Form AEC-313
8-64
10 CFR 30

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

Form approved
Budget Bureau No. 38-R027

INSTRUCTIONS. – Complete Items 1 through 16 if this is an initial application or an application for renewal of a license. Information contained in previous applications filed with the Commisson with respect to Items 8 through 15 may be incorporated by reference provided references are clear and specific. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail two copies to: U.S. Atomic Energy Commission, Washington, D.C., 20545, Attention: Isotopes Branch, Division of Materials Licensing. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT (Institution, firm, hospital, person, etc. Include ZIP Code.)

Monsanto Company
800 North Lindbergh Blvd.
St. Louis, Missouri 63166

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED (If different from 1 (a). Include ZIP Code.)

Same as 1(a)

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

Agricultural Research Department

3. PREVIOUS LICENSE NUMBER(S) (If this is an application for renewal of a license, please indicate and give number.)

24-1113-3 (L 67)

4. INDIVIDUAL USER(S) (Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)

Dr. Ernest Jaworski, Senior Scientist
Dr. Clark Porter, Scientist
Dr. Gino Marco, Group Leader
Dr. Paul Wright, Senior Research Chemist
Dr. Robert Freeman, Senior Research Chem.

5. RADIATION PROTECTION OFFICER (Name of person designated as radiation protection officer if other than individual user. Attach resumé of his training and experience as in Items 8 and 9.)

Dr. Gino J. Marco
(see attached sheet)

6. (a) BYPRODUCT MATERIAL (Elements and mass number of each.)

Tritium-3 and
any Element
Atomic Numbers
3-83

(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME (If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)

See attached sheets (page 1)

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED (If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)

See attached sheets (page 2)

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(Continued on reverse side)

ITEM 6(b) ATTACHMENT (Chemical and/or physical form and maximum number of millicuries of each chemical and/or physical form that you will possess at any one time.)

A. 10 millicuries each of elements, atomic numbers 3-83, in any chemical form except:

Tritium -3	5 curies
Carbon-14	2 curies
Sulfur-35	1 curie
Calcium-45	100 mc
Phosphorus-32	500 mc

B. 5 mc Cesium-137 calibrated sealed source.

C. Nuclear Chicago Model 5806 Depth Moisture Gauge, having an 80 mc Americium-Beryllium Source.

ITEM 7 ATTACHMENT (Purpose for which byproduct material will be used.)

A. These isotopes of atomic numbers 3-83 and including tritium, available in any chemical or physical form, will be utilized in the synthesis of labeled compounds and in agricultural and biochemical studies in plants and lower animals.

B. The calibrated 5 millicurie cesium-137 sealed source will be used for periodic checking of calibration of survey instruments and will be stored in the lead container provided by the seller.

C. The purpose of the Model 5806 Depth Moisture Probe is to measure the moisture of a medium into which the probe is inserted by using the neutron moderation technique.

ITEM 8 TRAINING WITH RADIOACTIVITY OF DR. GINO J. MARCO

	Type of Training	Trained At -	Duration of Training	On the Job
1.	Principles and practices of radiological health safety.	Monsanto Company St. Louis, Mo.	6 years	Yes - including directed reading.
2.	Radioactivity measurements standardization and monitoring techniques and instruments.	" "	7 years	Yes - including directed reading
3.	Mathematics and calculations basic to the use and measurement of radioactivity.	" "	7 years	Yes - including directed reading
4.	Biological effects of radiation.	" "	Informal reading covering 6 years	
5.	Actual use of radioisotopes. Synthesis of ^{14}C compounds. Metabolic tracer studies in plants and animals with ^{14}C, ^{3}H and ^{35}S.	" "	10 years	Yes

ITEM 8 TRAINING WITH RADIOACTIVITY OF DR. ROBERT C. FREEMAN

	Type of Training	Trained At -	Duration of Training	On the Job Training
1.	Principles and practices of radiological health safety. Ten lecture hours, formal course.	Monsanto Company St. Louis, Mo.	10 lecture hours	Yes - including directed reading
2.	Radioactivity measurements standardization and monitoring techniques and instruments.	" "	1.5 years	Yes - including directed reading
3.	Mathematics and calculations basic to the use and measurement of radioactivity.	" "	1.5 years	Yes - including directed reading
4.	Biological effects of radiation.	" "	Informal reading	
5.	Actual use of radioisotopes. Synthesis of ^{14}C and ^{3}H compounds.	" "	4.5 years	Yes
6.	Consultant (chemical) in the isolation of amino acid metabolite.	The Agricultural and Technical College of North Carolina, Greensboro, N.C.	2 years	Yes

