Code of Practice for the Disposal of Radioactive Wastes by the User (1985)

NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL

Code of Practice for the Disposal of Radioactive Wastes by the User (1985)

Reprinted from the Report of the 99th Session of the Council, June 1985

Australian Government Publishing Service
Canberra 1986

ISBN 0 644 04762 3

Printed by Watson Ferguson and Co., Brisbane

CODE OF PRACTICE FOR THE DISPOSAL OF RADIOACTIVE WASTE BY THE USER (1985)

CONTENTS

CODE OF PRACTICE FOR THE DISPOSAL OF RADIOACTIVE WASTE BY THE USER (1985)

1. Introduction

1.1 Purpose of Code

It is necessary to manage radioactive wastes in such a way that the exposure of persons to radiation is as low as reasonably achievable and below prescribed limits, thus satisfying the ALARA principle first promulgated by the International Commission on Radiological Protection in ICRP Publication No. 9 (1965) and by the National Health and Medical Research Council (1980) in its publication 'Recommended radiation protection standards for individuals exposed to ionising radiation'. The purpose of this Code is to recommend practices which have been found helpful in achieving these objectives for small quantities of radioactive waste and which will ensure a degree of uniformity in radioactive waste disposal procedures. It has been prepared to supplement the radiation control legislation implemented by the appropriate statutory authority (listed in Annexe A). State regulations may contain additional requirements.

1.2 Scope

This document is concerned with radioactive wastes containing relatively low levels of radioactivity, or radionuclides of short half-life, such as are generated by many current medical, industrial and research uses of radioactivity in Australia.

Users generating wastes containing more radioactivity than can be disposed of by the methods described here shall consult the appropriate statutory authority.

1.3 Radioactive waste hazards

Radioactive wastes may present a range of external radiation hazards depending on their activities and emissions and may, if ingested or inhaled, present a variety of internal radiation hazards to the human body dependent upon the nuclide and its chemical and physical forms. However, the radioactive waste considered in this publication is that which is in the lowest category of activities and which presents such a low hazard to the human body that it is considered safe enough to be disposed of by the user.

1.4 Specialised meaning of 'shall' and 'should'

The words 'shall' and 'should', where used in this Code of Practice, have specialised meanings. 'Shall' indicates that the particular requirement is essential for adequate protection against radiation. 'Should' indicates a procedure or precaution which is to apply, wherever practicable, in the interests of improving radiation protection.

1.5 Other regulations governing waste disposal

The disposal of all waste is governed by regulations which vary between and within States and which are administered by various environmental protection and health authorities. The user should take into account any additional restrictions contained in those regulations when planning the disposal of radioactive waste.

2. General Principles

2.1 Radiological hazard assessments

It is possible to carry out a formal radiological hazard assessment of any proposed radioactive waste disposal activity. Such an assessment provides estimates of the risk to a population which is potentially exposed to ionising radiation as a result of the activity. The formal application of the ALARA principle (ICRP, 1965) to waste disposal activity

would follow such an assessment. However, a considerable amount of time and effort is involved in making a radiological hazard assessment, and the limitations prescribed in this Code have been set well below the level at which a formal assessment is generally considered to be necessary under present prevailing conditions.

2.2 Physical form of radionuclides

2.2.1 Airborne wastes may be radioactive gases or vapours, or particulate material to which radioactive atoms are attached as contaminants.

2.2.2 The usual forms of liquid radioactive wastes are aqueous solutions of radionuclides or suspensions of radioactive material in water or water-miscible liquid. Biological waste in the form of excreta or macerated material can also be regarded and treated as liquid waste. However, it should be noted that some sewerage authorities will not permit macerated material to be discharged into their sewers. Another category of liquid wastes is that of organic solvents which, because they are flammable or toxic, usually require special methods of disposal such as incineration in an approved incinerator (see clause 4.3).

2.2.3 Solid wastes, which include liquid and gases in solid containers, occur as sealed sources, unsealed sources and trash. Sealed sources are generally in the form in which they were originally purchased, unsealed sources may include by-products of chemical analysis and residues of bulk supplies of radionuclides, whilst trash includes contaminated packing materials, laboratory glassware, pipette tips, plastic vials and trays, paper tissues, used syringes, tools, etc.

2.2.4 Radioactive animal carcasses need special consideration. Carcasses of small animals such as mice and rats, and excised organs of larger animals may be macerated and treated as liquid waste, disposed of in a tip as solid waste or incinerated and be thus converted into airborne waste emitted through the stack, with any solid residues being concentrated in the ashes. The nature and quantity of radioactivity involved should be taken into account in selecting the appropriate option. Larger animals are not normally sacrificed as part of the study for which radioactive material is administered. However, should a large animal die whilst contaminated with radioactive material, the animal should be incinerated or buried as solid waste.

2.3 Segregation of radioactive waste

It is sensible that the volume of radioactive waste be kept to a minimum and that it be categorised according to its method of disposal at as early a stage as possible. It is therefore advisable that the user sets up the appropriate organisation and educates his staff to achieve this. Guidelines for segregating both solid and liquid radioactive wastes from non-active wastes are given in Annexe B.

