LABELLED COMPOUNDS (^{14}C, ^{3}H, ^{35}S and ^{32}P) & LUMINOUS SOURCES (Tritium Filled)

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CONTENTS

I. GENERAL INFORMATION

Labelled compounds, or more specifically, radiolabelled compounds, are radiochemicals prepared from primary radioisotopes by employing suitable synthetic reactions or labeling procedures. These compounds find an array of applications and play an important role as radiotracers in chemistry, biology, agriculture and medicine. Their versatility as a research tool, especially in Life Sciences, has been amply demonstrated by many scientists in their pioneering work all over the world. Most of the important advances made in understanding the mechanism of photosynthesis, DNA replication during cell division, enzyme, metabolism and biosynthesis of proteins and nucleic acids, inheritance, action of hormones and drug, etc. and also in the studies on the role and fate of insecticides, weedicides and fungicides, soil-plant relationships, fertilizer action, organic and biochemical reaction mechanisms—all these have been possible using labelled compounds which otherwise would have been very difficult to unravel. There have also been extensive applications of labelled compounds in solving analytical problems which include radiometric enzyme assays, isotope dilution analysis, reverse isotope dilution analysis, double isotope derivative method and radioimmunoassay. The routine production and supply of labelled compounds on a commercial scale throughout the world attests to their growing significance.

BRIT has developed, over the years, state-of-the-art techniques, and methodologies for the synthesis of more than 200 compounds labelled with ^{14}C, ^{3}H, ^{35}S, ^{32}P and ^{33}P. The synthesis of ^{32}P and ^{33}P-labelled nucleotides and the assembling of a few molecular biology cold kits are carried out at the Jonaki Laboratory of BRIT at CCMB Campus, Hyderabad for supply to users and researchers working in the field of biotechnology, genetic engineering and molecular biology. The syntheses of a variety of ^{14}C-, ^{3}H-, ^{35}S- and ^{32}P-labelled compounds are carried out at the Labelled Compounds Laboratory of BRIT at Vashi Complex, Navi Mumbai.

Labelled Compounds Laboratory(LCL) at Navi Mumbai has been producing and supplying radiolabelled compounds of high quality at par with international standards for the past four to five decades. Apart from the labelled compounds, it has also been supplying non-radioactive compounds such as oligo nucleotides and cold kits for DNA/RNA labeling.

Custom Synthesis Labelling and Service

LCL also undertakes preparation of labelled compounds which are not mentioned in the catalogue under Custom Synthesis Labelling and Service. For this, the user is required to provide relevant technical information on the compound(see below). This information would be useful in deciding the method of labelled compound preparation from the point of feasibility and designing the chemical reactions, etc. and also to evaluate the approximate cost of the custom synthesis. The exact cost of the synthesis will be

intimated after receiving the following data and subsequent feasibility studies:

1. Name of the compound required to be labelled.
2. Structural formula of the compound.
3. Radioisotope to be labelled with.
4. Position of the label (Alternate choice may be mentioned).
5. Minimum acceptable specific radioactivity(mCi/mmole).
6. Minimum quantity of the labelled compound (mCi or MBq or any larger quantities) that may be needed.
7. Probable synthetic route available from literature, followed for non-radioactive (cold) synthesis.
8. Area of application of the labelled compound envisaged.
9. Any special time limit for the supply of labelled material.
10. Whether the applicant can supply any special chemicals required for the synthesis for avoiding delay.
11. The chemical purity criteria, if any, may be specified.
12. Whether you are agreeable to the condition that BRIT reserves the right for publishing the synthetic work and it will rest on BRIT alone.

Types of labeling services taken up by BRIT

C-14 labelling

H-3 labelling

P-32 labelling

S-35 labelling

In addition to the above preparation and supply of research products, LCL also has been making and supplying products for industrial and defence applications known as Luminous Sources.