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ITEM 8   TRAINING WITH RADIOACTIVITY OF DR. PAUL L. WRIGHT

	Type of Training	Trained At -	Duration of Training	On the Job Training
1.	Radiochemistry (formal course)	University of Wisconsin	1 semester	Yes - including directed reading
2.	Principles and practices of radiological health safety.	University of Tennessee Atomic Energy Commission Agricultural Res. Lab. Oak Ridge, Tennessee	3 1/2 years	Yes - including directed reading
3.	Radioactivity measurements standardization and monitoring techniques and instruments.	" "	3 1/2 years	Yes - including directed reading
4.	Mathematics and calculations basic to the use and measurement of radioactivity.	" "	3 1/2 years	Yes - including directed reading
5.	Actual use of high intensity gamma irradiation sources to study biological effects of radiation.	" "	3 1/2 years	Yes - including directed reading
6.	Actual use of radioisotopes in metabolic tracer studies.	" "	3 1/2 years	Yes
		Monsanto Company St. Louis, Mo.	2 1/2 years	Yes

ITEM 8

Drs. Ernest G. Jaworski and Clark A. Porter submitted their training and experience information in previous applications.

ITEM 9 EXPERIENCE WITH RADIATION (ACTUAL USE OF RADIOISOTOPES OR EQUIVALENT EXPERIENCE)

Dr. Gino J. Marco

Isotope	Maximum Amount	Experience was Gained at -	Duration of Experience	Type of Use
^{14}C	20 millicurie	Monsanto Company St. Louis, Mo.	10 years	Synthesis of compounds. Metabolic tracer studies in plants and animals.
^{3}H	2.25 curie	" "	4 years	Synthesis of compounds. Metabolic tracer studies in plants and animals.
^{35}S	1 millicurie	" "	2 years	Metabolic tracer studies in animals.
X-radiation	----	University of Pittsburgh	1 year	X-ray diffraction studies for structure identification.

ITEM 9 EXPERIENCE WITH RADIATION (ACTUAL USE OF RADIOISOTOPES OR EQUIVALENT EXPERIENCE)

Dr. Paul L. Wright

Isotope	Maximum Amount	Experience was Gained at -	Duration of Experience	Type of Use
Ce-144, Pr-144	3 curies	University of Tennessee	$3^1/2$ years	Metabolic Tracer
I-131	40 millicuries	Atomic Energy Commission		Studies
Mo-99	120 "	Agricultural Res. Lab.		
P-32	100 "	Oak Ridge, Tennessee		
Sr-89	100 "			
Sr-90	10 "			
Ca-45	100 "			
S-35	30 "			
Se-75	100 "			
Zn-65	10 "			
Te-132	10 "			
Te-127m	25 "			
Mn-54	20 "			
Pm-147	30 "			
Y-91	10 "			
Nb-95	12 "			
Ru-103	5 "			
Cs-134	3 "			
Ba-140	2 "			
La-140	15 "			
Pr-142	20 "			
Nd-147	4 "			
H-3	6 "	Monsanto Company St. Louis, Mo.	$2^1/2$ years	Metabolic Tracer Studies

ITEM 9 EXPERIENCE WITH RADIATION (ACTUAL USE OF RADIOISOTOPES OR EQUIVALENT EXPERIENCE)

Dr. Robert C. Freeman

Isotope	Maximum Amount	Experience was Gained at -	Duration of Experience	Type of Use
^{14}C	20 millicuries	Monsanto Company St. Louis, Mo.	3.5 years	Synthesis of Compounds
^{3}H	2.25 curies	" "	2 years	Synthesis of Compounds
^{14}C	license free amount	Agricultural & Technical College of North Carolina Greensboro, N.C.	2 years	Consultant in the Isolation of Amino Acid Metabolites