3. Responsibilities

3.1 Responsibilities of the statutory authority

A major aim of the user-disposal of radioactive waste concept is to transfer from the statutory authority to the users the task of disposal. However, the statutory authority will still devote some time to examining proposals for disposal submitted to it by the users, to providing further advice and guidance where necessary before issuing an appropriate licence and to checking on the operation of the user-disposal systems from time to time.

Though the user is the actual disposer of radioactive waste and is not directly supervised in most cases, the statutory authority remains the body ultimately responsible to the public for establishing safe practices for the disposal of radioactive waste. The value

of personal communication between representatives of the statutory authority and the user of radioactive material cannot be over-emphasised.

In carrying out its statutory functions, the statutory authority would normally

(a) satisfy itself before a licence to handle radionuclides is issued that the applicant is competent in their safe use and that the methods of disposal of the wastes arising and the limits to the quantities which may be disposed of by the user are clearly understood,

(b) be satisfied that any equipment or site to be used in the disposal process is adequate for the purpose, taking into account, especially in the case of a municipal tip, any future use to which the site may be put,

(c) require a user to appoint a radiation safety officer with specified responsibilities,

(d) ensure by inspection that adequate records are being kept by the user covering the purchase, use and disposal of radionuclides,

(e) remain vigilant for any breach of licence conditions, not hesitating to carry out unannounced inspections when it considers these may be warranted, and

(f) consult with local government and other relevant authorities on all matters connected with radioactive waste disposal since special provisions may have to be made.

3.2 Responsibilities of the user

The user is responsible for

(a) complying with the conditions of his licence and the regulations under the appropriate Act,

(b) ensuring that, before disposing of any radioactive waste in a municipal tip, the tip has been approved by the statutory authority as being suitable for that purpose,

(c) ensuring that, before disposing of any radioactive waste in an incinerator, the incinerator has been approved by the statutory authority as being suitable for the purpose,

(d) obtaining the approval of the statutory authority before disposing of any radioactive waste into a sewerage system and providing the statutory authority with those details of the proposed discharge system together with activities, volumes and types of radionuclides likely to be discharged and the expected frequency of discharge, as may be required,

(e) obtaining the approval of the statutory authority before disposing of any radioactive gaseous products into the atmosphere and providing the statutory authority with details of

- the design of its proposed discharge system,
- the activities, volumes and types of radionuclides likely to be discharged,
- the expected frequency of discharge,
- the meteorology of the area, especially with regard to usual wind direction and speed, and the occurrence of inversion conditions,
- the distribution of members of the public in the area,
- the proximity of inlet ducts for air-conditioning systems, and
- any other details that the statutory authority may require,

(f) seeking approval from the statutory authority for any changes which might affect the safety of the method of disposal of radioactive waste, with special attention being paid to

- modifications to the plumbing system carrying liquid radioactive effluents,

- modification to the extraction system for radioactive gaseous products,
- changes in the design or operation of an incinerator approved for the disposal of radioactive materials,
- installation of new inlets for air-conditioning systems or the construction of buildings or building extensions in the vicinity of the outlets of extraction systems for radioactive gases or incinerators,

(g) advising the statutory authority of any accident or incident which might have resulted in a discharge of effluent in excess of the approved maximum activity, or in spillage or radioactive waste being transported to a tip,

(h) informing the statutory authority of any loss or suspected loss of a radioactive source which might inadvertently have been included with waste for disposal,

(i) maintaining good management procedures and keeping accurate records of the purchase, use and disposal of radioactive materials,

(j) providing all the necessary equipment for the safe handling and disposal of all radioactive waste,

(k) providing detailed instructions for the handling of all radioactive waste and ensuring that employees receive, understand and comply with them,

(l) storing all radioactive waste in adequately shielded containers or in a secure shielded room as appropriate to the nature of the waste and so as to comply with the dose-rate limitations specified by the statutory authority,

(m) ensuring that all radioactive waste leaving the working area, either as gaseous or liquid effluent released to the environment or sewerage system, does so within the activity limits specified by the statutory authority,

(n) ensuring that all radioactive waste being transported from the premises to the place of disposal or storage is packed and transported so that in the event of an accident, there will be negligible risk to the public, and

(o) ensuring that any agent transporting radioactive waste from the premises of the user and disposing of it or storing it on behalf of the user is fully informed of and understands his responsibilities unless the statutory authority, by separately licensing the agent, absolves the user of that responsibility.

3.3 Responsibilities of tip and incinerator operators

Both tip and incinerator operators must regard the disposal of radioactive waste as a special operation which involves negligible risk provided the requirements of the statutory authority are complied with. In general they shall

- familiarise themselves with the requirements of the statutory authority for the disposal of radioactive waste,
- liaise with the user to develop mutually convenient procedures for the receipt and disposal of the waste, which will minimise health hazards arising through error, and
- only accept radioactive waste which is packaged according to the statutory authority's requirements.

