) for most vessels. Level detection is not affected by operating conditions such as temperature or pressure inside the vessel.

Maintenance

If the Type LD2220 Level Detector fails to operate while in service, it should be checked for physical damage. This section presents a maintenance procedure for checking the count rate meter (key 1, figure 8) for possible physical damage as well as a maintenance check for battery contacts and cable integrity. If parts require replacement, refer to the appropriate replacing the count rate meter, replacing the pole assembly, or replacing the head assembly procedure presented in this section. A procedure for disposal of the level detector is also presented.

Additionally, a wipe test procedure is presented in this section for intermittent maintenance of the radiation source (key 26, figure 8). Wipe tests must be performed at regular intervals not exceeding every six months. Key numbers referenced in all of these maintenance procedures are shown in figure 8 or 9 as indicated.

Meter Failure

Failure of the count rate meter (key 1, figure 8) is indicated by unsatisfactory battery check results when good batteries are connected to the count rate meter (see the battery check procedure). In many instances, the problem can be corrected simply by cleaning the battery contacts inside the count rate meter. If replacement of the count rate meter is necessary, refer to the replacing the count rate meter portion of this section.

Checks for Battery Contacts and Cable Integrity

Battery contacts should be checked periodically for cleanliness. Impaired or corroded battery connections can lead to excessive battery drainage and count rate meter failure.

Cable integrity of the coaxial cable (key 3, figure 8) can be checked by performing the following procedure. To perform this procedure, an ohmmeter is required.

1. Disconnect the MHV connector (key 7, figure 8) from the head assembly and disconnect the Type C connector (key 8, figure 8) from the count rate meter (key 1, figure 8).
2. Connect one lead of the ohmmeter to the inside center conductor of the Type C connector and connect the other lead of the ohmmeter to the inside center conductor of the MHV connector. If the ohmmeter shows continuity (reads zero or a low value), continue with the next step. If it does not show continuity (reads infinity or an extremely high value), proceed to step 7 of this procedure.

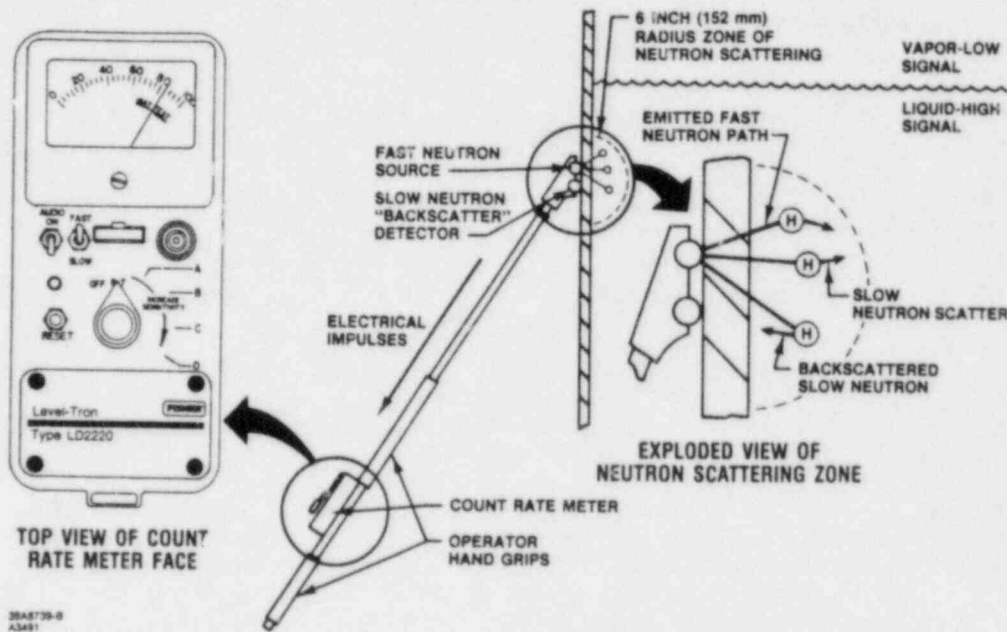


Figure 6. Operational Schematic

3. Connect one lead of the ohmmeter to the outside shield of the Type C connector and connect the other lead of the ohmmeter to the outside shield of the MHV connector. If the ohmmeter shows continuity, continue with the next step. If it does not show continuity, proceed to step 7 of this procedure.

4. Connect one lead of the ohmmeter to the outside shield of the Type C connector and connect the other lead of the ohmmeter to the inside center conductor of the MHV connector. If the ohmmeter does not show continuity, continue with the next step. If it does show continuity, proceed to step 7 of this procedure.

5. Connect one lead of the ohmmeter to the outside shield of the MHV connector and connect the other lead of the ohmmeter to the inside center conductor of the Type C connector. If the ohmmeter does not show continuity, continue with the next step. If it does show continuity, proceed to step 7 of this procedure.

6. Reconnect the MHV connector to the head assembly and the Type C connector to the count rate meter.

7. If the result of either step 2, 3, 4, or 5 has led to this step, the pole assembly may need to be replaced. Refer to the replacing the pole assembly portion of this section for additional information.

Replacing the Count Rate Meter

Perform this procedure if replacement of the count rate meter is necessary. Key numbers referenced in this procedure are shown in figure 8.

1. Disconnect the Type C connector (key 8) from the count rate meter (key 1).
2. Open the count rate meter and unscrew the two fillister screws (key 10) that secure the count rate meter to the pole assembly. Remove the count rate meter.
3. Install the new count rate meter. Secure the meter to the pole assembly with the fillister screws (key 10) and close the count rate meter.
4. Connect the Type C connector to the count rate meter.

Replacing the Pole Assembly

Perform this procedure if replacement of the pole assembly is necessary. This situation might result due to damage to the pole assembly or failure of the coaxial cable inside the pole assembly. Unless otherwise specified, key numbers referenced in this procedure are shown in figure 8.

WARNING

Be sure to keep hands and other bodily parts away from direct contact with the radiation source (key 26, figure 8) when performing this procedure. Failure to do so could cause personal injury due to radiation exposure. For safety reasons, it is recommended that all personnel in the immediate proximity of the level detector remain at least 18 inches (0.46 meters) from the radiation source whenever possible.

1. Disconnect the Type C connector (key 8) from the count rate meter (key 1).
2. Open the count rate meter and unscrew the two fillister screws (key 10) that secure the count rate meter to the pole assembly. Remove the count rate meter.
3. Disconnect the MHV connector (key 7) from the detector tube (key 29, figure 9) in the head assembly.
4. While disengaging the lock assembly (key 15, figure 9), remove the head assembly from the pole assembly.
5. Connect the new pole assembly to the head assembly by engaging the lock assembly. Connect the MHV connector to the detector tube in the head assembly.
6. Secure the count rate meter to the pole assembly with the fillister screws (key 10) and close the count rate meter. Connect the Type C connector to the count rate meter to complete the assembly.

Replacing the Head Assembly

Note

If an individual part of the head assembly requires replacement, the entire assembly must be replaced as a unit. Under no circumstances can the head assembly be disassembled to its individual parts.

Perform this procedure if replacement of the head assembly is necessary. Unless otherwise specified, key numbers in this procedure are shown in figure 8.

WARNING

Be sure to keep hands and other bodily parts away from direct contact with the radiation source (key 26, figure 8) when performing this procedure. Failure to do so could cause personal injury due to radiation exposure. For safety reasons, it is recommended that all personnel in the immediate

proximity of the level detector remain at least 18 inches (0.46 meters) from the radiation source whenever possible.

1. Disconnect the MHV connector (key 7) from the detector tube (key 29, figure 9) in the head assembly.
2. Disengage the lock assembly (key 15, figure 9) and remove the head assembly from the pole assembly.
3. Connect the new head assembly to the pole assembly by engaging the lock assembly. Connect the MHV connector to the detector tube in the head assembly.

Disposal

WARNING

The radiation source (key 26, figure 8) used with this level detector contains radioactive material which can cause personal injury if mishandled in any way. Therefore, under no circumstances is the source housing to be disassembled, modified, or application altered in any manner. For any maintenance work involving removal of the radiation source, or of the head cover (key 14, figure 9), the head assembly of the device should be returned to Nuclear Sources and Services Inc., 5711 Etheridge, Houston, Texas, 77087. Always contact your Fisher sales office or sales representative when the head assembly is being returned for service.

Special rules apply to the transportation and shipment of radioactive materials. If transportation of the Type LD2220 Level Detector is contemplated, all shipments must comply with either the rules and regulations published by the U.S. Department of Transportation, 46 C.F.R. Part 146, 49 C.F.R. Parts 173-179, and 14 C.F.R. Part 103 or the applicable IATA/ICAO regulations. For any situation requiring the return or maintenance of the head assembly, the head assembly must be repackaged in its original storage/shipping container with appropriate seal wire or security tape and shipped to Nuclear Sources and Services Inc., 5711 Etheridge, Houston, Texas 77087.

The radiation source (key 26, figure 8) used in the Type LD2220 Level Detector is double encapsulated in a welded, stainless steel, heavy-walled capsule. It is highly unlikely that an accident, including fire, explosion, or excessive damage due to impact, could rupture the source container and thereby result in loss or dispersion of the radioactive material.

Note

Even though the capsule that houses the radiation source (key 26, figure 8) is a rugged container, it should never be intentionally handled roughly.

In the unlikely event that it does become necessary to dispose of a damaged radiation source, special arrangements must be made for the disposal of the Americium-241 radioactive material. Arrangements can be made by contacting the Fisher sales office or sales representative or by contacting a licensed disposal service that is qualified in handling radioactive wastes. The Type LD2220 Level Detector must not be transported anywhere until it is inspected by a licensed individual and packaged in an appropriate shipping shield.

Wipe Tests

Fisher Controls requires that the Type LD2220 Level Detector be tested with a wipe test kit at regular intervals not exceeding every six months. This means that wipe tests must be performed on the unit at least twice a year. The only reason a wipe test might be performed at an interval less than six months is if there is some reason to suspect that the radiation source (key 26, figure 8) is leaking. Such a situation would arise following an accident, explosion, or any instance where damage to the radiation source is suspected.

To perform a wipe test, complete the following procedure.

1. A wipe test kit is furnished with the unit and it consists of several cellulose discs of filter paper, 2-3/4 inches (70 mm) in diameter, along with several pre-addressed envelopes. The envelopes enable the user to mail the wipe test samples to the appropriate nuclear agency for analysis. Ordering information for additional wipe test kits is available from:

Nuclear Sources and Services Inc.
5711 Etheridge
Houston, Texas 77087

WARNING

Be sure to keep hands and other bodily parts away from direct contact with the radiation source (key 26, figure 8) when performing the next step. Failure to do so could cause personal injury due to radiation exposure. For safety reasons, it is recommended that all personnel in the immediate

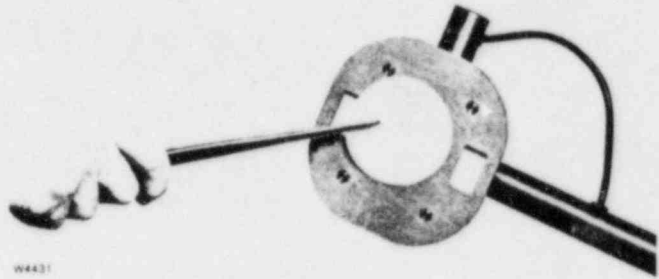


Figure 7. Wipe Test Procedure

proximity of the level detector remain at least 18 inches (0.46 meters) from the radiation source whenever possible.

2. Remove one of the wipe test discs from the kit and completely dampen it with tap water. Wring out any excess water. Hold the damp filter disc with a pair of forceps or tongs and wipe the outside of the radiation source (key 26, figure 8) thoroughly as shown in figure 7. Since extended exposure to the radiation source at close proximity is undesirable, this procedure should be performed as quickly and as vigorously as possible.

3. Mail the wipe test sample to:

Nuclear Sources and Services Inc.
5711 Etheridge
Houston, Texas 77087

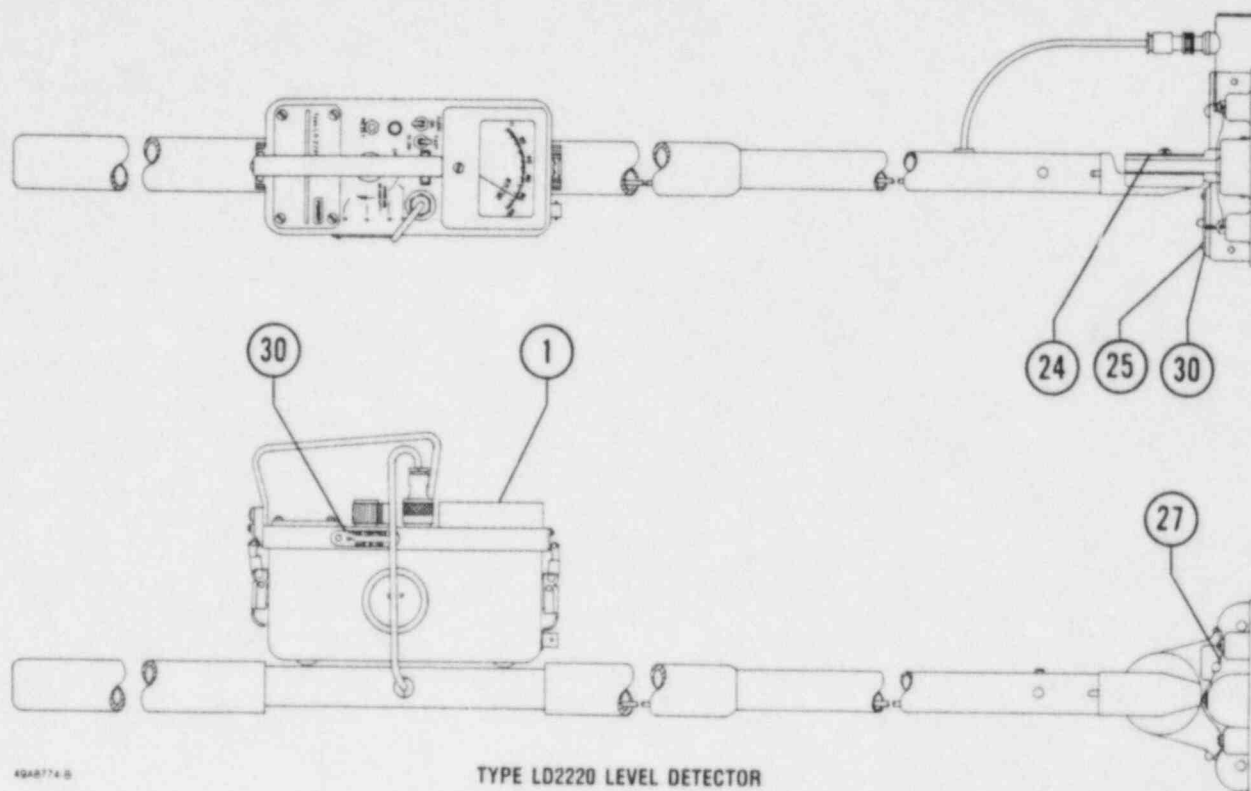
When mailing the wipe test sample, be sure to specify the following:

- The date the sample was taken,
- The serial number of the radiation source (located on the warning nameplate of the unit as shown in figure 2), and
- A return address where analysis results should be sent.

4. When testing is completed, the level detector should be returned immediately to storage. Refer to the storage section for instructions on how to properly store the level detector.