ITEM 10   RADIATION DETECTION INSTRUMENTS

	Type of Instrument	No. Available	Radiation Detected	Sensitivity Range	Window Thickness (mg/cm^2)	Use (Monitor Survey Measure)
1.	Packard Tricarb Liquid Scintillation Spectrometer - Model 314E	1	alpha beta	---	---	Measuring
2.	Nuclear-Chicago Mark I, Liquid Scintillation Counter	2	alpha beta	---	---	Measuring
3.	Packard Auto-Gamma Spectrometer	1	gamma	---	---	Measuring
4.	Tracerlab Laboratory Monitor	2	beta gamma	---	1.7 to 1.9	Survey Monitor
5.	Tritium Monitor Model 9160, Texas Nuclear Corp.	1	beta	---	---	Monitor
6.	Nuclear Chicago Model 2652 Survey Meter	1	alpha beta gamma	---	1.5 to 2	Survey Monitor
7.	Nuclear Chicago Model 2588 Cutie Pie Survey Meter (rate and integrate functions)	1	alpha beta gamma	---	less than 1	Measure Survey Monitor
8.	Nuclear Chicago Direct Reading Pocket Dosimeters Model 2044	6	gamma	---	---	Monitor
	Nuclear Chicago Dosimeter Charger	1				
9.	Nuclear Chicago Actograph III Strip Counter Model 1002	1	beta	---	---	Measuring

ITEM 11 METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE

The above instruments are calibrated as required. For the Model 2652 and Model 2588, the beta source furnished with the instrument is used for weaker radiation. They are calibrated with the 5 mc cesium-137 source for higher radiation intensities. The survey instruments are checked each time they are used. The measuring instruments are normally checked at least weekly.

ITEM 12 FILM BADGES, DOSIMETERS, AND BIOASSAY PROCEDURES USED

Every person using any form of radiation must provide monthly urine samples for counting by the Radiation Protection Officer or his appointee.

When highly energetic beta or any gamma is used, the personnel wear film badges. The service of R.S. Landauer, Jr. & Company, Matteson, Illinois will be used.

Medical emergencies arising from excessive exposure to radioactive materials will be handled by the company Medical Department with assistance of Dr. George Thoma, an expert in this medical field in the St. Louis area.

ITEM 13 EQUIPMENT AND FACILITIES

Laboratory Equipment

Laboratory equipment includes the measuring, monitoring, survey and personal dosimeters described under Section 10. In addition, a film badge service will be obtained for use of high intensity beta or and gamma radiation work. A Tracerlab DK-1 Radioactivity Decontamination Kit fully equipped with a variety of decontaminants, solutions, disposable plastic ware (e.g. shoe covers, gloves, coats, etc.) is available. Nuclear Supplies In- Model 04-103 complete 36 inch long handling tool (4 interchangeable ..s) and one Model 04-403 Posi-grip 36 inch beaker tong and a Tracerlab RPD-1 Remote Pipettor provide the long-handled safety handling equipment.

An Atomlab Rectangular Lead wall container Model RLC-1 (1" walls) cylindrical lead portable container (capable of fitting within the Model RLC-1) furnish the lead shielding for experiments involving hazardous quantities of gamma-emitting radioisotopes. Any gamma sealed source will be maintained in the shielding container provided by the manufacturer at the time of purchase.

Laboratory Facilities and Equipment

Completely equipped chemical laboratories are used for all work involving radioactive material not in the form of sealed sources. At least one fume hood is available in each laboratory for handling materials wherein a volatile component may be encountered. Bench tops and hood tops are of colorlith. Floors are covered with vinyl tile. Each laboratory is equipped with two sinks and adequate bench and storage space. Lead shielding is available for experiments involving quantities of gamma-emitting radioisotopes. Radioactive materials are stored in two primary locations: a locked cabinet in a laboratory is used for beta-emitters or very low-level gamma sources, and for cold storage, a deep freeze (with lock) is used. Tongs, forceps, rubber and plastic gloves are available for safe handling of radioactive materials. Special storage containers are kept in each laboratory using radioactive materials for the disposal of wastes.

A counting room is in a separate room and the lunch room is isolated from the working areas.

Isolated greenhouses and animal rooms are maintained for radioisotope studies and are inspected by the Radioisotope Committee.

ITEM 14 RADIATION PROTECTION PROGRAM

A. Isotope Committee

An Isotope Committee consisting of the following members will have full responsibility for the supervision of radioactive material used by the Agricultural Research Department.