Radioluminescence is the luminous emission of an excited body, while returning to stable state subsequent to absorption of ionising radiation. This phenomenon has commercial applications as exploited in the case of radioluminescent paints, which are used mainly in the clock and watch industries since 1930 for painting of the dials and clock needles. The first paint of this type used was based on radium-226. However, the substantial radiation dose delivered by radium-226 and its daughter product radon–222, together with their toxicity, led to its gradual abandonment in favour of pure beta emitters. Besides, from the public health point of view, one of the major disadvantages of radium is its inherent emission of a great deal of penetrating α-particles, which is not useful for the production of light but capable of providing radiation damage to the user. Moreover, only meager advantage, if any, is gained by the long physical half-life of the α-emitting isotope employed, as the phosphor in the vicinity of the α-emitting isotope is damaged. On the other hand, a pure β-emitter is found to cause comparatively very little radiation damage to the phosphor. The increasing attention being given to radiological safety has created an awareness and a need to develop self-luminous paints, which do not employ any of the toxic radioelements. With the advances in nuclear field and in radioisotope production methodologies, low energy pure β-emitting isotopes are available at a lower cost in

substantial quantities and thus provide a fillip for development of user friendly and cost effective illumination devices using suitable radioisotopes. These sources find application in illumination of bridge markers, aircraft signaling, mines, safety panels, aeroplanes, ships, watches and clocks, product advertisements, telephone numbers display, exit signs etc. Tritium and promethium-147 which are soft beta emitters are ideal radionuclides for this purpose. Owing to their relatively low radiotoxicity, they are used in a high specific activity form with reasonable safety, resulting in a high light output per unit volume. Self luminous signs can be prepared in either of two ways a) by using self luminous paints or b) by using a glass tube internally coated with a phosphorescent material and filled with tritium gas. The work employing the latter method has recently been relocated and carried out at LCL, Vashi.

Storage recommendations of radiolabelled compounds and guidelines for their use:

1. Store at low temperatures (but do not freeze unless specifically recommended) preferably diluting the product specific activity to the required level.
2. Whenever possible, dissolve the radiolabelled product in a solvent and keep it in the absence of light in an oxygen-free atmosphere. Pure benzene provides optimum protection. Benzene-ethanol and aqueous ethanol provide less protection than benzene, but more than water.

3. Use only those solvents which have been specially purified. Most common laboratory solvents have trace contaminants which can accelerate radiolytic decomposition.
4. Recheck labelled compounds for purity at appropriate intervals, preferably just before use.
5. Upon receipt, use the labelled product as soon as possible. Labelled compounds are most stable, if stored in the unopened containers. A useful precaution is to procure the required quantity in a number of smaller packages.

Complaints

Complaints regarding the quality of the products, if any, should be made to Senior General Manager, BRIT within 30 days of the receipt of the material. Purity of any labelled compound decreases with passing of time. It is recommended that the procurement of labelled compounds may be planned so as to avoid prolonged storage.

Procedure for ordering

Orders should be placed on an application form(A/1) which is available for downloading in our web site. Supply will be effected on obtaining the authorization from the competent authority(AERB) to receive the radioactive material in specified quantities. If the order placed is for quantity in excess of the quantity authorized, the same will be executed only after receiving their specific authorization. Orders are acknowledged by issuing an acknowledgement note which provides details such as the mode and date of despatch. Users are requested to make arrangements

for collection of the consignments from the respective airports/Mumbai and BRIT will communicate the Airway Bill No. and date by Fax/Phone as the case may be.

Cancellation/Amendment of orders

Cancellation/Amendment of orders already placed should reach us at least seven days in advance from the scheduled date of despatch by CSSC, BRIT.

Payment terms

Supplies will be made and charged for in accordance with the prices prevailing on the date of supply. Invoices, covering the supplies made, should be settled within 30 days by Demand Draft drawn in favour of Accounts Officer, BRIT. The Demand Draft should be sent to the Senior Manager, CSSC, Board of Radiation and Isotope Technology, V.N. Purav Marg, Deonar, Mumbai-400 094. Advance payment is also acceptable.