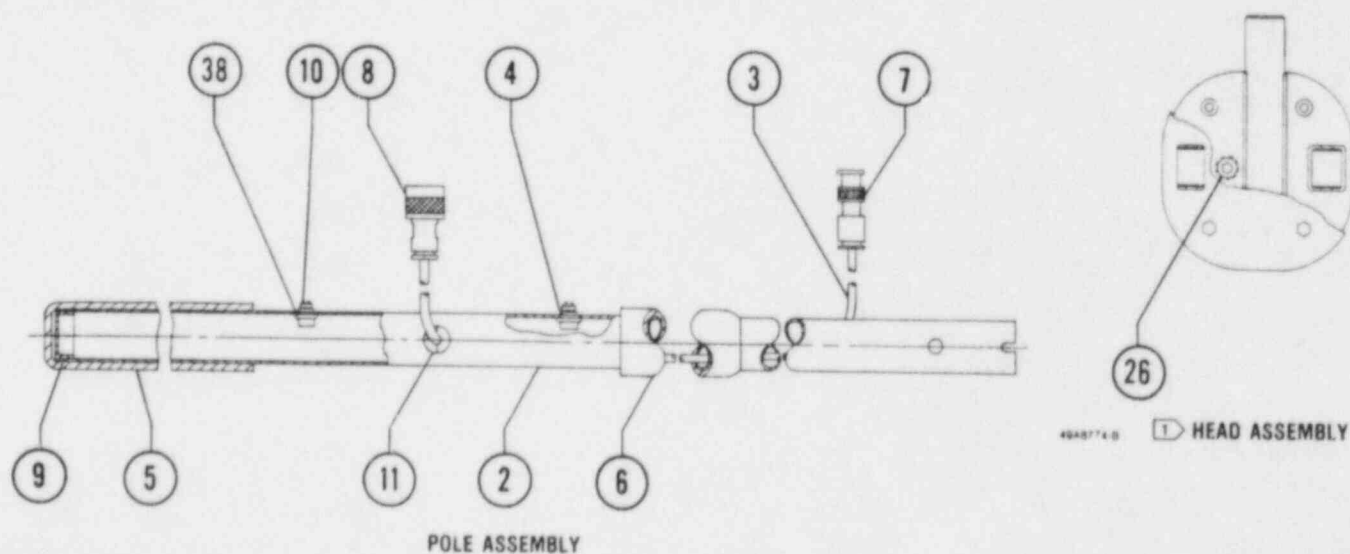
Parts Ordering

When corresponding with the Fisher sales office or sales representative about this equipment, always provide the serial number of the level detector. When ordering replacement assemblies or replacement parts, refer to the 11-character part number of each assembly or part as found in the following parts list.



4248774-B

TYPE LD2220 LEVEL DETECTOR



4248774-B

1 HEAD ASSEMBLY

NOTE:

1 SEE FIGURE 9 FOR DETAIL OF INDIVIDUAL PARTS OF HEAD ASSEMBLY.

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Figure 8. Type LD2220 Level Detector Assembly

Parts List

Parts Kits

Pole Assembly
Kit includes keys 2 through
11 and 38 39A8769 X012

Head Assembly
Kit includes keys 12 through
30, 36 and 37 30B2651 X012

Type LD2220 Level
Detector

Key	Description	Part Number
1	Count Rate Meter, aluminum housing	39A8739 X012
2	Pole, aluminum/Tufram ⁽²⁾	29A8740 X012
3	Coaxial Cable, 58 U shielded	19A8770 X012
4	Blind Thread Insert, (2 req'd)	19A8745 X012
5	Rear Hand Grip, vinyl	19A8762 X012
6	Front Hand Grip, vinyl	19A8761 X012
7	MHV Connector	19A8756 X012
8	Type C Connector	19A8755 X012

Key	Description	Part Number	Key	Description	Part Number
9	Vent Cap	19A8771 X012	25 ⁽³⁾	Drive Screw, stainless steel (8 req'd)	
10	Fillister Screw, stainless steel (2 req'd)	1J8415 X0012	26 ⁽³⁾	Radiation Source, Americium 241-Beryllium, 200 millicuries	
11	Strain Relief Bushing, black nylon (2 req'd)	10B1476 X012	27 ⁽³⁾	Seal Wire	
12 ⁽³⁾	Handle Half-Head, aluminum/iridite ⁽⁴⁾		28 ⁽³⁾	Set Screw, stainless steel (2 req'd)	
13 ⁽³⁾	Source Half-Head, aluminum/iridite		29 ⁽³⁾	Detector Tube, stainless steel housing	
14 ⁽³⁾	Head Cover, aluminum		30 ⁽³⁾	Serial Tag, stainless steel (2 req'd)	
15 ⁽³⁾	Lock Assembly, stainless steel		31	Storage Container, (Not shown)	19A8775 X012
16 ⁽³⁾	Roller, TFE (2 req'd)		32	Head Phones, (Not shown)	19A8776 X012
17 ⁽³⁾	Groove Pin, stainless steel (2 req'd)		33	Carrying Strap, (Not shown)	19A8777 X012
18 ⁽³⁾	Wave Spring Washer, stainless steel (2 req'd)		34	Lower Packing Foam (Not shown)	10B2151 X012
19 ⁽³⁾	Flat Washer, 316 stainless steel		35	Upper Packing Foam (Not shown)	10B2056 X012
20 ⁽³⁾	Shield, cadmium foil		36 ⁽³⁾	Adhesive, vinyl (Not shown)	
21 ⁽³⁾	Retainer, stainless steel		37 ⁽³⁾	Swage Standoff (4 req'd) (Not shown)	
22 ⁽³⁾	Fillister Screw, stainless steel (2 req'd)		38	Lock Washer, stainless steel (2 req'd) (Not shown)	14A9439 X012
23 ⁽³⁾	Drilled Head Screw, stainless steel (4 req'd)				
24 ⁽³⁾	Warning Nameplate, aluminum				

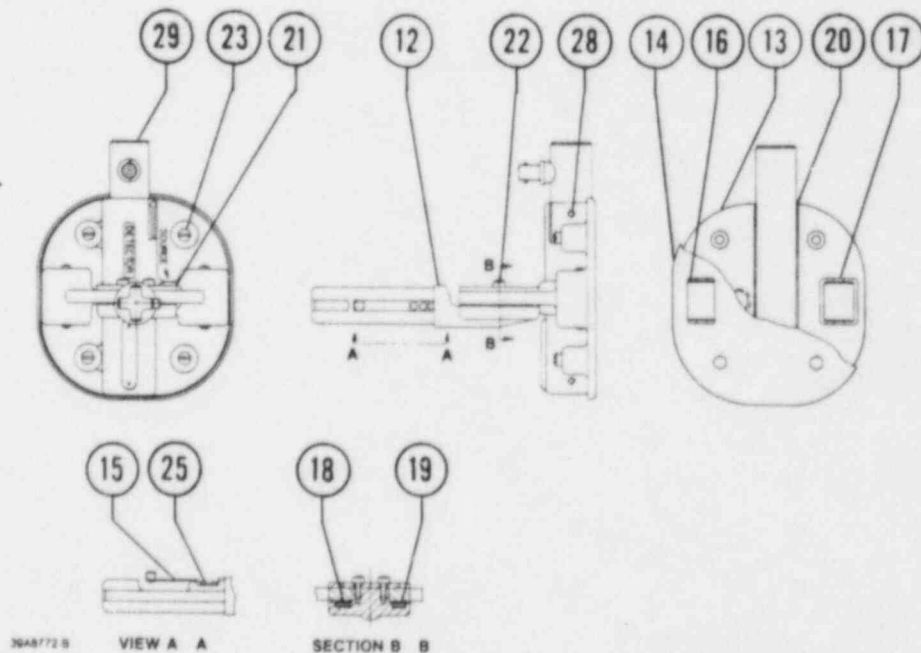


Figure 9. Head Assembly for Type LD2220 Level Detector

2. Trademark of American Magnaplate, Inc.

3. This part is replaceable only as part of a new head assembly, therefore no part number is shown.

4. Trademark of Witco Chemical Corp.

While this information is presented in good faith and believed to be accurate, Fisher Controls does not guarantee satisfactory results from reliance upon such information. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding the performance,

merchantability, fitness or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Fisher Controls reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

Fisher Controls

April 1985

Bulletin 15.2:LD2220

The Type LD2220 Level Detector (figure 1) is a light-weight, hand-held, portable device that enables the user to determine the levels of foams, liquids, solids, and other substances without intrusion into the vessel. By use of the neutron backscatter measurement principle (see the Principle of Operation section), this level detector can penetrate even heavy-walled vessels with fast neutrons to help determine the location of a liquid or solid level.

The Type LD2220 Level Detector gives accurate measurements for all common substances which contain hydrogen, such as water, hydrocarbons, acids, bases, and most organic liquids¹. The level can normally be located to within one inch (25.4 mm) on most vessels. Such accuracy makes the level detector ideal for use in the chemical, power, pulp and paper, refining, oil production, and other process industries.

Features

- **Level Detection is Non-Contacting and Non-Intrusive**—Neutron backscatter measurement principle allows detection of the process fluid or solid level from outside the process vessel. Analog and audio signal changes indicate level position.
- **No Installation or Calibration Required**—The level detector is ready for immediate operation as received. No installation or calibration is required.
- **Suitable for Almost Any Vessel Size and Type**—The portable, light-weight level detector allows hand-held operation by a single user to detect levels in almost any size and type of process vessel. And, because it is portable, the level detector can be used on any number of different vessels at a single location.

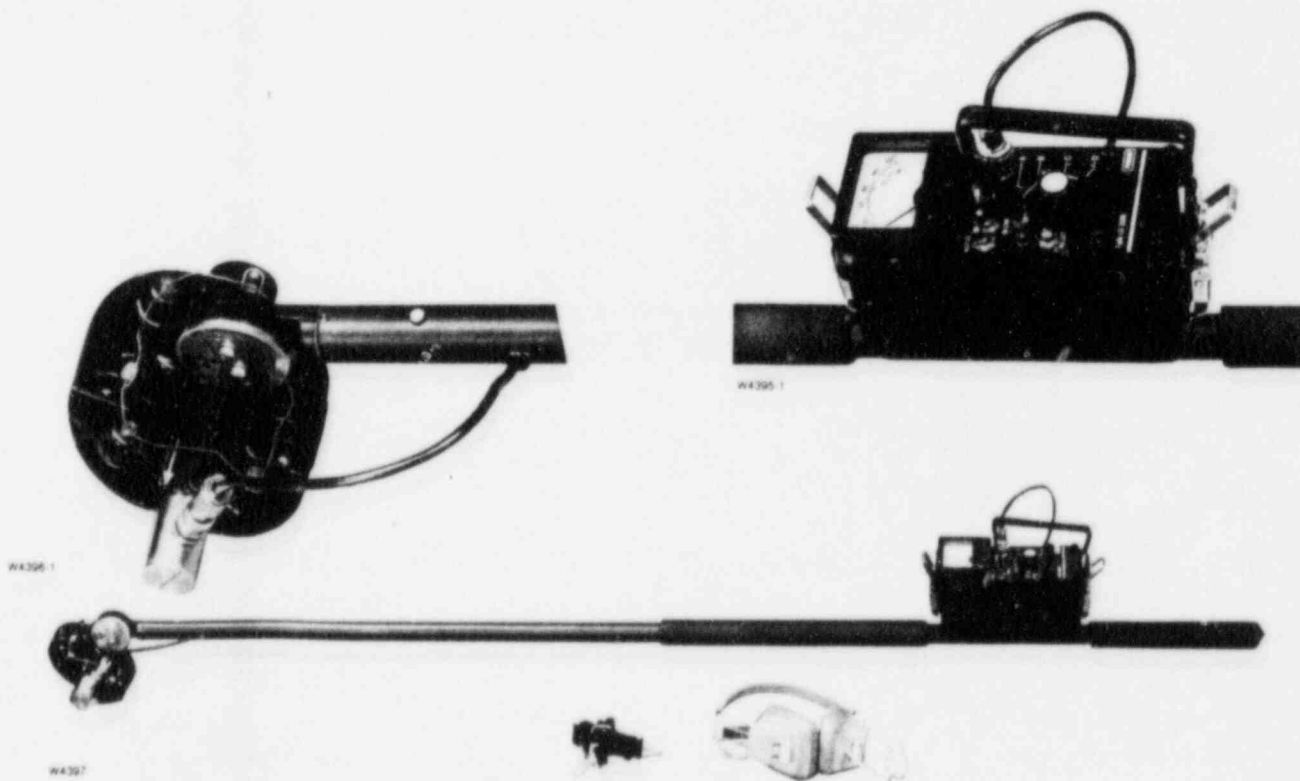


Figure 1. Type LD2220 Level Detector

1. If the process material to be measured contains cadmium, lithium, or boron, contact the Fisher sales office or sales representative.

Specifications

RADIOACTIVE SOURCE	Americium 241-Beryllium, 200 millicuries	VESSEL WALL TEMPERATURE LIMITS	- 112 to 500°F (- 80 to 260°C)
RADIATION LEVEL AT OPERATOR END OF DEVICE	0.47 mRem/hr	OPERATIVE AMBIENT TEMPERATURE LIMITS⁽²⁾	- 112 to 221°F (- 80 to 105°C)
METER LINEARITY	± 5 percent of full scale	CONSTRUCTION MATERIALS	Detector Housing: Stainless steel Head Assembly: Irridite ⁽³⁾ coated cast aluminum with hard epoxy paint Pole Assembly: Anodized, drawn aluminum tubing Count Rate Meter Housing: Drawn aluminum housing and cast aluminum cover with hard epoxy paint Hand Grips: Vinyl Cable: 58/U shielded, coaxial cable
METER POWER SUPPLY	Two D-cell batteries (approximately 100 hours of operation) furnished with the level detector	APPROXIMATE WEIGHT	7 pounds (3.2 kg)
METER RESPONSE TIME	3 or 11 seconds		
MEASUREMENT ACCURACY	± 0.5 inches (13 mm)		
MAXIMUM ALLOWABLE VESSEL WALL THICKNESS⁽¹⁾	6 inches (152 mm)		
MINIMUM ALLOWABLE VESSEL DIAMETER	2 inches (51 mm)		

1. Total wall thickness includes insulation, jackets, etc. For more information on total wall thickness, contact your Fisher sales office or sales representative.

2. This term is defined in ISA Standard 51.1-1979.
3. Trademark of Witco Chemical Corp.

● **Multi-Vessel Capability**—Because it is portable, the level detector can be used on any number of different vessels at a single location.

● **Highly Responsive and Accurate Measurement Indication**—Response time for level detection occurs within seconds. Levels can normally be located to within one inch (25.4 mm) for most processes.

● **Rugged Design**—Rugged design includes weather-resistant electronics assembly, corrosion-resistant construction materials, and cast aluminum housing for the radioactive source and detector. Power is supplied by two standard flashlight batteries.

● **Easy to Operate**—Pivoting head assembly with rollers (figure 2) allows rotation of the radioactive source for operational ease. The head assembly can also be turned sideways for ease of operation in special cases, such as for tanks with winding staircases.

● **No Process Shutdowns for Level Controller Calibration**—The portable level detector permits onstream calibration of process control equipment.

