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TITLE - RADIATION PRODUCING MATERIALS AND DEVICES

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Purpose

- A. To establish safeguards against accidental exposure of personnel to radiation and radioisotopes including:
1. X-rays from high voltage vacuum tubes emanating from equipment such as analytical x-ray diffraction or fluorescence analyzers, electron microscopes, electron spectroscopy for chemical analysis (ESCA) devices and electron microprobe analyzers.
  2. Hard x-rays, gamma rays, and accelerated electrons emanating from industrial electron accelerators such as van de Graaff electron accelerators and other devices emitting electrons in the voltage range .3 mev or greater.
  3. Encapsulated radioactive sources emitting alpha, beta, and/or gamma rays such as isotopes used in level controllers, thickness gauges, static-eliminators, radiographic equipment, electron-capture detectors in gas chromatographs, radium containing smoke detectors, etc.
  4. Unencapsulated radioisotopes used in tracer studies, as analytical reagents and as chemical reactants or additives.
  5. Microwave sources such as microwave ovens, high frequency RF transmitters, etc.
  6. Devices emitting visible, ultraviolet, or infrared radiation of such frequency and/or intensity as to constitute a hazard to the eyes or skin of personnel such as lasers, ultraviolet lamps, high-intensity infrared sources, flash photolysis units, etc.
- B. To assure compliance with federal and state regulations which govern radiation sources as follows:
1. State of New Jersey Department of Environmental Protection, Bureau of Protection
    - a. Requires initial registration and subsequent annual fees for devices listed under A-1 and A-2; A-5 and certain lasers under A-6.

- b. Requires licensing and leak-wipe testing of devices containing radium not otherwise regulated by the Federal government.
  - c. Requires licensing and annual fees for use, possession, receipt, storage, and transfer of radioactive material. See N.J.A.C. Chapter 28, Subchapter 7:28 - 3.8.
  - d. Requires personnel monitoring.
2. U.S. Nuclear Regulatory Commission (NRC)
- a. Requires licensing of devices containing by-product radioactive material other than radium and its associated decay daughters.
  - b. Requires periodic leak-wipe testing of encapsulated radioisotope sources.
  - c. Requires licensing subject to NRC "Standards for Protection Against Radiation," Part 20, Title 10, Code of Federal Regulations for acquisition, use, and disposal of unencapsulated radioisotopes.
3. U.S. Department of Transportation
- Code 49 CFR 173.391 regulates packaging, labeling, and shipping of radioactive materials.
4. OSHA Regulations
- 29 CFR 1910.96 and 1910.97 specifies allowable radiation doses, requirements for controls, posting, record-keeping, etc.

#### Procedure

##### A. Radiation Protection Officer

- 1. The R.P.O. shall be contacted whenever use of radiation producing devices or material is planned.
- 2. Functions of the Radiation Protection Officer:
  - a. Oversee the purchase, receipt, storage, maintenance, testing, and proper disposal of radiation sources, including the necessary security arrangements.
  - b. Maintain a list of radiation sources and issue annually to custodians of sources and line supervisors.

- c. Assist in the training of personnel in the safe handling of encapsulated radiation sources during normal use and under emergency conditions and qualify the user as required in the NRC regulations.
- d. Audit individual users who have responsibilities and accountabilities for radiation devices and sources.

B. Accountability of Requisitioner/Owner of Radiation Equipment or Radioactive Material

- 1. The requisitioner/owner shall advise the R&D Safety Coordinator and the Radiation Protection Officer on all matters involving the purchase, installation, revision, relocation, transfer, or disposition of all radioactive materials and radiation devices at the Technical Center. Building or equipment alterations which might compromise radiation shielding must be approved by both the R&D Safety Coordinator and the Radiation Protection Officer.
- 2. The requisitioner/owner with the assistance of the R&D Safety Coordinator and Radiation Protection Officer shall be accountable for procuring the necessary license prior to the arrival of the device, its proper handling and installation, conducting periodic radiation surveys and leak-wipe tests as required, and maintaining required records of such activities. The actual procurement of licenses, surveys, and leak-wipe tests shall be made by the Radiation Protection Officer.

C. Limitations on Use of Unencapsulated Radioisotopes

- 1. Persons wishing to initiate R&D projects involving the use of radioactive chemicals must obtain approval and funds for the construction and operation of an approved facility, i.e., a "hot lab" from R&D management. Purchase requisitions for the purchase of unencapsulated radioisotopes for use in chemical tracer studies, wear and corrosion tests, lubrication studies, etc., will not be approved unless a suitable "hot lab" has been constructed and the person who proposes to perform the experiments has been properly trained. A special U.S. NRC license will be issued for the Bound Brook site upon presentation of evidence that the site is qualified for the safe handling of these materials.
- 2. The purchase and use of uranium and thorium compounds as analytical reagents is permitted, subject to the following restrictions.
  - a. The user is permitted to maintain an inventory of 100 grams or less without the express permission of the Radiation Protection Officer.