All enquiries may be addressed to :

Senior Manager, Sales & Marketing
Customer Support Services Cell (CSSC)
Board of Radiation and Isotope Technology
V.N. Purav Marg, Anushakti NagarMumbai-400 094
Tel: 91-22-25573534
Fax: 91-22-25562161/91-22-25581319
e-mail: sales@britatom.com
Web site: www.britatom.gov.in

II. LIST OF LABELLED COMPOUNDS SUPPLIED BY BRIT

a. CARBON –14 LABELLED COMPOUNDS

Sr. No	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
1	Acetic-1-^{14}C anhydride	LCC 51	50-100(1.85-3.7)
2	L-Alanine-^{14}C (U) 3% Ethanol solution	LCC 153	> 75 (> 2.775)
3	e Protein Hydrolysate-^{14}C 01N HCl Solution	LCC 111	> 25 (> 0.925)
4	L-Arginine-^{14}C (U) 3% Ethanol solution	LCC 154	> 150 (> 5.55)
5	L-Aspartic acid-C-^{14}C U) 3% Ethanol solution	LCC 155	> 100 (> 3.7)
6	Benzoic acid (carboxyl-^{14}C) Solid	LCC 6	15 (0.555)
7	Choline-methyl-^{14}C chloride	LCC 195	5-10(0.185-0.37)
8	2-Deoxy glucose-^{14}C(U) (Enquire)	LCC 231	150-250(5.55-9.25)
9	D-Fructose-^{14}C (U) 80% Ethanol solution	LCC 8	150 – 250 (5.55 - 9.25)
10	D-Glucose-c-^{14}C (U) 80% Ethanol solution	LCC 9	150 - 250 (5.55 - 9.25)
11	D-Glucose-1-^{14}C 80% Ethanol solution	LCC 10	10 - 50 (0.37 - 1.85)

Sr. No	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
12	D-Glucosamine-^{14}C(U) Hydrochloride 80% Ethanol solution	LCC 193	150 - 250 (5.55 - 9.25)
13	L-Glutamic acid-^{14}C (U) 3% Ethanol solution	LCC 156	> 125 (> 4.625)
14	Glycine-^{14}C (U) 3% Ethanol solution	LCC 121	> 50 (> 1.85)
15	Glycine-2-^{14}C 3% Ethanol solution	LCC 12	20 - 30 (0.74 - 1.11)
16	Glycolic acid-1-^{14}C Aqueous solution	LCC 171	5 -10 (0.185 - 0.37)
17	Guanine-8-^{14}C. HCl Solid (Enquire)	LCC 14	10 - 30 (0.37 - 1.11)
18	DL-Glyceric acid-1-^{14}C Aqueous solution	LCC 189	2 - 5 (0.074 - 0.185)
19	Glycerol-1,3-^{14}C Aqueous solution	LCC 196	2 - 5 (0.074 - 0.185)
20	L-Lactic acid-^{14}C (U) Aqueous solution	LCC 139	60 - 120 (2.22 - 4.44)
21	L-Leucine-^{14}C (U) 3% Ethanol solution	LCC 157	> 150 (> 5.55)
22	L-Isoleucine-^{14}C (U) 3% Ethanol solution	LCC 124	> 150 (> 5.55)

Sr. No	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
23	L-Lysine-^{14}C (U) 3% Ethanol solution	LCC 158	> 125 (> 4.625)
24	L-Malic acid-^{14}C (U) 3% Ethanol solution	LCC 169	2 - 5 (0.074 - 0.185)
25	D-Mannose-^{14}C (U) 80% Ethanol solution	LCC 170	150 - 250 (5.55 - 9.25)
26	Methanol-^{14}C (minimum order 5 mCi)	LCC 71	10 - 50 (0.37 - 1.85)
27	Methyl iodide-^{14}C (minimum order 5 mCi)	LCC 77	10 - 50 (0.37 - 1.85)
28	Myristic acid-^{14}C Solid	LCC 18	3 (0.111)
28 A	Palmitic acid-1-^{14}C Toluene solution	LCC 21	10-50 0.37-1.8
29	2,4-(Dichloro) Phenoxy acetic acid-2-^{14}C Toluene solution	LCC 141	1 – 5 (0.037 - 0.185)
30	L-Phenyl alanine-^{14}C (U) 3% Ethanol solution	LCC 159	> 225 (> 8.325)
31	Potassium cyanide-^{14}C Solid	LCC 29	30 - 50 (1.11 - 1.85)
32	Potassium thiocyanate-^{14}C Solid	LCC 110	5 - 10 (0.185 - 0.37)