Dr. Gino J. Marco - Group Leader of Metabolism Group, Radiation Protection Officer, Isotope Committee Chairman

Dr. Robert C. Freeman - Senior Research Chemist
Dr. Paul L. Wright - Senior Research Chemist
Mr. Robert L. Merz - Research Chemist, Agricultural Research Department Safety Officer

Functions of the committee are as follows:

1. Designate areas of continued radioisotope use.
2. Approve each use of radioisotopes.
3. Approve personnel new in the use of radioisotopes. Consider recommendations of Radiation Protection Officer.
4. Perform an annual inspection of all areas in which radioisotopes have been used throughout the year.
5. In the absence of the radiation protection officer, any two members may authorize purchase of radioisotopes.

ITEM 14 ISOTOPE COMMITTEE MEMBER

Name: Gino J. Marco

Present Title and Position: Group Leader, Metabolism Group

Degree and Major: B.S. Chemistry
M.S. Chemistry
Ph.D Biochemistry

Positions/Company/Number of Years:

Research Chemist - Monsanto Company - 4
Project Leader - Monsanto Company - 1
Group Leader - Monsanto Company - 6

Radiochemical Experience:

See Item 8 on application

ITEM 14 ISOTOPE COMMITTEE MEMBER

Name: Robert C. Freeman

Present Title and Position: Senior Research Chemist - Chemistry

Degree and Major: B.S. Chemistry
M.S. Chemistry
Ph.D Organic Chemistry

Positions/Company/Number of Years:

Research Chemist - Monsanto Company - 4
Research Chemist - 2 year leave of absence from Monsanto as Prof. Chemistry, The Agricultural and Technical College of North Carolina

Senior Research Chemist - Monsanto Company - 5

Radiochemical Experience:

Total 4.5 years - practice and theory

ITEM 14 ISOTOPE COMMITTEE MEMBER

Name: Robert L. Merz

Present Title and Position: Research Chemist I, Herbicide Group

Degree and Major: B.S. Biology
M.A. Zoology

Positions/Company/Number of Years:

Technician - Monsanto Company - 3 summers
Research Chemist I - Monsanto Company - 4 years
Research Department Safety Officer - Monsanto Company - 3 months

Radiochemical Experience:

Attended Monsanto Company's Agricultural Research Department's Radiochemical Training Seminars which covered:

a) Fundamentals of Radiation
b) Measurement of Radioactivity
c) Application of Radioisotopes
d) Health Physics and Radiochemical Purity

ITEM 14 ISOTOPE COMMITTEE MEMBER

Name: Paul L. Wright

Present Title and Position: Senior Research Chemist

Degree and Major:
B.S. Animal Husbandry
M.S. Biochemistry - Animal Husbandry
Ph.D Biochemistry - Animal Husbandry

Positions/Company/Number of Years:

Assistant Professor - University of Tennessee - $3^1/2$ years
Atomic Energy Commission
Agricultural Res. Lab.
Oak Ridge, Tennessee

Senior Research Chemist - Monsanto Company - $2^1/2$ years

Radiochemical Experience:

See Item 8 on application

ITEM 14

B. Radiation Protection Officer and Function

1) Evaluate radiation hazards in experimentation with radioisotopes and make recommendations for safe usage.

2) Monitor and survey radiochemical experimentation and storage areas and incoming radioisotope shipments.

3) Maintain adequate records and insure that AEC regulations, in general, are followed.

4) Direct emergency activities in cooperation with the Department Safety Director (and Medical Department, if needed) in the case of serious accidents with radioisotopes.

5) Organize and be chairman of an Isotope Committee to assist in the above objectives.

6) Notify the Director of Research about Isotope Committee activities and depend upon the Director for enforcement of rules and regulations.

C. Rules and Regulations for Use of Radioisotopes

1) Radioactive materials may not be purchased without the authorization of the Isotope Committee.

2) Radioactive materials received by the purchaser are taken to the Radiation Protection Officer* where they are surveyed, receipt is noted and the sample coded. Central storage will be maintained for remaining material no longer wanted by the purchaser.

3) Radioactive materials in excess of license-free quantities are not to be used in the department by unauthorized personnel.

4) Radioactive materials are to be located only in the designated storage areas or in the work areas assigned for experimentation approved by the Radioisotope Committee.

5) Eating, drinking, smoking and application of cosmetics are prohibited in the laboratory bench area but may be performed at the writing desks only.

6) Pipeting or any similar operation involving radioactive isotopes with mouth suction is prohibited.

*If the Radiation Protection Officer is unavailable any member of the Isotope Committee may monitor the package and code the sample.