- b. The Radiation Protection Officer shall be provided with an inventory of such compounds every six months which describes the compound, the amount on hand, where it is stored, and the type of storage container used.
- c. Hazards of Uranium and Thorium Compounds--Compounds of uranium and thorium are  $\alpha$ -particle emitters which are very harmful to lung tissue. Such compounds should be stored in nonbreakable containers with nonspill tops to prevent spillage and dust inhalations. These compounds also emit radon-like radioactive gases. Containers which have been closed for some time should be opened in a fume hood. Uranium and thorium compounds should not be stored near personnel nor carried unless in a shielded container.
- d. Disposal of Uranium and Thorium Compounds--These substances should not be allowed to remain in the laboratory after they are no longer needed. Contact the Radiation Protection Officer to arrange for proper disposal.
- e. Spillage of Uranium or Thorium Compounds--The Radiation Protection Officer should be promptly notified in the event of spillage and the area sealed off to prevent dissemination of the material by wind or on shoe soles.

D. Responsibility of Users of Radiation Emitting Devices

- 1. Ultimate accountability for the safe usage of radiation emitting devices is a line responsibility. The technical staff is responsible for the training of nontechnical personnel in the safe use of radiation emitting devices.
- 2. Users of radiation emitting devices such as electron accelerators, electron microscopes, ESCA, and x-ray diffraction spectrometers are responsible for the proper operation, maintenance, and utilization of the devices, the integrity of the shielding, and the proper functioning of all protective interlocks.
- 3. Only authorized personnel are permitted access to designated regulated areas.
- 4. The qualifications of those personnel assigned to operate and maintain equipment licensed by the N.J. Bureau of Radiation Protection are subject to review by the state of New Jersey (N.J.A.C. Chapter 28, Subchapter 7.28-2.1 and 2.2).
- 5. Regulations Pertaining to the Use of Lasers

The state of New Jersey requires that industrial lasers be licensed, however, no regulations for use have been promulgated.

Low-powered lasers (in the milliwatt range) are harmless unless the beam is directed at one's eye. Depending on wavelength, such a laser could damage the retina. A precautionary sign warning personnel of this danger should be posted near any such laser beam.

Special precautions are required before a high-powered laser is put in operation.

6. Regulations Pertaining to the Use of Ultraviolet and Infrared Sources

Ultraviolet sources such as those for accelerated weathering of plastic and coatings formulations by the Physical Testing Laboratory require proper shielding of the system and skin from the harmful effects of ultraviolet exposure. This can be accomplished either by the use of actinic absorbing glass or opaque shields.

Special precautions are required for the safe operation of high-intensity laboratory ultraviolet sources for photoinitiated polymerization studies or the operation of flash photolysis units.

High intensity infrared heaters can also injure the eyes and skin by radiative heat transfer. Special precautions shall be required if such installations are to be operated by the R&D Department.

E. Microwave Ovens

The R&D Coordinator and Radiation Protection Officer shall be advised of all purchases of microwave ovens. Each oven, its location and intended use shall be placed on an inventory list by the Radiation Protection Officer.

All entrances to an area containing microwave ovens shall be properly marked with pacemaker wearers warning labels.

All ovens used for food in approved eating areas shall be inspected at least once every year. This inspection shall be done by the Radiation Protection Officer.

Ovens used in laboratory activities shall be marked "Not for Food." The maintenance and inspection of such ovens shall be the responsibility of the user. Testing will be performed on request by the R&D Site Engineering Group. These tests will be performed at least every three months or more often depending on severity of use.

## WASTE MANAGEMENT

The inventory of the proposal will be removed by two mechanisms: (1) disposal of water containing residual dissolved C-14 into the sanitary sewer system, and (2) disposal of solids into containers provided by Nuclear Diagnostic Laboratories (NDL). The NDL containers will be located in the Building 98 radiation laboratory 441. Quantities of C-14 in disposal containers will be considered part of the inventory until such containers are removed from the Bound Brook site. Disposal of C-14 in water into the sanitary sewer system shall never exceed quantities allowable under Middlesex County Sewerage Authority regulations.

All effluent water, while initially containing C-14 exempt concentrations according to Code Rule 38, will be passed through activated carbon filters to partially remove residual C-14. The activity of the source water will be determined routinely, as indicated in the experimental section. The effectiveness of the charcoal filtration will be determined through liquid scintillation counting of the filtrate. Disposal of the filtrate will be done only at the scrubber discharge drain at the chemical waste incinerator facility. Disposal will be coordinated with the Radiation Protection Officer.