● **Radioactivity Protection**—Radioactive material is enclosed in a double-encapsulated, stainless steel housing. Emitted radiation levels at the operator end of the device are 0.47 mRem/hr, which is well below the 2.0 mRem/hr limit established by the Nuclear Regulatory Commission for unrestricted areas. The Type LD2220 level detector is shipped in a storage case that also serves as a storage container when the device is not in use.

● **Field Tests and Operator Training Available**—Field demonstrations are available for any intended users of the device. Training materials that depict proper operation of the level detector and basics in radiation safety are also available. A training manual that outlines basic radiation characteristics as well as safety and regulatory considerations is supplied with the product.

● **Restricted Zone of Radiation**—Depth of radiation transmission within the liquid or solid in a vessel for neutron backscatter measurement is usually no more than 6 inches (152 mm). This is a significant advantage over other types of level detection, most of which require transmitting radiation across the entire width of the process vessel.

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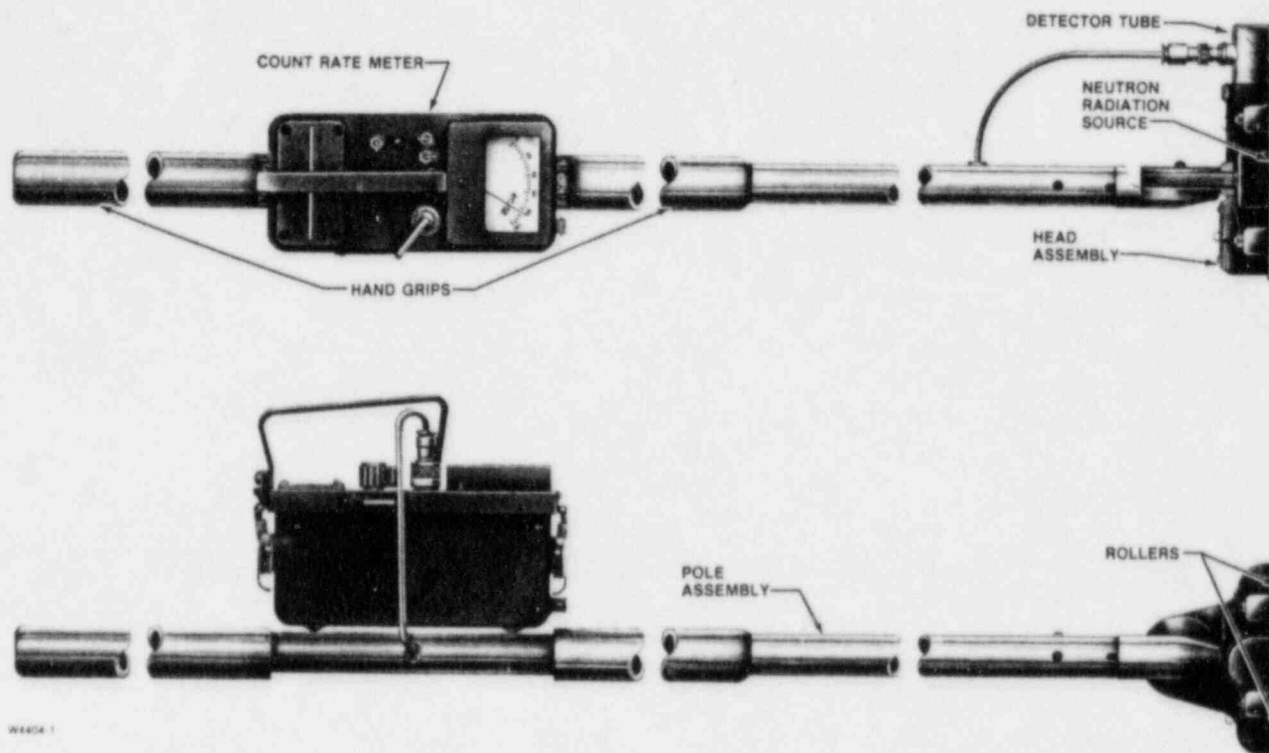


Figure 2. Type LD2220 Level Detector

Application Information

A specific materials license is required to possess and use the Type LD2220 Level Detector. Licensing information and applications for this license can be obtained from your Fisher sales office or sales representative or from your local regulatory agency.

Use of the Type LD2220 Level Detector is restricted to trained personnel who are instructed in the safe use and proper handling of the device. Fisher Controls provides a training program for designated personnel. A representative from Fisher Controls will be available to provide a field demonstration for any intended users of the device. Fisher Controls also offers:

- Training accessories that depict proper operation of the level detector,
- Training accessories that present basics in radiation safety, and
- A training manual, supplied with each product, that outlines basic radiation characteristics as well as safety and regulatory considerations.

When not in use, the Type LD2220 Level Detector must be stored in a secure area that is not accessible to the general public. The level detector is shipped in a storage case that also serves as a storage container when the

device is not in use. Dimensions for the level detector are shown in figure 4, and dimensions for the storage case are shown in figure 5.

Principle of Operation

The Type LD2220 level detector (shown in figure 3) consists of a sealed radioactive source mounted as an assembly next to a helium-3 slow neutron detector tube. The source-detector assembly is located at one end of a 5 foot (1.5 meter) aluminum pole assembly; the count rate meter and the operator hand grips are located at the opposite end.

The radioactive source of the level detector emits fast neutrons which can penetrate the wall of an enclosed vessel. When the source-detector assembly is moved along the outside wall of a vessel, the fast neutrons penetrate the vessel wall and enter approximately 6 inches (152 mm) inside the vessel. If no hydrogen atoms are contacted by the fast-neutrons when they enter the vessel, no signal is generated by the detector. When the source is moved below the level of a hydrogen-containing substance (liquid level), the fast neutrons interact with the hydrogen atoms in the liquid and lose energy. During this process some of the neutrons are reflected back (or backscattered) out of the vessel as slow neutrons to which the detector is highly sensitive.

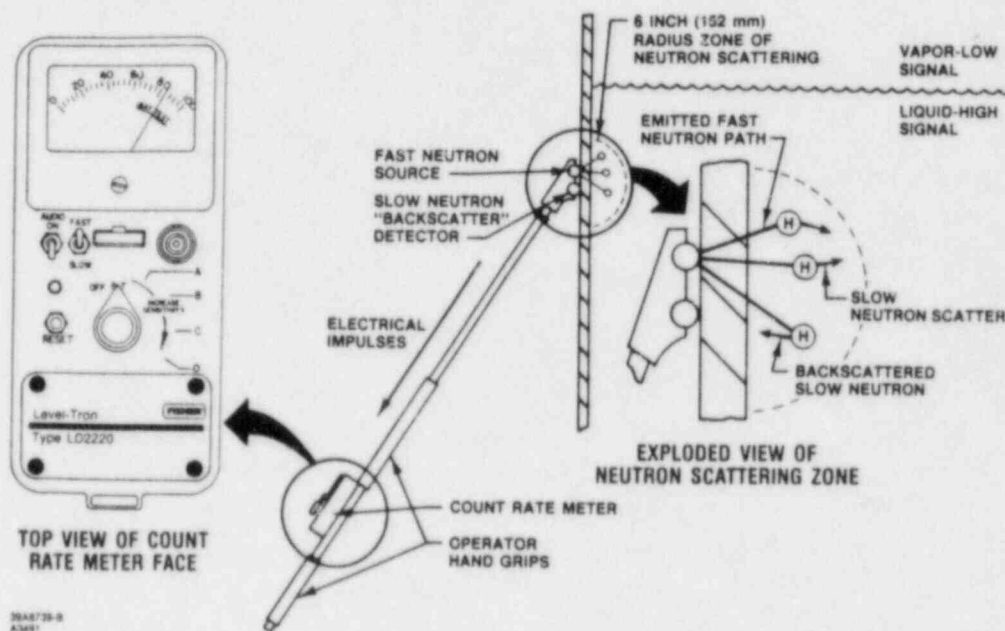


Figure 3. Operational Schematic

The number of slow neutrons backscattered to the level detector gives a signal which is directly related to the hydrogen density of the substances contained inside the vessel. Substances having different hydrogen densities give different signals and therefore an abrupt signal change occurs when a level is passed. Electrical impulses corresponding to the rate of slow neutrons passing through the detector tube are relayed from the detector tube to the battery-powered count rate meter. These impulses give both an analog and audio signal indication of the count rate and therefore they are an indication of level detection. The level can normally be determined to within one inch (25.4 mm) for most vessels. Level detection is not affected by operating conditions such as temperature or pressure inside the vessel.

Ordering Information

When ordering, specify:

- Description of process fluid or solid (Include chemical analysis if available),

- Type of process to measure,
- Thickness of vessel wall and tank wall material (Include any insulation, jackets, or special configurations),
- Vessel diameter,
- Vessel wall temperature range (if known), and
- Ambient temperature range.

Note

Special rules apply to the transportation and shipment of radioactive materials. It is the policy of Fisher Controls Company to comply with the rules and regulations published by the United States Department of Transportation when shipping any packages containing radioactive substances.

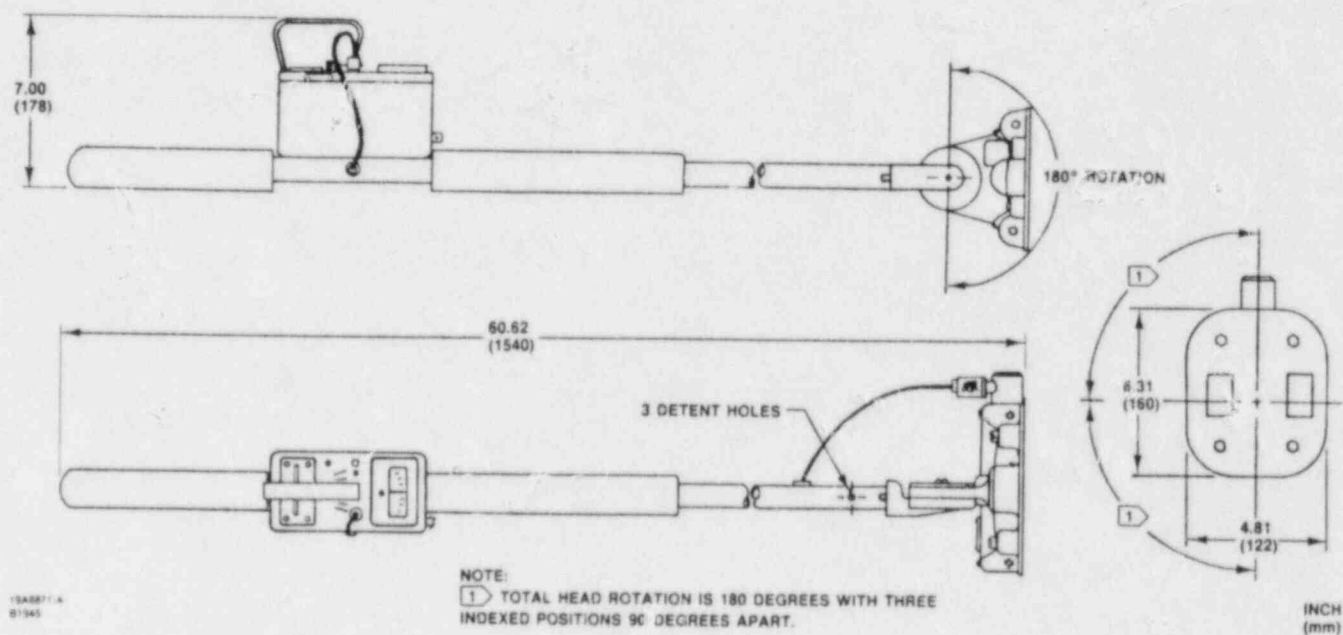


Figure 4. Type LD2220 Level Detector Dimensions

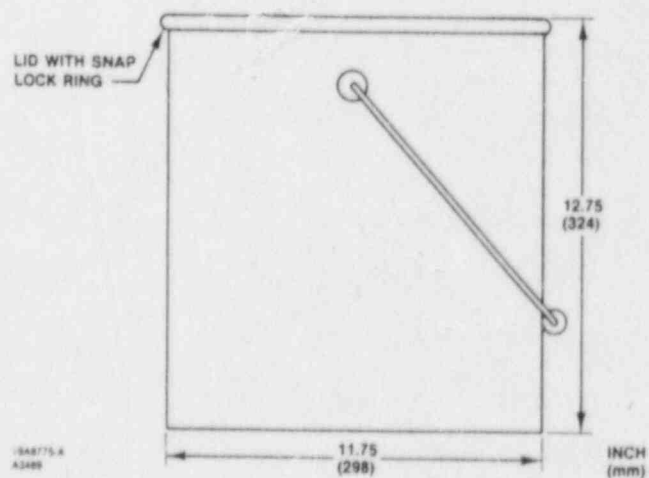


Figure 5. Storage Case Dimensions

LD 2220 PORTABLE LEVEL DETECTOR

TRAINING GUIDE

This advance information is being released prior to final publication. Training Manual Form 5606 is scheduled for distribution this summer.

TRAINING GUIDE

Use of the Type LD2220 is restricted to trained personnel who have been instructed in the safe use and proper handling of the device. Fisher Controls provides a training program for individuals responsible for radiation safety programs and designated personnel. The training package includes a video "Radiation Safety Training" and a training manual that presents basics in radiation characteristics, safety and regulatory concerns. For personnel already knowledgeable in radiation theory, the Fisher radiation safety training is not required. Their background and/or training must, however, be stated in the application for license (or amendment). Anyone who intends to use the device must receive training in the safe use and operation of the device. The Type LD2220 Instruction Manual is a good reference and contains many safety and application guidelines. It should be reviewed thoroughly by any intended users. A video, "Introduction to the LD2220," is also available which reviews some safety information as well as demonstrating how to safely operate the device. A training certificate is presented to individuals who receive the training and demonstrate an understanding of radiation principles and the safe use and operation of the LD2200. A representative of Fisher Controls is available to provide a field demonstration.

The individual responsible for the radiation safety program at a site must be trained by a trained representative of Fisher Controls. That individual may, in turn, present a short orientation course to qualify technicians as users.

In summary, proper training for the LD2220 involves:

1. Viewing "Radiation Safety Training" and reviewing the questions and answers as presented in the video; or have prior radiation knowledge.
2. Viewing "Introduction to the LD2220."
3. Reading the Type LD2220 Instruction Manual.

This training must be under the supervision of a trained representative of Fisher Controls.

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT _____
HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTA-
TIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN
UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE
TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS
ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS
DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES.
THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES
OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT
AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS
OF RADIATION. _____ IS QUALIFIED TO USE
OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE
LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: _____

TITLE: _____

DATE: _____

LD2220 PORTABLE LEVEL DETECTOR

Records Packet

This advance information is being released prior to final publication. Training Manual Form 5606 is scheduled for distribution this summer.

Records Packet

State and federal regulations require radioactive materials licensees to retain certain documents and post others. Here is a listing of the documents involved; examples of each are attached.

TO BE KEPT ON FILE:

- o Copy of the specific materials license obtained from appropriate Regional NRC or agreement state agency.
- o Special form certificate that is shipped with the device.
- o Training certificates for the radiation safety officer and all authorized users.
- o Semiannual wipe test records. A wipe test must be made 6 months (max.) from the date of receipt of the device, see the Instruction Manual for details. Records of this and each subsequent semi-annual test must be retained.
- o Transfer records. If device is transported to other locations, a transfer "log" must be kept.