ITEM 14 - C. Continued

7) Appropriate protective clothing is to be worm when contamination with radioactive isotopes is possible, (e.g. using amounts above license-free quantities). This clothing is not to be worn in the counting area.

8) Hood exhaust fans are to be kept running when the hood areas contain radioactive materials.

9) Wearing of film badge (body and/or hands) and/or pocket dosimeter is required by all personnel who work with or who are regularly exposed to gamma, X-irradiation or a neutron source.

10) Minor radioactive spills are to be cleaned up promptly and the area monitored. If radioactive residues remain that constitute potential hazards, the contaminated area must be decontaminated or removed. In case of serious spills, evacuate area of personnel, confine or localize the contamination if possible and notify the Radiation Protection Officer. In these cases, protective clothing and respiration equipment must be worn to monitor and decontaminate the area.

11) Hands, feet and clothing must be monitored before leaving an area where radioactive materials are handled. Contaminated clothing must be removed at once and properly stored. If it cannot be readily decontaminated, it must be discarded with other solid wastes. (Not applicable to amounts at or below license-free quantities.)

12) The designated work areas where radioactive materials are handled are to be monitored at regular intervals and at special intervals, as needed, to control contamination and assure radiation dosages are no greater than AEC recommended limits.

13) Personnel regularly exposed to radiation and radioactive materials are to have blood counts routinely taken at least once yearly. In the event it is suspected that radioactivity has been inhaled or ingested, appropriate specimens are to be submitted for bioassays and the Medical Department notified. Monthly urine samples must be submitted to the Radiation Protection Officer for recording. In a single use of 1 mc or higher of radioactivity, urine analyses must be performed immediately before and after the experiment.

14) Radioactive waste that can be dissolved or dispersed in water is sewered or is collected in suitable containers and sent to Tracerlab for burial. Solid wastes, of short-lived radioisotopes are stored in a designated storage area

ITEM 14 - C. Continued

until radioactivity has decayed to levels permitting dispersal through the commercial disposal service. Radioactive water soluble short lived gammas are to be drummed and held in designated storage until decayed sufficiently to disperse in solvents and sewer. Other solid waste disposals are to be carried out using the commercial waste disposal service in accordance with AEC and ICC regulations. All storage containers are to carry appropriate warning signs. Water insoluble radioactive liquids will be absorbed onto appropriated absorbant before placing in waste disposal barrel.

15) All items in the radioactive chemical storage areas are to be coded and identified as to isotope, chemical form and total activity. All isotopes are to be stored in secure containers that minimize danger of spillage and reduce radiation hazards to a safe level. All storage areas are kept locked where activities of higher than license-free quantities are stored.

16) All persons using radioisotopes are to be trained in proper procedures and safety precautions before being allowed to use any radioactive material at any concentration. The Radiation Protection Officer and Isotope Committee reserve the right to evaluate this training.

17) All personnel handling radioactive materials at this location are to be familiar with these regulations.

D. Sealed Source Leak Test

Dr. Paul Wright is responsible for initial surveys, installation surveys, and leak testing of all sealed sources. The experience and training of Dr. Wright are detailed in Sections 8, 9 and 14. All leak tests will be performed by the wet-tissue wipe-method. Detection of radioactivity on the wipe will be made first by a thin-end window counter (see Section 10) and by the measuring gamma (or beta) counter (see Section 10). Dr. Wright has had three and one-half years experience in leak testing and surveying of sealed sources. In the event that servicing, maintenance, or repair of sealed sources is required, such work will be done by the manufacturer or supplier of the source.

ITEM 15 WASTE DISPOSAL

A. Drainage Disposal (Water Soluble Materials)

Sewage disposal is based on a company sewage flow estimate of about 5000 gal/day going into the main trunk which has a flow of about 10,000 gal/day.

While this would permit 350 millicuries ^{14}C per day, 7000 millicuries tritium per day and 35 millicuries ^{35}S per day, the gross quantity is not permitted to exceed one curie per year.

B. Burial Disposal (Solids and Water-insoluble Materials)

Fiber Lever Paks with plastic liners are kept in each laboratory using radioisotopes. When the container is full, the plastic liner is knotted, and the radioisotopes contained as well as amounts will be written on bags. The bags are placed in 30 or 55 gal ICC approved waste disposal barrels. The barrels are sent to Tracerlabs, Waltham, Mass. for proper burial.