When the activity of the carbon filter is depleted, it will be dried and disposed of into NDL disposal containers, at intervals frequent enough as not to contain greater than exempt quantities of C-14. Vials containing scintillation cocktails and fabric or water will be placed in a separate and appropriate NDL container, with a double plastic liner and absorbent. The total activity in each bag will never exceed 100 microcuries.

All other solid wastes, such as disposable syringes and absorbent paper will be placed in separate plastic bags and disposed of in separate and appropriate containers supplied by NDL.



APPENDIX 1TEST PROCEDURE FOR SUBSTANTIVITY STUDYBY LIQUID SCINTILLATION COUNTING

## TYPES OF HAIR:

Hair supplied by DeMeo Brothers, Inc.

1. Natural Brown
2. Bleached

## SHAMPOO PRODUCTS:

The shampoo base was supplied by a customer of Union Carbide. To this was added the appropriate amounts of  $^{14}\text{C}$ -tagged UCARE Polymer JR-30M. Specific activity 38  $\mu\text{C/g}$ .

## PROCEDURE:

1. Prepare hair tresses of five grams each for both virgin brown and bleached hair. The finished tress is ten inches long, not including the secured end.
2. Prepare the shampoos according to the following instructions:
  - a. Dissolve 0.6 g  $^{14}\text{C}$ -tagged UCARE Polymer JR-30M in 29.4 g water using rapid agitation.
  - b. Heat the desired amount of shampoo concentrate to 140°F minimum, maintaining good agitation.
  - c. Add the desired amount of the 2% solution of JR-30M. Apply good agitation and readjust temperature to 140°F.
  - d. Continue agitation for five minutes.
  - e. Force cool to 80°F.
  - f. Add 0.45 g citric acid, maintaining good agitation for three minutes.
  - g. The following are the quantities used for each shampoo.

	<u>Formula A</u>	<u>Formula B</u>
Shampoo Concentrate (grams)	42.5	46.25
2% Polymer JR-30M Solution (grams)	7.5	3.75

3. Prewash each five-gram tress with a shampoo containing 20% by weight triethanolamine lauryl sulfate (actives), 2% by weight high purity lauric diethanolamide, and 78% by weight water, in the following manner.

- a. Wet the hair with 40°C tap water and work the shampoo (2 g/5 g hair) thoroughly through the hair.
- b. Rinse the hair under the 40°C tap water.
- c. Repeat the above.
- d. Dry the hair in a Lady Schick Beauty Mist Dryer at the hot setting.

4. Cut the 200 milligram sample of hair from each tress to provide the blank.

5. Wet the tress with 40°C water and apply two grams of tagged shampoo.

6. Work shampoo through the hair thoroughly for 30 to 45 seconds.

7. Using the thumb and forefinger, squeeze out as much foam as possible.

8. Rinse the tress by dipping into one liter of 40°C tap water to remove all foam.

9. Rinse the tress similarly in two more beakers of 40°C tap water.

10. Discard the first beaker of rinse water by the procedure detailed in our license.

11. Repeat the shampooing and rinsing procedure defined in Items 5 through 9.

12. Use the second and third beakers and add a fresh beaker for the final rinse. Discard the first beaker as in Item 10.

13. Dry the tress at the hot setting of the hair dryer (approximately one hour).

14. Take a 200 mg sample of hair.

15. Repeat the shampoo-rinse protocol four times and take samples of the dried hair after every cycle.

16. Weight approximately 100 mg of hair into a "Combusto-cone", recording the weight to the fourth decimal place.

17. The sample is then prepared for counting by oxidation.

18. The completed samples are counted using standard liquid scintillation techniques.



#### Details of Radioisotope Reports

Complete records of all handling of radiochemicals will be kept, as follows:

1. The activity of any radiochemical on order will be recorded in the laboratory notebook and on the inventory sheet.
2. The reported activity of any radiochemical will be recorded in the laboratory notebook, and on the inventory sheet, when received.
3. The activity and volume of the filter wash and rinse water will be recorded in the laboratory notebook and on the inventory sheet.
4. A cumulative record of the activity on the charcoal will be kept in the laboratory notebook. When the charcoal is changed, this activity will be recorded on the inventory sheet.
5. A cumulative record of the activity in the scintillation vials will be kept as part of the computer program which determines dpm from cpm. This activity will be retrieved from the computer file and recorded on the inventory sheet when the bag is closed and placed in its appropriate container.
6. A record of the net radioactive material in use will be kept on the inventory sheet and in the laboratory notebook. Inventory of stock in use will be taken quarterly to verify the net activity.
7. Completion of the disposal sequence for solid wastes will be recorded on the inventory sheet.