TO BE POSTED OR KEPT ON FILE:

- o LD2220 Instruction Manual - shipped with the device
- o U.S.N.R.C., Title 10, Chapter 1, Code of Federal Regulations*
 - Part 19 - "Notices, Instructions, and Reports to Workers; Inspections"
 - Part 20 - "Standards for Protection Against Radiation"

* or comparable Agreement State regulations

TO BE POSTED:

- o U.S.N.R.C. Form 3 - "Notice to Employees"



UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSPECTIONS AND REPORTS TO WORKERS, INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The Nuclear Regulatory Commission (NRC) in its Rules and Regulations, Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC. Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities, Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas.
2. Measures to be taken after accidental exposure.
3. Personnel monitoring, surveys and equipment.
4. Caution signs, labels, and safety interlock equipment.
5. Exposure records and reports.
6. Options for workers regarding NRC inspections.
7. Identifies "protected activities" that employees may engage in.
8. Prohibits discrimination against employees who engage in these protected activities.
9. Identifies the Department of Labor as a source of relief in the event of discrimination, and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written

report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.

2. If you work where personnel monitoring is required pursuant to Section 20.202:
 - (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
 - (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regula-

tions issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred due to engaging in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation

and shall, where discrimination has occurred, issue an order providing relief to the employee if relief is not provided by other means of settlement.

PROTECTION OF INSPECTORS

The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal law covering the safety of licensed facilities or the safety of radioactive materials. The acts described above are criminal not only if taken against inspection personnel who are engaged in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

SABOTAGE OF NUCLEAR FACILITIES OR FUEL

The amended Atomic Energy Act, section 236, provides criminal penalties against any individual who intentionally and willfully destroys or causes physical damage, or attempts to do so to any production, utilization, or waste storage facility licensed under the act, or any nuclear fuel or spent fuel regardless of location.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.



Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 831 Park Avenue King of Prussia, PA 19406	215 337 5000
II	U.S. Nuclear Regulatory Commission Region II 101 Marietta St., N.W., Suite 3100 Atlanta, GA 30303	404 221 4603
III	U.S. Nuclear Regulatory Commission Region III 790 Roosevelt Road Glen Ellyn, IL 60137	312 832 2500
IV	U.S. Nuclear Regulatory Commission Region IV 811 Ryan Plaza Drive, Suite 1000 Arlington, TX 76012	817 486 8100
V	U.S. Nuclear Regulatory Commission Region V 1465 Maria Lane, Suite 210 Walnut Creek, CA 94596	415 943 3700



GAMMATRON INC.

P.O. BOX 34042 • HOUSTON, TEXAS 77034 • AREA CODE 713/641-0391

SEALED SOURCE CERTIFICATE

1. PURCHASER FISHER CONTROLS P.O. # 59820

2. MANUFACTURER GAMMATRON, INC.

3. MODEL AN-HP SERIAL # F-03

4. ACTIVE MATERIAL Am-241 Be

MAXIMUM CONTENT 200 mCi

MINIMUM CONTENT 180 mCi

ACTUAL CONTENT BASED ON WEIGHT INPUT AND
CI/GRAM AS SUPPLIED BY ORNL $\pm 1\%$ 198 mCi

YIELD:

STD _____

GAMMATRON STD F-01 = 5.72 X 10 NPS

SERIAL # F-03 = 5.72 X 10 NPS $\pm 7.5\%$

5. THIS IS TO CERTIFY THAT THIS SOURCE MEETS THE REQUIREMENTS FOR SPECIAL FORM AS DEFINED IN DOT
TITLE 49 (173.398) AND THE REQUIREMENTS OF:

ANSI CLASSIFICATION 56535 SIGNATURE [Signature]

TEXAS REGULATIONS PART 36.108 N/A SIGNATURE _____

6. MATERIAL OF CONSTRUCTION 304SS

7. WIPE TEST:

INNER CAPSULE .005 uCi

OUTER CAPSULE .0005 uCi DATE 11/12/84

BY [Signature]

8. HELIUM TEST NEG INNER NEG OUTER _____

9. PRESSURE TEST N/A WT. N/A FINAL OUT _____

10. CONTAINER WIPE TEST .0005 uCi

11. TYPE 7A SERIAL # 10H-A

12. SURFACE 80 INDEX 4 LABEL III

Fisher Controls
Marshalltown, Iowa 50158

Attention: Donna Bresin

This is to certify that the wipe tests of the NBS-1 serial number 109 source and holder made in December 1984 showed no radioactivity.

The cellulose wipes were radioassayed by liquid scintillation spectrometry with a detection sensitivity of 1×10^{-5} μCi .

Royal H. Benson

QUALIFICATION STATEMENT

FISHER CONTROLS, HEREBY CERTIFIES THAT _____
HAS RECEIVED TRAINING FROM AN AUTHORIZED REPRESENTA-
TIVE OF FISHER CONTROLS AND HAS DEMONSTRATED AN
UNDERSTANDING OF THE SAFE USE AND OPERATION OF THE
TYPE LD 2220 PORTABLE LEVEL DETECTOR. HE/SHE HAS
ALSO RECEIVED TRAINING IN RADIATION BASICS AND HAS
DEMONSTRATED AN UNDERSTANDING OF THOSE PRINCIPLES.
THE TRAINING HAS COVERED PRINCIPLES AND PRACTICES
OF RADIATION PROTECTION, RADIOACTIVITY MEASUREMENT
AND MONITORING TECHNIQUES AND BIOLOGICAL EFFECTS
OF RADIATION. _____ IS QUALIFIED TO USE
OR SUPERVISE THE USE OF THE FISHER CONTROLS TYPE
LD 2220 PORTABLE LEVEL DETECTOR.

FISHER CONTROLS INTERNATIONAL, INC.

BY: _____

TITLE: _____

DATE: _____

UNITED STATES NUCLEAR REGULATORY COMMISSION
RULES and REGULATIONS

TITLE 10, CHAPTER 1, CODE OF FEDERAL REGULATIONS—ENERGY

**PART
19**

**NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS;
INSPECTIONS**

Sec.

- 19.1 Purpose.
- 19.2 Scope.
- 19.3 Definitions.
- 19.4 Interpretations.
- 19.5 Communications.
- 19.11 Posting of notices to workers.
- 19.12 Instructions to workers.
- 19.13 Notifications and reports to individuals.
- 19.14 Presence of representatives of licensees and workers during inspections.
- 19.15 Consultation with workers during inspections.
- 19.16 Requests by workers for inspections.
- 19.17 Inspections not warranted; informal review.
- 19.30 Violations.
- 19.31 Application for exemptions.
- 19.32 Discrimination prohibited.

Authority: Secs. 53, 63, 81, 103, 104, 161, 166, 86 Stat. 930, 933, 935, 936, 937, 948, 955, as amended; sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2073, 2083, 2111, 2133, 2134, 2201, 2236, 2282); sec. 201, 86 Stat. 1242, as amended by Pub. L. 94-79, 89 Stat. 413 (42 U.S.C. 5841); Pub. L. 95-601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273): §§ 19.11(a), (c), (d), and (e) and 19.12 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); and §§ 19.13 and 19.14(a) are issued under sec. 161a, 68 Stat. 950, as amended (42 U.S.C. 2201(a)).

§ 19.1 Purpose.

The regulations in this part establish requirements for notices, instructions, and reports by licensees to individuals participating in licensed activities, and options available to such individuals in connection with Commission inspections of licensees to ascertain compliance with the provisions of the Atomic Energy Act of 1954, as amended, Title II of the Energy Reorganization Act of 1974, and regulations, orders, and licenses thereunder regarding radiological working conditions.

§ 19.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed by the Nuclear Regulatory Commission pursuant to the regulations in Parts 30 through 35, 40, 60, 61, 70 or 72 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter and persons licensed to possess power reactor spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter.

§ 19.3 Definitions.

As used in this part:

- (a) "Act" means the Atomic Energy Act of 1954, (68 Stat. 919) including any amendments thereto;
- (b) "Commission" means the United States Nuclear Regulatory Commission;
- (c) "Worker" means an individual engaged in activities licensed by the Commission and controlled by a licensee, but does not include the licensee.

(d) "License" means a license issued under the regulations in Parts 30 through 35, 40, 60, 61, 70 or 72 of this chapter, including licenses to operate a production or utilization facility pursuant to Part 50 of this chapter and licenses to possess power reactor spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter. "Licensee" means the holder of such a license.

(e) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

§ 19.4 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 19.5 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street, NW., Washington, D.C.; or at 7920 Norfolk Avenue, Bethesda, Maryland.

§ 19.11 Posting of notices to workers.

(a) Each licensee shall post current copies of the following documents: (1) The regulations in this part and in Part 20 of this chapter; (2) the license, license conditions, or documents incorporated into a license by reference, and amendments thereto; (3) the operating procedures applicable to licensed activities; (4) any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to Subpart B of Part 2 of this chapter, and any response from the licensee.

(b) If posting of a document specified in paragraph (a) (1), (2) or (3) of this section is not practicable, the licensee may post a notice which describes the document and states where it may be examined.

(c) Each licensee and applicant shall post Form NRC-3, (Revision 8-82 or later) "Notice to Employees," as required by Parts 30, 40, 50, 60, 70, 72, and 150 of this chapter.

(d) Documents, notices, or forms posted pursuant to this section shall appear in a sufficient number of places to permit individuals engaged in licensed activities to observe them on the way to or from any particular licensed activity location to which the document applies, shall be conspicuous, and shall be replaced if defaced or altered.

(e) Commission documents posted pursuant to paragraph (a) (4) of this section shall be posted within 2 working days after receipt of the documents from the Commission; the licensee's response, if any, shall be posted within 2 working days after dispatch by the licensee. Such documents shall remain posted for a minimum of 5 working days or until action correcting the violation has been completed, whichever is later.

§ 19.12 Instructions to workers.

All individuals working in or frequenting any portion of a restricted area shall be kept informed of the storage, transfer, or use of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the health protection problems associated with exposure to such radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed; shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of Commission regulations

PART 19 • NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

and licenses for the protection of personnel from exposures to radiation or radioactive materials occurring in such areas; shall be instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of Commission regulations and licenses or unnecessary exposure to radiation or to radioactive material; shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and shall be advised as to the radiation exposure reports which workers may request pursuant to § 19.13. The extent of these instructions shall be commensurate with potential radiological health protection problems in the restricted area.

§ 19.13 Notifications and reports to individuals.

(a) Radiation exposure data for an individual, and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual, shall be reported to the individual as specified in this section. The information reported shall include data and results obtained pursuant to Commission regulations, orders or license conditions, as shown in records maintained by the licensee pursuant to Commission regulations. Each notification and report shall: be in writing; include appropriate identifying data such as the name of the licensee, the name of the individual, the individual's social security number; include the individual's exposure information; and contain the following statement:

This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 CFR Part 19. You should preserve this report for further reference.

(b) At the request of any worker, each licensee shall advise such worker annually of the worker's exposure to radiation or radioactive material as shown in records maintained by the licensee pursuant to § 20.401(a) and (c).

(c) At the request of a worker formerly engaged in licensed activities controlled by the licensee, each licensee shall furnish to the worker a report of the worker's exposure to radiation or radioactive material. Such report shall be furnished within 30 days from the time the request is made, or within 30 days after the exposure of the individual has been determined by the licensee, whichever is later; shall cover, within the period of time specified in the request, each calendar quarter in which the worker's activities involved exposure to radiation from radioactive materials licensed by the Commission; and shall include the dates and locations of licensed activities in which the worker participated during this period.

(d) When a licensee is required pursuant to § 20.405 or § 20.408 of this chapter to report to the Commission any exposure of an individual to radiation or radioactive material the licensee shall also provide the individual a report on his exposure data included therein. Such

report shall be transmitted at a time not later than the transmittal to the Commission.

(e) At the request of a worker who is terminating employment in a given calendar quarter with the licensee in work involving radiation dose, or of a worker who, while employed by another person, is terminating assignment to work involving radiation dose in the licensee's facility in that calendar quarter, each licensee shall provide to each such worker, or to the worker's designee, at termination, a written report regarding the radiation dose received by that worker from operations of the licensee during that specifically identified calendar quarter or fraction thereof, or provide a written estimate of that dose if the finally determined personnel monitoring results are not available at that time. Estimated doses shall be clearly indicated as such.

§ 19.14 Presence of representatives of licensees and workers during inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect materials, activities, facilities, premises, and records pursuant to the regulations in this chapter.

(b) During an inspection, Commission inspectors may consult privately with workers as specified in § 19.15. The licensee or licensee's representative may accompany Commission inspectors during other phases of an inspection.

(c) If, at the time of inspection, an individual has been authorized by the workers to represent them during Commission inspections, the licensee shall notify the inspectors of such authorization and shall give the workers' representative an opportunity to accompany the inspectors during the inspection of physical working conditions.

(d) Each workers' representative shall be routinely engaged in licensed activities under control of the licensee and shall have received instructions as specified in § 19.12.

(e) Different representatives of licensees and workers may accompany the inspectors during different phases of an inspection if there is no resulting interference with the conduct of the inspection. However, only one workers' representative at a time may accompany the inspectors.

(f) With the approval of the licensee and the workers' representative an individual who is not routinely engaged in licensed activities under control of the licensee, for example, a consultant to the licensee or to the workers' representative, shall be afforded the opportunity to accompany Commission inspectors during the inspection of physical working conditions.

(g) Notwithstanding the other provisions of this section, Commission inspectors are authorized to refuse to permit accompaniment by any individual who

deliberately interferes with a fair and orderly inspection. With regard to areas containing information classified by an agency of the U.S. Government in the interest of national security, an individual who accompanies an inspector may have access to such information only if authorized to do so. With regard to any area containing proprietary information, the workers' representative for that area shall be an individual previously authorized by the licensee to enter that area.

§ 19.15 Consultation with workers during inspections.

(a) Commission inspectors may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of Commission regulations and licenses to the extent the inspectors deem necessary for the conduct of an effective and thorough inspection.

(b) During the course of an inspection any worker may bring privately to the attention of the inspectors, either orally or in writing, any past or present condition which he has reason to believe may have contributed to or caused any violation of the act, the regulations in this chapter, or license condition, or any unnecessary exposure of an individual to radiation from licensed radioactive material under the licensee's control. Any such notice in writing shall comply with the requirements of § 19.16(a).

(c) The provisions of paragraph (b) of this section shall not be interpreted as authorization to disregard instructions pursuant to § 19.12.

§ 19.16 Requests by workers for inspections.

(a) Any worker or representative of workers who believes that a violation of the Act, the regulations in this chapter, or license conditions exists or has occurred in license activities with regard to radiological working conditions in which the worker is engaged, may request an inspection by giving notice of the alleged violation to the Director of Inspection and Enforcement, to the Director of the appropriate Commission Regional Office, or to Commission inspectors. Any such notice shall be in writing, shall set forth the specific grounds for the notice, and shall be signed by the worker or representative of workers. A copy shall be provided the licensee by the Director of Inspection and Enforcement, Regional Office Director,

or the inspector no later than at the time of inspection except that, upon the request of the worker giving such notice, his name and the name of individuals referred to therein shall not appear in such copy or on any record published, released, or made available by the Commission, except for good cause shown.

(b) If, upon receipt of such notice, the Director of Inspection and Enforcement or Regional Office Director determines that the complaint meets the requirements set forth in paragraph (a) of this section, and that there are reasonable grounds to believe that the alleged violation exists or has occurred, he shall cause an inspection to be made as soon as practicable, to determine if such alleged violation exists or has occurred. Inspections pur-

PART 19 • NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

suant to this section need not be limited to matters referred to in the complaint.