Sr. No	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
33	L-Proline-^{14}C (U) 3% Ethanol solution	LCC 128	25 - 50 (0.925 - 1.85)
34	L-Serine-^{14}C (U) 3% Ethanol solution	LCC 160	> 75 (> 2.775)
35	Sodium acetate-1-^{14}C Aqueous solution	LCC 32	40 - 50 (1.48 - 1.85)
36	Sodium acetate-2-^{14}C Aqueous solution	LCC 33	10 - 50 (0.37 - 1.85)
37	Sodium acetate-1,2-^{14}C Aqueous solution	LCC 34	10 - 40 (0.37 - 1.48)
38	Sodium bicarbonate-^{14}C Aqueous solution	LCC 35	40 - 50 (1.48 - 1.85)
39	Sodium bicarbonate-^{14}C for phytoplankton productivity studies Aqueous solution, pH 9.5 (5µCi/ ml /ampoule)	LCC 162	2.1 (0.0777)
40	Sodium carbonate-^{14}C Aqueous solution	LCC 37	40 - 50 (1.48 - 1.85)
41	Sucrose-^{14}C (U) 80% Ethanol solution	LCC 164	> 100 (> 3.7)
42	Thiourea-^{14}C Solid	LCC 45	5 - 10 (0.185 - 0.37)

Sr. No	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
43	L-Threonine-^{14}C (U) 3% Ethanol solution	LCC 130	> 100 (> 3.7)
44	Thymine-2-^{14}C Solid	LCC 46	10 - 50 (0.37 - 1.85)
45	L-Tyrosine-^{14}C(U) 3% Ethanol solution	LCC 166	> 225 (> 8.325)
46	Uracil-2-^{14}C Solid	LCC 48	10 – 40 (0.37 - 1.48)
47	Urea-^{14}C Solid	LCC 49	10 - 40 (0.37 - 1.48)
48	L-Valine-^{14}C (U) 3% Ethanol solution	LCC 132	> 100 (> 3.7)
49	n- Hexadecane-1-^{14}C (Reference standard for calibration of LSA / LSS)	LCR 3	2 X 103 dpm / mg

b. Custom Synthesised Carbon-14 Compounds

Sr. No.	CUSTOM SYNTHESISED COMPOUNDS	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
1	Ethyl formate-^{14}C	LCCS 1	As specified
2	Ethylene urea-^{14}C	LCCS 2	"
3	Hexaconazole-^{14}C	LCCS 3	"
4	Acephate-^{14}C(methylthio)	LCCS 4	"
5	Ammonium thiocyanate-^{14}C	LCCS 5	"
6	Dimethyl isosorbide[Ring U-^{14}C]	LCCS 6	"
7	Pyrithiobac-^{14}C sodium	LCCS 7	"
8	Diuron-^{14}C	LCCS 8	"
9	Kresoxim-methyl-^{14}C	LCCS 9	"
10	Chloramphenicol-acetyl-1-^{14}C	LCCS 10	"
11	Coenzyme-Acetyl-1-^{14}C	LCCS 11	"
12	Potassium ^{32}P-phosphonate	LCSP 1	"

c. TRITIUM LABELLED COMPOUNDS

Sr. No.	COMPOUND	CODE	SPECIFIC ACTIVITY mCi / mmole (GBq / mmole)
1	Thymidine - methyl - T 50% Ethanol solution	LCT 3	5000 - 10000 (185 - 370)
2	Thymidine - methyl - T 50% Ethanol solution	LCT 53	10000 - 20000 (370 - 740)
3	Tritiated water	LCT 17	1 - 10 mCi / ml (0.037 - 0.37 GBq/ml)
4	Tritiated water	LCT 51	70 - 1000 mCi /ml (2.59 - 37 GBq /ml)
5	Uracil-5-T 50% Ethanol solution	LCT 30	5000 – 10000 (185-370)
6	Uridine -5 -T 50% Ethanol solution	LCT 55	10000 - 20000 (370 - 740)
7	L-Leucine - T(G) 50% Ethanol solution	LCT 11	5000 - 10000 (185 - 370)
8	n- Hexadecane-1,2-T (Ref-erence Standard for calibration of LSA /LSS)	LCR 4	4 X 10^3 dpm / mg
9	Tritium Labelling Service	TLS	Enquire