## MATERIALS LICENSE

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

Licensee		
1. Union Carbide Corporation	3. License number	29-01348-10
2. P. O. Box 670 Bound Brook, New Jersey 08805	4. Expiration date	August 31, 1989
	5. Docket or Reference No.	030-20754 29-01348-05
6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Nickel 63	A. Foil in Perkin-Elmer Model 330-0119 detector cells	A. Not to exceed 15 millicuries per foil
B. Cesium 137	B. Sealed sources (Texas Nuclear Model 570-57157C)	B. Not to exceed 20 millicuries per source
9. Authorized use		
A. For use in gas chromatographs for sample analysis.		
B. For use in Texas Model 5192 source holder for level measurements.		

## CONDITIONS

10. Licensed material shall be used only at the licensee's facilities at One River Road, Piscataway, New Jersey.
11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 19, "Notices, Instructions, and Reports to Workers; Inspections" and Part 20, "Standards for Protection Against Radiation."
12. Licensed material shall be used by, or under the supervision of, Jay D. Keough, U. S. Haapala, I. E. Treble.
13. In lieu of using the conventional radiation caution colors (magenta or purple on yellow background) as provided in Section 20.203(a)(1), Title 10, Code of Federal Regulations, Part 20, the licensee is hereby authorized to label detector cells and cell baths, containing licensed material and used in gas chromatography devices, with conspicuously etched or stamped radiation caution symbols without a color requirement.

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**MATERIALS LICENSE**  
SUPPLEMENTARY SHEET

License number:

29-01348-10

Docket or Reference number:

030-20754

29-01348-05

(continued)

**CONDITIONS**

14. A. Each chromatograph detector containing Nickel 63 shall be tested for leakage and/or contamination at intervals not to exceed six months. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, a detector received from another person shall not be put into use until tested.
  - B. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the surfaces of the device in which the foil is mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.
  - C. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the licensee shall immediately withdraw the foil from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Commission regulations. A report shall be filed within 5 days of the test with the U.S. Nuclear Regulatory Commission, Region I, 631 Park Avenue, King of Prussia, Pennsylvania 19406, describing the equipment involved, the test results, and the corrective action taken.
  - D. The licensee is authorized to collect leak test samples in accordance with the procedures described in the licensee's application dated May 10, 1984, and letter dated June 28, 1984, for analysis by the manufacturer. Alternatively, leak test samples may be collected and/or analyzed by other persons specifically authorized by the Commission or an Agreement State to perform such services.
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15. A.
    - (1) Each sealed source containing licensed material, other than Hydrogen 3, with a half-life greater than thirty days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months, except those sealed sources as specified by the manufacturer and specifically authorized by the Commission or an Agreement State may be leak tested at intervals not to exceed three years. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, a sealed source received from another person shall not be put into use until tested.
    - (2) Notwithstanding the periodic leak test required by this condition, any licensed sealed source is exempt from such leak tests when the source contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.
    - (3) The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months prior to the date of use or transfer.

MATERIALS LICENSE  
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License number

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(15.continued)

## CONDITIONS

- B. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.
- C. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Commission regulations. A report shall be filed within 5 days of the test with the U. S. Nuclear Regulatory Commission, Region I, 631 Park Avenue, King of Prussia, Pennsylvania 19406, describing the equipment involved, the test results, and the corrective action taken.
- D. The licensee is authorized to collect leak test samples in accordance with the procedures described in the licensee's application dated May 10, 1984, and letter dated June 28, 1984, for analysis by the manufacturer. Alternatively, leak test samples may be collected and/or analyzed by other persons specifically authorized by the Commission or an Agreement State to perform such services.
16. Sealed sources containing licensed material shall not be opened or removed from their respective source holders by the licensee.
17. The licensee shall conduct a physical inventory every six (6) months to account for all sealed sources and detector foils, received and possessed under the license. The records of the inventories shall be maintained for two (2) years from the date of the inventory for inspection by the Commission, and shall include the quantities and kinds of byproduct material, manufacturer's name and model numbers, location of sealed sources and detector foils and the date of the inventory.
18. Detector cells containing licensed material shall not be opened or the foil sources removed from the detector cell by the licensee.
19. Installation, relocation, removal from service, and initial radiation survey of devices containing licensed material and installation, replacement, and disposal of sealed sources containing licensed material used in devices shall be performed only by Union Carbide Corporation or by other persons specifically authorized by the Commission or an Agreement State to perform such services.

MATERIALS LICENSE  
SUPPLEMENTARY SHEET

License number

29-01348-10

Docket or Reference number

030-20754

29-01348-05

(continued)

## CONDITIONS

20. Except as specifically provided otherwise by this license, the licensee shall possess and use licensed material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated May 10, 1984, and letters dated June 28, 1984, and August 1, 1984. The Nuclear Regulatory Commission's regulations shall govern the licensee's statements in applications or letters, unless the statements are more restrictive than the regulations.

For the U.S. Nuclear Regulatory Commission

Original Signed By:

John E. Glenn

By

Nuclear Materials and Safeguards Branch  
Region I  
King of Prussia, Pennsylvania 19406Date SEP 05 1984