§ 19.17 Inspections not warranted; informal review.

(a) If the Director of Inspection and Enforcement or of the appropriate Regional

Office determines, with respect to a complaint under § 19.16, that an inspection is not warranted because there are no reasonable grounds to believe that a violation exists or has occurred, he shall notify the complainant in writing of such determination. The complainant may obtain review of such determination by submitting a written statement of position with the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, who will provide the licensee with a copy of such statement by certified mail, excluding, at the request of the complainant, the name of the complainant. The licensee may submit an opposing written statement of position with the Executive Director for Operations who will provide the complainant with a copy of such statement by certified mail. Upon the request of the complainant, the Executive Director for Operations or his designee may

hold an informal conference in which the complainant and the licensee may orally present their views. An informal conference may also be held at the request of the licensee, but disclosure of the identity of the complainant will be made only following receipt of written authorization from the complainant. After considering all written and oral views presented, the Executive Director for Operations shall affirm, modify, or reverse the determination of the Director of Inspection and Enforcement or of the appropriate Regional Office and furnish the complainant and the licensee a written notification of his decision and the reason therefor.

(b) If the Director of Inspection and Enforcement or of the appropriate Regional Office determines that an inspection is not warranted because the requirements of § 19.16(a) have not been met, he shall notify the complainant in writing of such determination. Such determination shall be without prejudice to the filing of a new complaint meeting the requirements of § 19.16(a).

§ 19.30 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder.

A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act or any rule, regulation, or order issued thereunder, or any term, condition or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

§ 19.31 Application for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 19.32 Discrimination prohibited.

No person shall on the ground of sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity licensed by the Nuclear Regulatory Commission. This provision will be enforced through agency provisions and rules similar to those already established, with respect to racial and other discrimination, under title VI of the Civil Rights Act of 1964. This remedy is not exclusive, however, and will not prejudice or cut off any other legal remedies available to a discriminatee.

§ 19.20 Employee protection.

Employment discrimination by a licensee or a contractor or subcontractor of a licensee against an employee for engaging in protected activities under this part or Parts 30, 40, 50, 60, 70, 72, or 150 of this chapter is prohibited.

UNITED STATES NUCLEAR REGULATORY COMMISSION

RULES and REGULATIONS

TITLE 10, CHAPTER 1, CODE OF FEDERAL REGULATIONS—ENERGY

PART 20

STANDARDS FOR PROTECTION AGAINST RADIATION

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

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AUTHORITY: Secs 53, 63, 65, 81, 103, 104, 161, 68 Stat. 930, 933, 935, 936, 937, 948, as amended, 42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201. For the purposes of sec. 223, 68 Stat. 958, as amended, 42 U.S.C. 2273, §§ 20.401-20.408, issued under sec. 1610, 68 Stat. 950, as amended, 42 U.S.C. 2201(c). Secs 202, 206, Pub. L. 93-438, 88 Stat. 1244, 1246 (42 U.S.C. 5842, 5846), unless otherwise noted.

SOURCE: 25 FR 10914, Nov. 17, 1960, unless otherwise noted.

NOMENCLATURE CHANGES: 40 FR 8783, Mar. 3, 1975; 45 FR 14200, Mar. 5, 1980.

GENERAL PROVISIONS

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission and are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974.

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that the total dose to an individual (including exposures to licensed and unlicensed radioactive material and to other unlicensed sources of radiation, whether in the possession of the licensee or any other person, but not including exposures to radiation from natural background sources or medical diagnosis and therapy) does not exceed the standards of radiation protection prescribed in the regulations in this part.

(c) In accordance with recommendations of the Federal Radiation Council, approved by the President, persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 should, in addition to complying with the requirements set forth in this

part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed pursuant to the regulations in Parts 30 through 35, 40, 60, 70, or 72 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter and persons licensed to possess power reactor spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter.

§ 20.3

§ 20.3 Definitions.

(a) As used in this part:

(1) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto;

(2) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases;

(3) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(4) "Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be such that no day is included in more than one calendar quarter or omitted from inclusion within a calendar quarter. No licensee shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

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(5) "Commission" means the Nuclear Regulatory Commission or its duly authorized representatives;

(6) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(7) "Individual" means any human being;

(8) "Licensed material" means source material, special nuclear material, or by-product material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter;

(9) "License" means a license issued under the regulations in Parts 30 through 35, 40, 60, 70, or 72 of this chapter. "Licensee" means the holder of such license;

(10) "Occupational dose" includes exposure of an individual to radiation (i) in a restricted area, or (ii) in the course of employment in which the individual's duties involve exposure to radiation, provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) "Person" means: (i) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department (except that the Department shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244)), any State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing.

(12) "Radiation" means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light;

(13) "Radioactive material" includes any such material whether or not subject to licensing control by the Commission;

(14) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

(15) "Source material" means: (i) Uranium or thorium, or any combination thereof, in any physical or chemical form; or (ii) ores which contain by weight one-twentieth of one percent (0.05%) or more of (a) uranium, (b) thorium or (c) any combination thereof. Source material does not include special nuclear material.

(16) "Special nuclear material" means: (i) Plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material;

(17) "Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

(18) "Department" means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 *et seq.*) to the extent that the Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233

at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

(19) "Termination" means the end of employment with the licensee or, in the case of individuals not employed by the licensee, the end of a work assignment in the licensee's restricted areas in a given calendar quarter, without expectation or specific scheduling of reentry into the licensee's restricted areas during the remainder of that calendar quarter.

(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) "Airborne radioactivity area" defined in § 20.203;

(2) "Radiation area" and "high radiation area" defined in § 20.202;

(3) "Personnel monitoring equipment" defined in § 20.202;

(4) "Survey" defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section.

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad)=0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem)=0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to be equivalent to a dose of one rem:

(1) A dose of 1 r due to X- or gamma radiation;

(2) A dose of 1 rad due to X-, gamma, or beta radiation;

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(3) A dose of 0.1 rad due to neutrons or high energy protons;

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye; If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in paragraph (c)(3) of this section, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

NEUTRON FLUX DOSE EQUIVALENTS

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm ²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm ² sec)
Thermal	970×10^4	670
0.0001	720×10^4	500
0.005	820×10^4	570
0.02	400×10^4	280
0.1	120×10^4	80
0.5	43×10^4	30
1.0	26×10^4	18
2.5	25×10^4	20
5.0	26×10^4	18
7.5	24×10^4	17
10	24×10^4	17
10 to 30	14×10^4	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies.

One curie = 3.7×10^{10} disintegrations per second (dps) = 2.2×10^{12} disintegrations per minute (dpm). Commonly used submultiples of the curie are the millicurie and the microcurie:

(1) One millicurie (mCi) = 0.001 curie (Ci) = 3.7×10^7 dps.

(2) One microcurie (μCi) = 0.000001 curie = 3.7×10^4 dps.

(b) [Deleted 40 FR 50704.]

(c) [Deleted 39 FR 23990.]

§ 20.6 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 20.7 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street, N.W., Washington, D.C.; or at 7920 Norfolk Avenue, Bethesda, Maryland.

PERMISSIBLE DOSES, LEVELS, AND CONCENTRATIONS

§ 20.101 Radiation dose standards for individuals in restricted areas.

(a) In accordance with the provisions of § 20.102(a), and except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation a total occupational dose in excess of the standards specified in the following table:

REMS PER CALENDAR QUARTER

1. Whole body, head and trunk, active blood-forming organs, lens of eyes, or gonads	15*
2. Hands and forearms, feet and ankles	18*
3. Skin of whole body	75*

(b) A licensee may permit an individual in a restricted area to receive a total occupational dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the total occupational dose to the whole body shall not exceed 3 rems; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday; and

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form NRC-4, or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

§ 20.102 Determination of prior dose.

(a) Each licensee shall require any individual, prior to first entry of the individual into the licensee's restricted area during each employment or work assignment under such circumstances that the individual will receive or is likely to receive in any period of one calendar quarter an occupational dose in excess of 25 percent of the applicable standards specified in § 20.101(a) and § 20.104(a), to disclose in a written, signed statement, either: (1) That the individual had no prior occupational dose during the current calendar quarter; or (2) the nature and amount of any occupational dose which the individual may have received during that specifically identified current calendar quarter from sources of radiation possessed or controlled by other persons. Each licensee shall maintain records of such statements until the Commission authorizes their disposition.

(b) Before permitting, pursuant to § 20.101(b), any individual in a restricted area to receive an occupational radiation dose in excess of the standards specified in § 20.101(a), each licensee shall:

(1) Obtain a certificate on Form NRC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form NRC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c)(1) In the preparation of Form NRC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains

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such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1— Assumed exposure in rems for calendar quarters prior to Jan. 1, 1961	Column 2— Assumed exposure in rems for calendar quarters beginning on or after Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3%	1%

(2) The licensee shall retain and preserve records used in preparing Form NRC-4 until the Commission authorizes their disposition.

If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

§ 20.103 Exposure of individuals to concentrations of radioactive materials in air in restricted areas.

(a)(1) No licensee shall possess, use, or transfer licensed material in such a manner as to permit any individual in a restricted area to inhale a quantity of radioactive material in any period of one calendar quarter greater than the quantity which would result from inhalation for 40 hours per week for 13 weeks at uniform concentrations of radioactive material in air specified in Appendix B, Table I, Column 1.¹²³ If

the radioactive material is of such form that intake by absorption through the skin is likely, individual exposures to radioactive material shall be controlled so that the uptake of radioactive material by any organ from either inhalation or absorption or both routes of intake¹²⁴ in any calendar quarter does not exceed that which would result from inhaling such radioactive material for 40 hours per week for 13 weeks at uniform concentrations specified in Appendix B, Table I, Column 1.

(2) No licensee shall possess, use, or transfer mixtures of U-234, U-235, and U-238 in soluble form in such a

manner as to permit any individual in a restricted area to inhale a quantity of such material in excess of the intake limits specified in Appendix B, Table I, Column 1 of this part. If such soluble uranium is of a form such that absorption through the skin is likely, individual exposures to such material shall be controlled so that the uptake of such material by any organ from

either inhalation or absorption or both routes of intake¹²⁴ does not exceed that which would result from inhaling such material at the limits specified in Appendix B, Table I, Column 1 and footnote 4 thereto.

(3) For purposes of determining compliance with the requirements of this section the licensee shall use suitable measurements of concentrations of radioactive materials in air for detecting and evaluating airborne radioactivity in restricted areas and in addition, as appropriate, shall use measurements of radioactivity in the body, measurements of radioactivity excreted from the body, or any combination of such measurements as may be necessary for timely detection and assessment of individual intakes of radioactivity by exposed individuals. It is assumed that an individual inhales radioactive material at the airborne concentration in which he is present unless he uses respiratory protective equipment pursuant to paragraph (c) of this section. When assessment of a particular individual's intake of radioactive material is necessary, intakes less than those which would result from inhalation for 2 hours in any one day or for 10 hours in any one week at uniform concentrations specified in Appendix B, Table I, Column 1 need not be included in such assessment, provided that for any assessment in excess of these amounts the entire amount is included.

(b)(1) The licensee shall, as a precautionary procedure, use process or other engineering controls, to the extent practicable, to limit concentrations of radioactive materials in air to levels below those which delimit an airborne radioactivity area as defined in § 20.203(d)(1)(ii).

(2) When it is impracticable to apply process or other engineering controls to limit concentrations of radioactive material in air below those defined in § 20.203(d)(1)(ii), other precautionary procedures, such as increased surveillance, limitation of working times, or provision of respiratory protective equipment, shall be used to maintain intake of radioactive material by any individual within any period of seven consecutive days as far below that intake of radioactive material which

would result from inhalation of such material for 40 hours at the uniform concentrations specified in Appendix B, Table I, Column 1 as is reasonably achievable. Whenever the intake of radioactive material by any individual exceeds this 40-hour control measure, the licensee shall make such evaluations and take such actions as are necessary to assure against recurrence.

The licensee shall maintain records of such occurrences, evaluations, and actions taken in a clear and readily identifiable form suitable for summary review and evaluation.

(c) When respiratory protective equipment is used to limit the inhalation of airborne radioactive material pursuant to paragraph (b)(2) of this section, the licensee shall use equipment that is certified or had certification extended by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA). The licensee may make allowance for this use of respiratory protective equipment in estimating exposures of individuals to this material provided that:

¹²³Since the concentration specified for tritium oxide vapor assumes equal intakes by skin absorption and inhalation, the total intake permitted is twice that which would result from inhalation alone at the concentration specified for H-3 in Appendix B, Table I, Column 1 for 40 hours per week for 13 weeks.

¹²⁴For radon-222, the limiting quantity is that inhaled in a period of one calendar year. For radioactive materials designated "Sub" in the "Isotope" column of the table, the concentration value specified is based

upon exposure to the material as an external radiation source. Individual exposures to these materials may be accounted for as part of the limitation on individual dose in § 20.101. These nuclides shall be subject to the precautionary procedures required by § 20.103(b)(1).

¹²⁵Multiply the concentration values specified in Appendix B, Table I, Column 1, by 6.3×10^4 ml to obtain the quarterly quantity limit. Multiply the concentration value specified in Appendix B, Table I, Column 1, by 2.5×10^4 ml to obtain the annual quantity limit for Rn-222.

¹²⁶Significant intake by ingestion or injection is presumed to occur only as a result of circumstances such as accident, inadvertence, poor procedure, or similar special conditions. Such intakes must be evaluated and accounted for by techniques and procedures as may be appropriate to the circumstances of the occurrence. Exposures so evaluated shall be included in determining whether the limitation on individual exposures in § 20.103(a)(1) has been exceeded.

¹²⁷Regulatory guidance on assessment of individual intakes of radioactive material is given in Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program," single copies of which are available from the Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, upon written request.

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(1) The licensee selects respiratory protective equipment that provides a protection factor greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in Appendix B, Table I, Column 1 of this part. The equipment so selected shall be used so that the average concentration of radioactive material in the air that is inhaled during any period of uninterrupted use in an airborne radioactivity area, on any day, by any individual using the equipment, does not exceed the values specified in Appendix B, Table I, Column 1 of this part. For the purposes of this paragraph, the concentration of radioactive material in the air that is inhaled when respirators are worn may be estimated by dividing the ambient concentration in air by the protection factor specified in Appendix A of this part. If the exposure is later found to be greater than estimated, the corrected value shall be used; if the exposure is later found to be less than estimated, the corrected value may be used.

(2) The licensee maintains and implements a respiratory protection program that includes, as a minimum: air sampling sufficient to identify the hazard, permit proper equipment selection and estimate exposures; surveys and bioassays as appropriate to evaluate actual exposures; written procedures regarding selection, fitting, and maintenance of respirators, and testing of respirators for operability immediately prior to each use; written procedures regarding supervision and training of personnel and issuance records; and determination by a physician prior to initial use of respirators, and at least every 12 months thereafter, that the individual user is physically able to use the respiratory protective equipment.

(3) A written policy statement on respirator usage shall be issued covering such things as: use of practicable engineering controls instead of respirators; routine, nonroutine, and emergency use of respirators; and periods of respirator use and relief from respirator use. The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that might require such relief.

(4) The licensee uses equipment within limitations for type and mode of use and provides proper visual, communication, and other special capabilities (such as adequate skin protection) when needed.