d. S-35 LABELLED COMPOUNDS

Sr. No.	COMPOUND	CODE	FORMULATION	SPECIFIC ACTIVITY Ci/mmole (TBq/mmole)
1	L-^{35}S-Methionine	LCS 1	Solution containing 20 mM potassium acetate and 0.1 % 2-mercaptoethanol	> 1000 (>37)
2	L-^{35}S-Methionine	LCS 2	Solution containing 0.1 % 2-mercaptoethanol	> 1000 (>37)
3	L-^{35}S-Cysteine	LCS 3	Solution containing 5mM DTT and 20 mM potassium acetate	> 1000 (>37)
4	L-^{35}S-Cystine	LCS 4	Solution containing 5mM DTT & 20 mM potassium acetate	> 1000 (>37)
5	(^{35}S)dATP αS	LCS 5	Solution containing 20 mM DTT& 0.1% 2-mercaptoethanol	> 1000 (>37)
6	^{35}S-Glutathione	LCS 6	Solution containing 0.1% 2- mercapto ethanol	> 1000 (>37)

Sr. No.	COMPOUND	CODE	FORMULATION	SPECIFIC ACTIVITY Ci/mmole (TBq/mmole)
7	ELEGMIX-^{35}S (Met-Cys~70:30)	LCS 7	Solution containing 20 mM potassium acetate and 0.1 % 2-mercaptoethanol	> 1000 (>37)
8	^{35}S-INVIVO PROTWIN LABEL MIX (Met-Cys~ 65:25)	LCS 8	Solution containing 0.1 % 2-mercapto ethanol and 25 mM tricine	> 1000 (>37)

e. TRITIUM FILLED LUMINOUS SOURCES

Sr. No.	Code	OD (mm)	Length (mm)	Shape	Pressure (cm) (Activity mCi)	Temp	Brightness μlamberts
1.	TFS 6	4	25	Curved	55 (300)	Ambient	450
2.	TFS 7	3	10	Straight	60 (120)	Liq N_2	500
3.	TFS 8	3	25	Straight	60 (300)	Liq N_2	200
4.	TFS 10	6	35	Curved	(1000)		500-600
5.	TFS 11	4	26	Curved	55 (300)	Ambient	520
6.	TFS 12	4	30	Curved	55 (370)	Ambient	550
7.	TFS 13	3	13	Curved	60 (140)	Liq N_2	675
8.	TFS 14	3	12	Curved	60 (140)	Liq N_2	300-400
9.	TFS 15	6	20	Curved	40 (400)	Ambient	575
10.	TFS 17	4	29	Curved	55 (370)	Ambient	400
11.	TFS 18	6	50	Straight	35 (1500)	Ambient	1000
12.	TFS 20	8	65	Straight	50 (1000)	Ambient	
13.	TFS 21	6	42	Straight	50 (870)	Ambient	1000
14.	TFS 22	12	17.5	Spherical	(4800)		
15.	TFS 23	22	8 (h)	Disc	50(1000)	Ambient	1000
16.	TFS 26	4	20	Straight	55 (200)	Ambient	440
17.	TFS 27	3	18	Curved	60 (175)	Liq N_2	500
18.	TFS 31	1	10	Capillary	60 (18)	Liq N_2	
19.	TFS 32	1	12	Capillary	60 (22)	Liq N_2	
20	TFS 33	3	45	Curved	55 (400)	Ambient	600

Sr. No.	Code	OD (mm)	Length (mm)	Shape	Pressure (cm) (Activity mCi)	Temp	Brightness μlamberts
21	TFS 34	4	55	Curved	55 (550)	Ambient	500
22.	TFS 35	3	10	Curved	55 (90)	Ambient	600
23	TFS 36	5	150	Straight	40 (3000)	Ambient	
24.	TFS 37	4	45	Straight	55 (450)	Ambient	500
25	TFS 101	4	25	Straight	55 (250)	Ambient	150
26.	TFS 102	22	--	Dome	40 (1700)	Ambient	

f. NON-RADIOACTIVE LABELLING KITS FOR MOLECULAR BIOLOGY

Sr. No.	NAME OF KIT	CODE	No. OF REACTIONS
1	Nick Translation Kit	LCK 1	20
2	Random Primer Kit	LCK 2	30
3	5'-End Labelling Kit	LCK 3	10

g. OLIGONUCLEOTIDES

(Custom synthesis as per the specific requirement of the user)

h. MEDICAL PRODUCTS

Urea-^{14}C capsules (LCM 1)