(d) Unless otherwise authorized by the Commission, the licensee shall not assign protection factors in excess of

those specified in Appendix A of this part in selecting and using respiratory protective equipment. The Commission may authorize a licensee to use higher protection factors on receipt of an application (1) describing the situation for which a need exists for higher protection factors, and (2) demonstrating that the respiratory protective equipment will provide these higher protection factors under the proposed conditions of use.

(e) Where equipment of a particular type has not been tested and certified, or had certification extended, by NIOSH/MSHA, or where there is no existing schedule for test and certification of certain equipment, the licensee shall not make allowance for this equipment without specific authorization by the Commission. An application for this authorization must include a demonstration by testing, or on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(f) Only equipment that has been specifically certified or had certification extended for emergency use by NIOSH/MSHA shall be used as emergency devices.

(g) The licensee shall notify, in writing, the Director of the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix D at least 30 days before the date that respiratory protective equipment is first used under the provisions of this section.

§ 20.104 Exposure of minors.

(a) No licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20.101.

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of §§ 20.103(b)(2) and 20.103(c) shall apply to exposures subject to paragraph (b) of this section except that the references in §§ 20.103(b)(2) and 20.103(c) to Appendix B, Table I, Column 1 shall be deemed to be references to Appendix B, Table II, Column 1.

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour, or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

(c) In addition to other requirements of this part, licensees engaged in uranium fuel cycle operations subject to the provisions of 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," shall comply with that part.

§ 20.106 Radioactivity in effluents to unrestricted areas.

(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix B, Table II of this part, except as authorized pursuant to § 20.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

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(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Commission will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix B, Table II of this part.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit;

(2) A description of the properties of the effluents, including:

(i) Chemical composition;

(ii) Physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) The hydrogen ion concentrations (pH) of liquid effluents; and

(iv) The size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year:

(i) In air at any point of human occupancy; or

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible recon-

centrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For the purposes of this section the concentration limits in Appendix B, Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Commission may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix B, Table II of this part.

(f) The provisions of paragraphs (a) through (e) of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by § 20.303.

(g) In addition to other requirements of this part, licensees engaged in uranium fuel cycle operations subject to the provisions of 40 CFR Part 190, "Environmental Radiation Protection Standard for Nuclear Power Operations," shall comply with that part.

§ 20.107 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

PRECAUTIONARY PROCEDURES

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as (1) may be necessary for the licensee to comply with the regulations in this part, and (2) are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present.

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:

(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

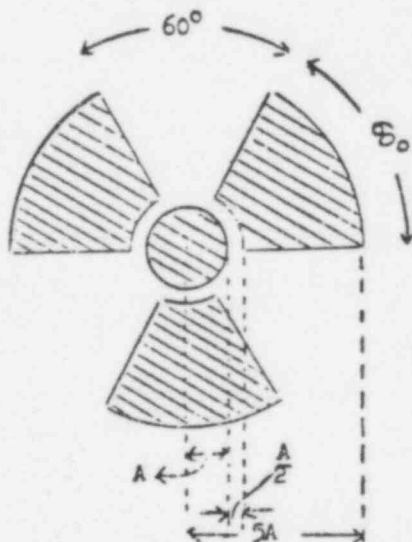
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§ 20.203 Caution signs, labels, signals and controls.

(a) **General.** (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) **Radiation areas.** Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

RADIATION AREA

(c) **High radiation areas.** (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

HIGH RADIATION AREA

Or "Danger"

(2) Each entrance or access point to a high radiation area shall be:

(i) Equipped with a control device which shall cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area; or

(ii) Equipped with a control device which shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering the high radiation area and the licensee or a supervisor of the activity are made aware of the entry; or

(iii) Maintained locked except during periods when access to the area is required, with positive control over each individual entry.

(3) The controls required by paragraph (c)(2) of this section shall be established in such a way that no individual will be prevented from leaving a high radiation area.

(4) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required by paragraph (c)(2) of this section.

(5) Any licensee, or applicant for a license, may apply to the Commission for approval of methods not included in paragraphs (c)(2) and (4) of this section for controlling access to high radiation areas. The Commission will approve the proposed alternatives if the licensee or applicant demonstrates that the alternative methods of control will prevent unauthorized entry into a high radiation area, and that the requirement of paragraph (c)(3) of this section is met.

(6) Each area in which there may exist radiation levels in excess of 500 rems in one hour at one meter from a sealed radio-active source² that is used to irradiate materials shall:

(i) Have each entrance or access point equipped with entry control devices which shall function automatically to prevent any individual from inadvertently entering the area when such radiation levels exist; permit deliberate entry into the area only after a control device is actuated that shall cause the radiation level within the area, from the sealed source, to be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and prevent operation of the source if the source would produce radiation levels in the area that could result in a dose to an individual in excess of 100 mrem in one hour. The entry control devices required by this paragraph (c)(6) shall be established in such a way that no individual will be prevented from leaving the area.

(ii) Be equipped with additional control devices such that upon failure of the entry control devices to function as required by paragraph (c)(6)(i) of this section the radiation level within the area, from the sealed source, shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make an individual attempting to enter the area aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of such failure of the entry control devices.

(iii) Be equipped with control devices such that upon failure or removal of physical radiation barriers other than the source's shielded storage container the radiation level from the source shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour; and visible and audible alarm signals shall be generated to make potentially affected individuals aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier. When the shield for the stored source is a liquid, means shall be provided to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding. Physical radiation barriers that com-

¹This paragraph (c)(6) does not apply to radioactive sources that are used in teletherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual. This paragraph (c)(6) also does not apply to sources from which the radiation is incidental to some other use nor to nuclear reactor generated radiation other than radiation from byproduct, source, or special nuclear materials that are used in sealed sources in non-self-shielded irradiators.

²These requirements apply after Mar. 14, 1978. Each person licensed to conduct activities to which this paragraph (c)(6) applies and who is not in compliance with the provisions of this paragraph on Mar. 14, 1978, shall file with the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, on or before June 14, 1978, information describing in detail the actions taken or to be taken to achieve compliance with this paragraph by Dec. 14, 1978, and may continue activities in conformance with present license conditions and the provisions of the previously effective § 20.203 until such compliance is achieved. For such persons compliance must be achieved not later than Dec. 14, 1978.

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prise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of this paragraph (c)(6)(iii).

(iv) Be equipped with devices that will automatically generate visible and audible alarm signals to alert personnel in the area before the source can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device which shall be installed in the area and which can prevent the source from being put into operation.

(v) Be controlled by use of such administrative procedure and such devices as are necessary to assure that the area is cleared of personnel prior to each use of the source preceding which use it might have been possible for an individual to have entered the area.

(vi) Be checked by a physical radiation measurement to assure that prior to the first individual's entry into the area after any use of the source, the radiation level from the source in the area is below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour.

(vii) Have entry control devices required in paragraph (c)(6)(i) of this section which have been tested for proper functioning prior to initial operation with such source of radiation on any day that operations are not interruptedly continued from the previous day or before resuming operations after any unintended interruption, and for which records are kept of the dates, times, and results of such tests of function. No operations other than those necessary to place the source in safe condition or to effect repairs on controls shall be conducted with such source unless control devices are functioning properly. The licensee shall submit an acceptable schedule for more complete periodic tests of the entry control and warning systems to be established and adhered to as a condition of the license.

(viii) Have those entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through such portals. Exit portals for processed materials shall be equipped to detect and signal the presence of loose radiation sources that are carried toward such an exit and to automatically prevent such loose sources from being carried out of the area.

(7) Licensees with, or applicants for, licenses for radiation sources that are within the purview of paragraph (c)(6) of this section, and that must be used in a variety of positions or in peculiar locations, such as open fields or forests, that make it impracticable to comply with certain requirements of paragraph (c)(6) of this section, such as those for the automatic control of radiation levels, may apply to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, for approval, prior to use of safety measures that are alternative to those specified in paragraph (c)(6) of this section, and that will provide at least an equivalent degree of personnel protection in the use of such sources. At least one of the alternative measures must include an entry-preventing interlock control based on a physical measurement of radiation that assures the absence of high radiation levels before an individual can gain access to an area where such sources are used.

(d) *Airborne radioactivity areas.* (1) As used in the regulations in this part "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B, Table I, Column 1 of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

AIRBORNE RADIOACTIVITY AREA

(e) *Additional requirements.* (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

¹ Or "Danger".

² As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, mass enrichment, etc.

CAUTION¹

RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in any amount exceeding one hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION¹

RADIOACTIVE MATERIAL(S)

(f) *Containers.* (1) Except as provided in paragraph (f)(3) of this section, each container of licensed material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to paragraph (f)(1) of this section shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information² to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(3) Notwithstanding the provisions of paragraph (f)(1) of this section labeling is not required:

(i) For containers that do not contain licensed materials in quantities greater than the applicable quantities listed in Appendix C of this part.

(ii) For containers containing only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Appendix C of this part.

(iii) For containers that do not contain licensed materials in concentrations greater than the applicable concentrations listed in Appendix B, Table I, Column 2, of this part.

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part.

(v) For containers when they are in transport and packaged and labeled in accordance with regulations of the Department of Transportation.

(vi) For containers which are accessible³ only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(vii) For manufacturing or process equipment, such as nuclear reactors, reactor components, piping, and tanks.

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(4) Each licensee shall, prior to disposal of an empty uncontaminated container to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

§ 20.204 Same: exceptions.

Notwithstanding the provisions of § 20.203,

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(b) Rooms or other areas in hospitals are not required to be posted with caution signs, and control of entrance or access thereto pursuant to § 20.203(c) is not required, because of the presence of patients containing by-product material provided that there are personnel in attendance who will take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part.

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and; (2) such area or room is subject to the licensee's control.

(d) A room or other area is not required to be posted with a caution sign, and control is not required for each entrance or access point to a room or other area which is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with regulations of the Department of Transportation.

§ 20.205 Procedures for picking up, receiving, and opening packages.

(a)(1) Each licensee who expects to receive a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section shall:

(i) If the package is to be delivered to the licensee's facility by the carrier, make arrangements to receive the package when it is offered for delivery by the carrier; or

(ii) If the package is to be picked up by the licensee at the carrier's terminal, make arrangements to receive notification from the carrier of the arrival of the package, at the time of arrival.

(2) Each licensee who picks up a package of radioactive material from a carrier's terminal shall pick up the package expeditiously upon receipt of notification from the carrier of its arrival.

(b)(1) Each licensee, upon receipt of a package of radioactive material, shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents, except:

(i) Packages containing no more than the exempt quantity specified in the table in this paragraph;

(ii) Packages containing no more than 10 millicuries of radioactive material consisting solely of tritium, carbon-14, sulfur-35, or iodine-125;

(iii) Packages containing only radioactive material as gases or in special form;

(iv) Packages containing only radioactive material in other than liquid form (including Mo-99/Tc-99m generators) and not exceeding the Type A quantity limit specified in the table in this paragraph; and

(v) Packages containing only radionuclides with half-lives of less than 30 days and a total quantity of no more than 100 millicuries.

The monitoring shall be performed as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or eighteen hours if received after normal working hours.

(2) If removable radioactive contamination in excess of 0.01 microcuries (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, the licensee shall immediately notify the final delivering carrier and, by telephone and telegraph, mailgram or facsimile, the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office shown in Appendix D of this part.

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group ¹	Exempt quantity limit (in millicuries)	Type A quantity limit (in curies)
I	0.1	0.001
II	0.1	0.050
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	25,000	1000
Special Form	1	20

¹The definitions of "transport group" and "special form" are specified in § 71.4 of this chapter.

²The reporting requirements in § 20.205 have been approved by GAO under number B-180 225 (R 0054).

(c)(1) Each licensee, upon receipt of a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section, other than those transported by exclusive use vehicle, shall monitor the radiation levels external to the package. The package shall be monitored as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or 18 hours if received after normal working hours.

(2) If radiation levels are found on the external surface of the package in excess of 200 millirem per hour, or at three feet from the external surface of the package in excess of 10 millirem per hour,

the licensee shall immediately notify by telephone and telegraph mailgram, or facsimile, the director of the appropriate NRC Regional Office listed in Appendix D, and the final delivering carrier.

(d) Each licensee shall establish and maintain procedures for safely opening packages in which licensed material is received, and shall assure that such procedures are followed and that due consideration is given to special instructions for the type of package being opened.

§ 20.206 Instruction of personnel.

Instructions required for individuals working in, or frequenting any portion of a restricted area are specified in § 19.12 of this chapter.

§ 20.207 Storage and control of licensed materials in unrestricted areas.

(a) Licensed materials stored in an unrestricted area shall be secured from unauthorized removal from the place of storage.

(b) Licensed materials in an unrestricted area and not in storage shall be

¹For example, containers in locations such as water-filled canals, storage vaults, or hot cells.

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tended under the constant surveillance and immediate control of the licensee.

WASTE DISPOSAL

§ 20.301 General requirement.

No licensee shall dispose of licensed material except:

(a) By transfer to an authorized recipient as provided in the regulations in Parts 30, 40, 60, 70 or 72 of this chapter, whichever may be applicable; or

(b) As authorized pursuant to § 20.302; or

(c) As provided in § 20.303, applicable to the disposal of licensed material by release into sanitary sewerage systems, or in § 20.306 for disposal of specific wastes, or in § 20.106 (Radioactivity in effluents to unrestricted areas).

§ 20.302 Method for obtaining approval of proposed disposal procedures.

(a) Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

(b) The Commission will not approve any application for a license to receive licensed material from other persons for disposal on land not owned by the Federal government or by a State government.

(c) The Commission will not approve any application for a license for disposal of licensed material at sea unless the applicant shows that sea disposal offers less harm to man or the environment than other practical alternative methods of disposal.

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of paragraphs (b)(1) or (2) of this section.

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part; and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

(d) The gross quantity of licensed and other radioactive material, excluding hydrogen-3 and carbon-14, released into the sewerage system by the licensee does not exceed one curie per year. The quantities of hydrogen-3 and carbon-14 released into the sanitary sewerage system may not exceed 5 curies per year for hydrogen-3 and 1 curie per year for carbon-14. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration except for materials listed under § 20.306 or as specifically approved by the Commission pursuant to §§ 20.106(b) and 20.302.

§ 20.306 Disposal of specific wastes.

Any licensee may dispose of the following licensed material without regard to its radioactivity:

(a) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of medium, used for liquid scintillation counting; and

(b) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of animal tissue averaged over the weight of the entire animal; provided however, tissue may not be disposed of under this section in a manner that would permit its use either as food for humans or as animal feed.

(c) Nothing in this section, however, relieves the licensee of maintaining records showing the receipt, transfer and disposal of such byproduct material as specified in § 30.51 of this chapter; and

(d) Nothing in this section relieves the licensee from complying with other applicable Federal, State and local regulations governing any other toxic or hazardous property of these materials.

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form NRC-5, in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Form NRC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

(b) Each licensee shall maintain records in the same units used in this part, showing the results of surveys required by § 20.201(b), monitoring required by §§ 20.205(b) and 20.205(c), and disposals made under §§ 20.302, 20.303, and deleted § 20.304.

(c)(1) Records of individual exposure to radiation and to radioactive material which must be maintained pursuant to the provisions of paragraph (a) of this section and records of bioassays, including results of whole body counting examinations, made pursuant to § 20.108, shall be preserved until the Commission authorizes disposition.

(2) Records of the results of surveys and monitoring which must be maintained pursuant to paragraph (b) of this section shall be preserved for two years after completion of the survey except that the following records shall be maintained until the Commission authorizes their disposition: (i) Records of the results of surveys to determine compliance with § 20.103(a); (ii) in the absence of personnel monitoring data, records of the results of surveys to determine external radiation dose; and (iii) records of the re-

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sults of surveys used to evaluate the release of radioactive effluents to the environment.

(3) Records of disposal of licensed material made pursuant to §§ 20.302, 20.303, and deleted § 20.304¹ are to be maintained until the Commission authorizes their disposition.

(4) Records which must be maintained pursuant to this part may be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by Commission regulations.

(5) If there is a conflict between the Commission's regulations in this part, license condition, or technical specification, or other written Commission approval or authorization pertaining to the retention period for the same type of record, the retention period specified in the regulations in this part for such records shall apply unless the Commission pursuant to § 20.501, has granted a specific exemption from the record retention requirements specified in the regulations in this part.

§ 20.402 Reports of theft or loss of licensed material

(a) Each licensee shall report by telephone to the Director of the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix D of this part, immediately after its occurrence becomes known to the licensee, any loss or theft of licensed material in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

(b) Each licensee who is required to make a report pursuant to paragraph (a) of this section shall, within thirty (30) days after he learns of the loss or theft, make a report in writing to the appropriate NRC Regional Office listed in Appendix D of this part with copies to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, setting forth the following information:

Section 20.304 provided for burial of small quantities of licensed materials in soil. Notice of its deletion appears in the FEDERAL REGISTER of October 30, 1980 (45 FR 71762).

(1) A description of the licensed material involved, including kind, quantity, chemical, and physical form;

(2) A description of the circumstances under which the loss or theft occurred;

(3) A statement of disposition or probable disposition of the licensed material involved;

(4) Radiation exposures to individuals, circumstances under which the exposures occurred, and the extent of possible hazard to persons in unrestricted areas;

(5) Actions which have been taken, or will be taken, to recover the material; and

(6) Procedures or measures which have been or will be adopted to prevent a recurrence of the loss or theft of licensed material.

(c) Subsequent to filing the written report the licensee shall also report any substantive additional information on the loss or theft which becomes available to the licensee, within 30 days after he learns of such information.

(d) Any report filed with the Commission pursuant to this section shall be so prepared that names of individuals who may have received exposure to radiation are stated in a separate part of the report.

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix D of this part of any incident involving byproduct, source, or special nuclear material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II of this part; or

(3) A loss of one working week or more of the operation of any facilities affected; or

(4) Damage to property in excess of \$200,000.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours notify by telephone and telegraph, mailgram, or facsimile, the Director of the appropriate NRC Regional Office listed in Appendix D of this part of any incident involving licensed material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II of this part; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of \$2,000.

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

(d) For nuclear power reactors licensed under § 50.21 or § 50.22, the incidents included in paragraph (a) and paragraph (b) in this section shall in addition be reported pursuant to § 50.72.

§ 20.404 [Reserved]

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a) In addition to any notification required by § 20.403, each licensee shall make a report in writing within 30 days to the Regional Office listed in Appendix D of this part, with a copy to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, of:

(1) Each exposure of an individual to radiation in excess of the applicable limits in §§ 20.101 or 20.104(a) or the license; (2) each exposure of an individual to radioactive material in excess of the applicable limits in §§ 20.103(a)(1), 20.103(a)(2), 20.104(b) or the license; (3) levels of radiation or concentrations of radioactive material in a restricted area in excess of any other applicable limit in the license; (4) any incident for which notification is required by § 20.403; and (5) levels of radiation or concentrations of radioactive material (whether or not invol-

PART 20 • STANDARDS FOR PROTECTION AGAINST RADIATION

ing excessive exposure of any individual in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the license.

Each report required under this paragraph shall describe the extent of exposure of individuals to radiation or to radioactive material, including estimates of each individual's exposure as required by paragraph (b) of this section; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels or concentrations; and corrective steps taken or planned to assure against a recurrence.

(b) Any report filed with the Commission pursuant to paragraph (a) of this section shall include for each individual exposed the name, social security number, and date of birth, and an estimate of the individual's exposure. The report shall be prepared so that this information is stated in a separate part of the report.

(c) In addition to any notification required by § 20.403, each licensee shall make a report in writing within 30 days to the appropriate NRC Regional

Office listed in Appendix D, with a copy to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, of levels of radiation or releases of radioactive material in excess of limits specified by 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," or in excess of license conditions related to compliance with 40 CFR Part 190. Each report required under this paragraph shall describe the extent of exposure of individuals to radiation or to radioactive material; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels or concentrations; and corrective steps taken or planned to assure against a recurrence, including the schedule for achieving conformance with 40 CFR Part 190 and associated license conditions.

§ 20.406 [Reserved]

§ 20.407 * Personnel monitoring reports.

Each person described in § 20.408 of this part shall, within the first quarter of each calendar year, submit to the Director of Management and Program Analysis, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, the reports specified in paragraphs (a) and (b) of this section covering the preceding calendar year.¹ All other persons specifically licensed by the Commission shall, within the first

quarter of calendar years 1979 and 1980, submit to the Director of Management and Program Analysis, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, the reports specified in paragraphs (a) and (b) of this section covering the preceding calendar years 1978 and 1979.^{1,2}

(a) A report of either (1) the total number of individuals for whom personnel monitoring was required under § 20.202(a) or § 34.33(a) of this chapter during the calendar year; or (2) the total number of individuals for whom personnel monitoring was provided during the calendar year: *Provided, however, That such total includes at least the number of individuals required to be reported under paragraph (a)(1) of this section. The report shall indicate whether it is submitted in accordance with paragraph (a)(1) or (a)(2) of this section. If personnel monitoring was not required to be provided to any individual by the licensee under §§ 20.202(a) or 34.33(a) of this chapter during the calendar year, the licensee shall submit a negative report indicating that such personnel monitoring was not required.*

(b) A statistical summary report of the personnel monitoring information recorded by the licensee for individuals for whom personnel monitoring was either required or provided, as described in paragraph (a) of this section, indicating the number of individuals whose total whole body exposure recorded during the previous calendar year was in each of the following estimated exposure ranges:

Estimated whole body exposure range (rems)	Number of individuals in each range
No measurable exposure	
Measurable exposure less than 0.1	
0.1 to 0.25	
0.25 to 0.5	
0.5 to 0.75	
0.75 to 1	
1 to 2	
2 to 3	
3 to 4	
4 to 5	
5 to 6	
6 to 7	
7 to 8	
8 to 9	
9 to 10	
10 to 11	
11 to 12	
12 +	

¹Individual values exactly equal to the values separating exposure ranges shall be reported in the higher range.

The low exposure range data are required in order to obtain better information about the exposures actually recorded. This section does not require improved measurements.

²A licensee whose license expires or terminates prior to, or on the last day of the calendar year, shall submit reports at the expiration or termination of the license, covering that part of the year during which the license was in effect.

§ 20.408 Reports of personnel monitoring on termination of employment or work.

(a) This section applies to each person licensed by the Commission to:

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or § 50.22 of this chapter or a testing facility as defined in § 50.2(r) of this chapter;

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter;

(3) Possess or use at any one time, for purposes of fuel processing, fabricating, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof pursuant to Part 70 of this chapter;

(4) Possess high-level radioactive waste at a geologic repository operations area pursuant to Part 60 of this chapter; or

(5) Possess spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter; or

(6) Possess or use at any one time, for processing or manufacturing for distribution pursuant to Parts 30, 32, or 33 of this Chapter, byproduct material in quantities exceeding any one of the following quantities:

Radionuclide ¹	Quantity in Curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Indium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

¹The Commission may require, as a license condition, or by rule regulation or order pursuant to § 20.502, reports from licensees who are licensed to use radionuclides not on this list in quantities sufficient to cause comparable radiation levels.

(b) When an individual terminates employment with a licensee describe in paragraph (a) of this section, or an individual assigned to work in such a licensee's facility but not employed by the licensee, completes the work assignment in the licensee's facility, the licensee shall furnish to the Director

²The Commission will evaluate the data obtained for 1978 and 1979 pursuant to this paragraph, and the benefits derived therefrom and may take action, including publication of notice of proposed rulemaking, to extend or otherwise modify this reporting requirement.

PART 20 • STANDARDS FOR PROTECTION AGAINST RADIATION

43 FR 4827
of Management and Program Analysis, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, a report of the individual's exposures to radiation and radioactive material, incurred during the period of employment or work assignment in the licensee's facility, containing information recorded by the licensee pursuant to §§ 20.401(a) and 20.108. Such report shall be furnished within 30 days after the exposure of the individual has been determined by the licensee or 90 days after the date of termination of employment or work assignment, whichever is earlier.

any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

§ 20.409 Notifications and reports to individuals.

(a) Requirements for notifications and reports to individuals of exposure to radiation or radioactive material are specified in § 19.13 of this chapter.

(b) When a licensee is required pursuant to §§ 20.405 or 20.408 to report to the Commission any exposure of an individual to radiation or radioactive material, the licensee shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Commission, and shall comply with the provisions of § 19.13(a) of this chapter.

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 20.502 Additional requirements.

The Commission may, by rule, regulation, or order, impose upon any licensee such requirements, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

ENFORCEMENT

§ 20.601 Violations.

40 FR 8774
An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or

NOTE: The reporting and record keeping requirements contained in this part have been approved by the General Accounting

Office under B-180225 (R0043), (R0044), and (R0084).

Note

Appendices A, B, C, and D can be obtained from your regional NRC office, if appropriate.

LD 2220 PORTABLE LEVEL DETECTOR

TRANSPORTATION GUIDELINE

This advance information is being released prior to final publication. Training Manual Form 5606 is scheduled for distribution this summer.

TRANSPORTATION GUIDELINE

In addition to NRC regulations controlling the use of radioactive materials, there are government regulations (e.g., D.O.T., I.A.T.A., I.C.A.O.) that control the transport of such materials via land, air or water. Should the need arise to transport the LD2220 to another location or to return it for service or disposal, there are procedures that must be followed in packaging, marking, labeling, and documenting the shipment to comply with the regulations. This guide is intended to be an aid in doing so. You are encouraged to obtain the latest copies of transportation regulations. Names and addresses where you can order the most commonly used regulations can be found at the end of this guide.

PACKAGING

The shipping/storage container the LD2220 was originally shipped in is an approved DOT Type 7A container. It is an appropriate shipping container for the device and should be retained for storage and for reuse in transporting the device should the need occur.

- o Following the procedure on page 9 of the Type LD2220 Instruction Manual, detach the head assembly from the pole/meter assembly.
- o Place the head assembly in the form fit foam cavity of the shipping/storage container and replace the top foam piece. Place the lid on the container and secure it using the snap lock ring.
- o A security seal must be affixed before the package may be transported by carrier. This can be a lead seal wire, a security tape or any type of seal which is (a) not readily breakable and which, while intact, (b) will be evidence that the package has not been opened. A simple wire seal is a good idea to prevent inadvertent opening regardless of what security seal is used. A small piece of wire twisted through the latch can accomplish this.

- o The container must be in good condition. If the original container has signs of damage that could affect its integrity, contact your Fisher representative to obtain a new container.
- o Make sure old shipping labels and markings have been removed before transporting. Do not remove markings and labels required for transport (i.e. radioactive labels, warning label, description of contents and DOT 7A markings). See the following sections for details.

PACKAGE MARKINGS

The following marketings must appear on the outside of the package.

**RADIOACTIVE MATERIAL NOS
USA DOT 7A TYPE A UN 2974
NSSI 5711 ETHERIDGE HOUSTON, TEXAS**

If the original decal or marking bearing this information has been removed from the shipping container, affix a new label. It can be placed anywhere it does not obscure any other labels except on the bottom of the container.

LABELS

The following labels must be affixed as specified to the shipping container. If a label is missing, it must be replaced before transporting. They can be obtained from authorized carriers (e.g., Emery, Federal Express, Roadway, etc.) or from N.S.S.I., 5711 Etheridge, Houston, Texas 77234.

- o Two (2) "Radioactive II" labels applied to opposite vertical sides and marked with:

Contents - Am 241

Activity - .200 Curies

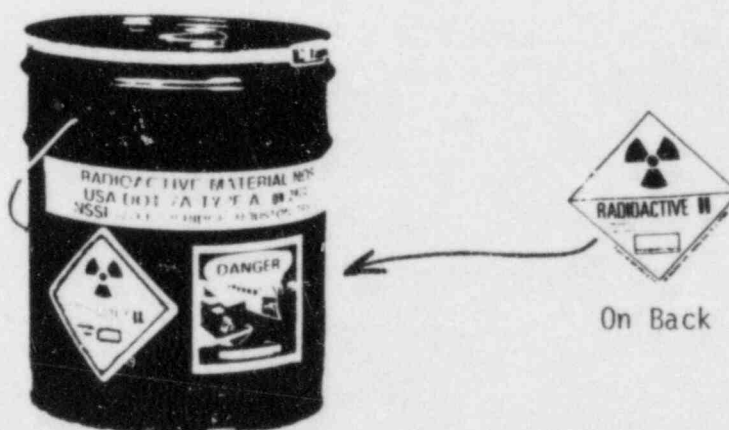
Transport Index - 0.5



- o One (1) "Danger" label applied adjacent to one of the radioactive labels.



The following diagram shows the proper placement of labels and markings for transport.



DOCUMENTATION

To transport the LD2220 by highway in a company vehicle, a copy of the shipping papers must be kept next to the driver on the seat or in a pouch on the door of the vehicle. A copy of shipping papers you can use, which should also include the opening instructions, is found in Attachment A. The paperwork you can use may be duplicated on another form, however, the precise words and the sequence in which they appear must not be altered.

To truck air freight the LD2220, a "Shippers Declaration for Dangerous Goods: as well as a shipping bill must be filled out. Find examples of these forms for Emery Air Worldwide in Attachment B. Again the information on these forms may be duplicated, however, the precise words and sequence in which they appear must not be altered. NOTE: These forms are filled out per Title 49CFR regulations and are appropriate for transport within continental U.S. For ex-continental U.S. shipments, the forms must be filled out per IATA/ICAO regulations and copy of the the source "Special Form Certificate" must accompany the air bill. See examples of these forms in Attachment C.

GENERAL INFORMATION

Transport by company vehicle (e.g. to another plant site):

1. Shipping papers (see "Documentation" and Attachment A) must accompany the driver, either in the front seat or in a pouch on the door of the vehicle.
2. The bucket containing the head assembly should be transported in the locked trunk of the vehicle. If an open bed vehicle is used (e.g. pickup truck), the bucket must be secured to the frame of the vehicle. Bungee cords or tie downs can be used for this. In either case, the bucket should not be able to move around within the vehicle under normal transport conditions.

3. While at a temporary job site, at all times the device should either be kept locked in the truck of the vehicle, secured to the vehicle, locked in a storage area or attended by an authorized individual who has been trained in the safe use and operation of the device.

Transport by licensed carrier (e.g. Emery, Federal Express):

1. The device may not be transported on or carried onto a passenger aircraft (i.e. Air Cargo only).
2. When transporting the device to a facility, make arrangements with them to receive or to pick up the device.
3. Ship the "hazardous" head assembly on a separate bill from the "non-hazardous" pole assembly. (See shipping bill examples in Attachment B.)
4. Send a copy of the "Opening Instructions" ahead of the device or include it with the shipping papers if no one is familiar with unpacking it.