III. RADIATION SAFETY DEVICES (Enquire)

1. Beta Shield(Acrylic)
2. Rubber Apron
3. Crimpers (Capping and Decapping tools)

IV. Labelled Compounds dispensing and despatch

All ^{14}C- labelled products are supplied in multiples of 0.1 mCi (3.7MBq) and tritium labelled products in multiples of 1.0 mCi (37MBq) , unless otherwise stated whereas ^{35}S-labelled compounds are supplied in multiples of 0.5 mCi. Orders for less than these quantities are not entertained. Enquiries are invited for compounds other than those listed in this catalogue. (U) refers to uniformly labelled compounds and (G) refers to compounds which are generally or randomly labelled . No warranty is given for sterility or freedom from pyrogens. In cases where the compounds are supplied as aqueous solution , they are autoclaved at steam pressure of 15lbs / sq. inch for 20 minutes . These labelled compounds are radiochemicals and are not meant for use on human beings or for clinical diagnosis. The user has to take the sole responsibility for their use and subsequent disposal. Great care is taken to ensure the highest order of purity . Quality is controlled and assessed before dispensing and dispatch and it is assured . ^{35}S-products are shipped in dry ice.

V. DECAY TABLE OF ^{35}S

To use the decay table find the number of days in the top row and left hand column of the chart then find the corresponding decay factor. To obtain a pre-calibration number, divide by the decay factor. For a post-calibration number multiply by the decay factor.

days	0	3	6	9	12	15	18	21	24	27
0	1.000	0.976	0.954	0.931	0.909	0.888	0.867	0.847	0.827	0.807
30	0.788	0.770	0.752	0.734	0.717	0.700	0.683	0.667	0.652	0.636
60	0.621	0.607	0.593	0.579	0.565	0.552	0.539	0.526	0.514	0.502
90	0.490	0.478	0.467	0.456	0.445	0.435	0.425	0.415	0.405	0.395
120	0.386	0.377	0.368	0.360	0.351	0.343	0.335	0.327	0.319	0.312
150	0.304	0.297	0.290	0.283	0.277	0.270	0.264	0.258	0.252	0.246
180	0.240	0.234	0.229	0.223	0.218	0.213	0.208	0.203	0.198	0.194
210	0.189	0.185	0.180	0.176	0.172	0.168	0.164	0.160	0.156	0.153

VI. DECAY TABLE OF ^{32}P

(Factors for calculating the activity at the time of use is given below)

Day from reference date	-6	-5	-4	-3	-2	-1	0
Factor	1.337	1.274	1.214	1.156	1.102	1.050	1.000
Day from reference date	1	2	3	4	5	6	7
Factor	0.953	0.908	0.865	0.824	0.785	0.748	0.712
Day from reference date	8	9	10	11	12	13	14
Factor	0.679	0.646	0.616	0.587	0.559	0.533	0.507
Day from reference date	15	16	17	18	19	20	21
Factor	0.483	0.460	0.439	0.418	0.398	0.379	0.361
Day from reference date	22	23	24	25	26	27	28
Factor	0.344	0.328	0.312	0.298	0.284	0.271	0.258

VII. General Precautions for Handling Radioisotopes

1. Wear disposable lab coat and hand gloves while handling the radioisotope.
2. Label all the containers used for handling ^{35}S and ^{32}P and designate the working area.
3. While handling radio isotope, prohibit eating, drinking, smoking and mouth pipetting in the laboratory.
4. Use sufficient absorbent materials to take care of any accidental spillage of radioactive solution.
5. Handle potentially volatile compounds in ventilated fume-hoods.
6. Regularly monitor and promptly decontaminate the working area
7. To indicate uptake by working personnel, submit periodic urine samples for bio-assay.
8. Allow the radioisotopes to decay in clearly labeled sealed containers.
9. On completion of work, secure the unused isotope, dispose of the waste, monitor and decontaminate self and surfaces.