RETURN FOR REPAIR OR DISPOSAL

1. Return the device to:

Nuclear Sources and Services, Inc.
5711 Etheridge
Houston, Texas 77234

Notify your Fisher representative that the device is being returned.

2. In case of emergency: If there is reason to believe the source has been damaged, contact your Fisher Controls representative or a licensed disposal service to survey the instrument before packaging for transport.

ATTACHMENT A

- o Shipping Papers
- o Opening Instructions

SHIPPING PAPERS
FISHER CONTROLS TYPE LD2220
PORTABLE LEVEL DETECTOR

One (1) metal can, radioactive material, special form, n.o.s., UN2974,
Radiation Level Detector, Am Be, solid - special form, 200 mCi, Radioactive
Yellow II, 0.5 transport index, container DOT Type 7A-USA, cargo aircraft only.

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

Signed _____

(company)

(street address)

(city, state, and zip)

(telephone)

OPENING INSTRUCTIONS
FISHER CONTROLS TYPE LD2220

*NOTICE - READ BEFORE OPENING PACKAGE

The Fisher Controls Type LD2220 level detector is shipped in two packages:

1. A foam packed cardboard box containing the pole and meter assembly, headphones, carrying strap, and packets including instruction and training manuals. A wipe test kit and the source special form certificate are also included.
2. A metal bucket containing the head assembly with the radioactive source. Do not open this container until either the person to whom the package is addressed or the safety officer at the site has been notified.

The cardboard box should be opened first and the instruction manual reviewed. Refer to the "initial assembly" section of the manual for instructions to safely assemble the device.

NOTE: The metal bucket should not be discarded; it is to be used in the storage of the device and it must be used in any transfer of the device from the site, either to change locations or to return for repair.

ATTACHMENT B

- o Example - "Shipper's Declaration of Hazardous Goods
- o Example - Shipping Bills

*Per CFR49 regulations for continental U.S. transport only.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper	Air Waybill No. Page of Pages Shipper's Reference Number <i>(optional)</i>																				
Consignee																					
<i>Five completed and signed copies of this Declaration must be handed to the operator.</i>																					
TRANSPORT DETAILS This shipment is within the limitations prescribed for <i>(delete non applicable)</i> <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="padding: 2px;">PASSENGER AIR CARGO AIR MAIL</td><td style="padding: 2px;">CARGO AIRCRAFT ONLY</td></tr></table> Airport of Departure	PASSENGER AIR CARGO AIR MAIL	CARGO AIRCRAFT ONLY	WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent. Shipment type <i>(delete non applicable)</i> <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="padding: 2px;">NOT RADIOACTIVE</td><td style="padding: 2px;">RADIOACTIVE</td></tr></table>	NOT RADIOACTIVE	RADIOACTIVE																
PASSENGER AIR CARGO AIR MAIL	CARGO AIRCRAFT ONLY																				
NOT RADIOACTIVE	RADIOACTIVE																				
NATURE AND QUANTITY OF DANGEROUS GOODS <i>Parts 171 and 172 of 49CFR Sub-Section 8.1 of IATA Dangerous Goods Regulations</i> <table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="6" style="text-align: center; padding: 5px;">Dangerous Goods Identification</th></tr><tr><th style="width: 30%; padding: 5px;">Proper Shipping Name</th><th style="width: 15%; padding: 5px;">Class or Division</th><th style="width: 10%; padding: 5px;">UN or ID No.</th><th style="width: 10%; padding: 5px;">Subsidiary Risk</th><th style="width: 30%; padding: 5px;">Quantity and type of packing</th><th style="width: 5%; padding: 5px;">Packing Inst.</th><th style="width: 10%; padding: 5px;">Authorization</th></tr></thead><tbody><tr><td style="padding: 10px; vertical-align: top;">Radioactive Material Special Form, N.O.S.</td><td></td><td style="padding: 10px; vertical-align: top;">UN2974</td><td></td><td style="padding: 10px; vertical-align: top;">Am-241 , Solid Sealed Source 1, Type A Package x .200 Curies</td><td style="padding: 10px; vertical-align: top;">II Yellow TI .5</td><td></td></tr></tbody></table> Additional Handling Information		Dangerous Goods Identification						Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization	Radioactive Material Special Form, N.O.S.		UN2974		Am-241 , Solid Sealed Source 1, Type A Package x .200 Curies	II Yellow TI .5	
Dangerous Goods Identification																					
Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization															
Radioactive Material Special Form, N.O.S.		UN2974		Am-241 , Solid Sealed Source 1, Type A Package x .200 Curies	II Yellow TI .5																
This shipment prepared according to: ☒ 49CFR ☐ IATA Regulations																					
I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labelled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations Name/Title of Signatory Place and Date Signature <i>(see warning above)</i>																					



UNITED STATES / CANADA

INTERNATIONAL

FORM OF PAYMENT

☐ Bill to Shipper ☐ GBL
☐ Bill to Consignee ☐ Cash

Received By: \$ /

STANDARD SERVICES AM PM
 PACKAGES/CARGO ☐ ☐
 URGENT LETTER ☐
 URGENT POUCH ☐
 URGENT PACK ☐

SPECIAL SERVICES
 Same Day ☐ 9 AM ☐ Day 2 ☐
 Saturday Delivery ☐ Other ☐

NON-DUTIABLE DOCUMENTS

URGENT POUCH ☐
 URGENT PACK ☐

PACKAGES/CARGO

FIRST CLASS ☐
 BUSINESS CLASS ☐
 STANDARD CLASS ☐
 OTHER ☐

Shipper's Account Number		Date	Origin Airport	Shipment Number 26862	Destination Airport	Gateway
From:	Phone	Department	Collect Shipper's Charges On Delivery	To:	Phone	Department
			C.O.D.			
			\$			
State Country			☐ Company Check Payable To Shipper Acceptable	State Country		
Shipper's Reference No.	Zip Code (Required)			Consignee's Ref. No.	Zip Code (Required)	
				Consignee's Acct. No.		

No. Pieces	Description and Marks	Commodity Code	Weight	Package Dimensions			
				PCS.	L	W	H
1	5 gal. metal can radioactive material, special form, N.O.S.		7 lbs.				

SPECIAL INSTRUCTIONS:

☐ GOVT.

Subject to terms and conditions on reverse Shipper's Signature ☒

This non-negotiable air way bill is subject to the Terms and Conditions set forth on the reverse side of this copy. Emery shall not be liable for special, incidental, or consequential damages and disclaims all warranties, expressed or implied, with respect to carriage of this shipment. Unless a higher value is declared and an additional charge paid, the liability of Emery for this shipment is limited to an amount set forth in the Emery Service Guide in effect on the date of shipment, or \$10 per pound, whichever is higher.

☐ Bill To: Address Below
 Paying For ☐ Shipper ☐ Consignee ☐ Third Party

Declared Value \$	Customs Value \$	Insurance \$	International Charges
INTERNATIONAL & CANADIAN SHIPMENTS ONLY			At Origin
			Base Charge
			At Destination
			Other
			TOTAL

Goods Received At:
☐ Shipper's Door ☐ Residence Door ☐ Airport Terminal ☐ City Terminal ☐ Carrier's Advance ☐ Drop Box
 Time Date No. Shipments This Stop
 By: Advance Override AO - AD -

Non-Negotiable Airbill
 Form OP-1 Rev. 4-84 Printed in U.S.A. Executive Offices
 Wilton, Connecticut 06097

1 - Consignee's Copy

**FORM OF PAYMENT**

☐ Bill to Shipper ☐ GBL
☐ Bill to Consignee ☐ Cash

Received By: \$ /

UNITED STATES / CANADA

STANDARD SERVICES AM PM
PACKAGES/CARGO ☐ ☐
URGENT LETTER ☐
URGENT POUCH ☐
URGENT PACK ☐

SPECIAL SERVICES
Same Day ☐ 9 AM ☐ Day 2 ☐
Saturday Delivery ☐ Other ☐

INTERNATIONAL**NON-DUTIABLE DOCUMENTS**

URGENT POUCH ☐
URGENT PACK ☐

PACKAGES/CARGO

FIRST CLASS ☐
BUSINESS CLASS ☐
STANDARD CLASS ☐
OTHER ☐

Shipper's Account Number		Date	Origin Airport	Shipment Number 26861	Destination Airport	Gateway
From:	Address	Phone	Collect Shipper's Charges On Delivery C.O.D. \$ ☐ Company Check Payable To Shipper Acceptable	To:	Address	
City/State/Zip		Country		City/State/Zip		
State		Country		State		
Shipper's Reference No.		Zip Code (Required)		Zip Code (Required)		
No. Pieces	Description and Marks			Commodity Code	Weight	Package Dimensions
1	Instrument				7 lbs.	PCS. L W H

SPECIAL INSTRUCTIONS:☐ GOVT.

Subject to terms and conditions on reverse Shipper's Signature ☒

This non-negotiable air way bill is subject to the Terms and Conditions set forth on the reverse side of this copy. Emery shall not be liable for special, incidental, or consequential damages and disclaims all warranties, expressed or implied, with respect to carriage of this shipment. Unless a higher value is declared and an additional charge paid, the liability of Emery for this shipment is limited to an amount set forth in the Emery Service Guide in effect on the date of shipment, or \$10 per pound, whichever is higher.

☐ Bill To: Address Below
Paying For ☐ Shipper ☐ Consignee ☐ Third Party

Declared Value	Customs Value	Insurance	International Charges
\$	\$	\$	At Origin Base Charge At Destination Other TOTAL
INTERNATIONAL & CANADIAN SHIPMENTS ONLY			
Goods Received At			
☐ Shipper's Door	☐ Residence Door	☐ Airport Terminal	☐ City Terminal
Time		Date	Carrier's Advance No. Shipments This Stop
By:		Advance Override	AD - AD -

Non-Negotiable Airbill
Form OP-1 Rev. 4-84 Printed in U.S.A. Executive Offices
Wilton, Connecticut 06897

1 - Consignee's Copy

ATTACHMENT C

- o Example - "Shipper's Declaration for Dangerous Goods"
- o Example - Shipping Bills
- o Example - Special Form Certificate

*Per I.A.T.A./I.C.A.O. regulations for ex-continental U.S. transport

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper	Air Waybill No
	Page of Pages
	Shipper's Reference Number (optional)

Consignee	 
-----------	--

Five completed and signed copies of this Declaration must be handed to the operator

TRANSPORT DETAILS

This shipment is within the Airport of Departure limitations prescribed for
(delete non applicable)

CARGO	CARGO
AIRCRAFT	AIRCRAFT
ONLY	ONLY

Airport of Destination

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type (delete non applicable)

~~NON-RADIOACTIVE~~ RADIOACTIVE

NATURE AND QUANTITY OF DANGEROUS GOODS

Para's 171 and 172 of 49CFR

Sub-Section 9.1 of IATA Dangerous Goods Regulations

Dangerous Goods Identification

Proper Shipping Name	Class or Division	UN or ID No	Subsidiary Risk	Quantity and Type of Packing	Packing Inst.	Authorization
Radioactive Material, Special Form, N.O.S.	7	UN2974		AM-241, Solid Sealed Source 1, Type A Package X.200 Curies	II Yellow TI.5 DIM 30 x 30 x 40 cm Each	

* NOTE: Fill in Special Form Certificate number here. →

SP. Form Certificate no. Attached

Additional Handling Information

This shipment prepared according to: ☐ 49CFR ☒ IATA Regulations

I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labelled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations

Name/Title of Signatory

Place and Date

Signature



UNITED STATES / CANADA

INTERNATIONAL

STANDARD SERVICES AM PM
 PACKAGES/CARGO ☐ ☐
 URGENT LETTER ☐
 URGENT POUCH ☐
 URGENT PACK ☐

NON-DUTIABLE DOCUMENTS

URGENT POUCH ☐
 URGENT PACK ☐

PACKAGES/CARGO

FIRST CLASS ☐
 BUSINESS CLASS ☐
 STANDARD CLASS ☐
 OTHER ☐

FORM OF PAYMENT

☐ Bill to Shipper
☐ Bill to Consignee
☐ GBL
☐ Cash

Received By: \$ /

SPECIAL SERVICES

Same Day ☐ 9 AM ☐ Day 2 ☐
 Saturday Delivery ☐ Other ☐

Shipper's Account Number		Date	Origin Airport	Shipment Number 26863	Destination Airport	Gateway
From:		Collect Shipper's Charges On Delivery		To:		
		C.O.D.				
		\$				
		☐ Company Check Payable To Shipper Acceptable				
Shipper's Reference No.	Zip Code (Required)		Consignee's Ref. No.		Zip Code (Required)	
				Consignee's Acct. No.		
No. Pieces	Description and Marks		Commodity Code	Weight	Package Dimensions	
1	Dangerous goods as per attached shipper's declaration Cargo Aircraft Only			7 lbs.	PCS.	L W H

SPECIAL INSTRUCTIONS:

☐ GOVT.

Subject to terms and conditions on reverse Shipper's Signature ☒

This non-negotiable air way bill is subject to the Terms and Conditions set forth on the reverse side of this copy. Emery shall not be liable for special, incidental, or consequential damages and disclaims all warranties, expressed or implied, with respect to carriage of this shipment. Unless a higher value is declared and an additional charge paid, the liability of Emery for this shipment is limited to an amount set forth in the Emery Service Guide in effect on the date of shipment, or \$10 per pound, whichever is higher.

☐ Bill To: Address Below
 Paying For ☐ Shipper ☐ Consignee ☐ Third Party

Declared Value \$	Customs Value \$	Insurance \$	International Charges
INTERNATIONAL & CANADIAN SHIPMENTS ONLY			At Origin _____ Base Charge _____ At Destination _____ Other _____ TOTAL
Goods Received At:			
☐ Shipper's Door	☐ Residence Door	☐ Airport Terminal	☐ City Terminal
Time		Date	Carrier's Advance ☐ Drop Box ☐
By:		No. Shipments This Stop	
		Advance Override	AO - _____ AD - _____

Non-Negotiable Airbill Form 12P-1 Rev. 4-84 Printed in U.S.A. Executive Offices: Wilton, Connecticut 06897

1 - Consignee's Copy

ATTACHMENT D

Availability of Federal and International Regulations

Federal Regulations - For continental U.S. transport

- o U.S. Department of Transportation
Title 49, Code of Federal Regulations Parts 100-177
Available from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Approximately \$9.00

- o "A Review of the Department of Transportation Regulations for
Transportation of Radioactive Materials"
Available from

Department of Transportation Research
and Special Programs Administration
Materials Transportation Bureau
Information Services Division (DMT-11)
Washington, D.C. 20590

International Regulations - For ex-continental U.S. transport

- o "Regulations for the Safe Transportation of Radioactive Materials, Safety
Series No. 6, 1973 Edition (as amended)," International Atomic Energy
Agency (IAEA), Vienna, Austria.
Available from:

UNIPUB
1180 Avenue of the Americas
New York, New York 10038

- o International Civil Aviation Organization (ICAO), Technical Instructions
for the Safe Transport of Dangerous Goods by Air, 1983 Edition.

Available from:

INTEREG
P.O. Box 60105
Chicago, Illinois 60660

- o International Air Transport Association (IATA), Restricted Articles
Regulations, 25th Edition, plus Supplement and Amendment issued
March 1, 1981, effective December 1982.

Available from:

International Air Transport Association
2000 Peel Street
Montreal, Quebec
Canada H3A 2R4