In particular, tip operators shall

- prepare a site near the base of an advancing wall of deposited non-active waste in anticipation of the receipt of radioactive waste,
- immediately cover the radioactive waste with at least one metre depth of non-active waste or soil and ensure that sufficient non-active waste or soil is deposited on top of this within twenty-four hours to give a total coverage of at least three metres,
- keep records as may be required by the statutory authority,

- advise the statutory authority of any irregularity in the disposal procedure which might give rise to a health hazard.

In particular, incinerator operators shall

- carry out such tests as may be required by the statutory authority to ensure that the incinerator may safely be used for the disposal of radioactive waste,
- supply samples of slag or fly ash as may be requested by the statutory authority and/or allow officers of the statutory authority to take them,
- keep records as may be required by the statutory authority, seek approval from the statutory authority before making any changes in the design or operation of the incinerator, and
- advise the statutory authority of any irregularity in the agreed disposal procedure or operation of the incinerator whilst radioactive waste is being disposed of.

4. Mechanisms of Disposal

4.1 Transport of radioactive waste

It will often be necessary to transport radioactive waste from the premises of the user to an incinerator, store or municipal tip. In such cases the Code of Practice for the Safe Transport of Radioactive Substances (1982) shall be followed in addition to the requirements of the appropriate statutory authority. Practical guidelines for the transport of typical waste are given in Annexe C.

4.2 Municipal tips

All tips at which radioactive waste is disposed of shall be approved for that purpose by the statutory authority. Disposal of radioactive waste at tips should be restricted to solid waste and the waste shall be packaged for transport to and disposal at the tip according to the guidelines laid down in C1 of Annexe C. The user shall receive the approval of the statutory authority before disposing of any waste contained in any other form of package.

The following regulations shall govern the routine disposal of radioactive waste at a tip by the user

(a) Disposal at a municipal tip shall be restricted to solid waste, including animal carcasses.

(b) The maximum activity of each radionuclide which may be included in any package of waste for disposal at a municipal tip is determined by its half-life and is given in terms of its current Annual Limit on Intake (ALI) by Ingestion for radiation workers, as recommended by the International Commission of Radiological Protection, as follows:

For radionuclides from the natural uranium or natural thorium decay series, including the parent uranium and thorium radionuclides themselves, no more than 250 Bq of each per kg of waste.

For other radionuclides having a half-life of 1 year or greater: 0.1 ALI.

For other radionuclides having a half-life between 60 days and 1 year: 1 ALI.

For other radionuclides having a half-life of 60 days or less: 10 ALI.

Ref. (NOTE: Current ALI values are given in ICRP (1979-82) and IAEA (1982)).

(c) Regardless of the activities of the radionuclides contained in a package, the maximum dose-rate at the surface of the package shall be not more than 5 μSv/h and this shall be checked with a survey meter before the package leaves the premises of the user.

(d) There is no limit to the number of packages which may be disposed of at any one time, but the total activity of each radionuclide contained in all packages placed in any one

burial trench or pit shall not exceed ten times the limit which may be contained in any one package, unless the prior approval of the statutory authority has been obtained.

(e) Short-lived materials not meeting the requirement of (b) and packages not meeting the requirement of (c) above, should be stored until they have decayed to below the limits stated.

(f) Advice shall be sought from the statutory authority on the disposal of solid radioactive waste which does not meet the requirements of this Code for disposal at a municipal tip or by incineration.

When disposing of radioactive waste in a municipal tip, the user or his agent shall

- liaise with the tip operators and ensure that a site for the receipt of the waste is prepared in an area which will be covered by non-radioactive waste or soil within twenty-four hours,
- observe the placing of the package at the site, and
- observe the covering of the radioactive waste by at least one metre of inactive waste or soil.

4.3 Incineration

Radioactive waste suitable for disposal by incineration includes flammable solid waste, animal carcasses, vials containing organic solvents and bulk solvents. Glass vials with closed metal caps are not acceptable because of the risk of explosion and the possibility of radioactive glass residue in the slag; the contents of these should be transferred to plastic containers for incineration. However, glass vials with plastic caps can usually be safely disposed of in limited numbers. Plastic vials containing organic solvents are perfectly acceptable provided the smoke emitted from the incinerator stack does not contravene the standards laid down by air pollution control legislation applicable to the area. This same restriction applies to incineration of bulk solvents.

Before disposal of radioactive waste by incineration, the user shall demonstrate to the statutory authority that the maximum activity of the gaseous products likely to be released to the atmosphere complies with emission standards specified by the authority.

The user shall also observe any requirements of the statutory authority regarding the acceptable forms of packaging for introduction of the waste into the incinerator. He shall comply with any requirements of the incinerator operator for acceptance of material for incineration and shall keep records of the type and activity of radionuclides disposed of by this method, as may be specified by the statutory authority.

Although the statutory authority does not routinely supervise the disposal of radioactive material by incineration, it may periodically check the operation of the incineration system and collect any samples of gaseous effluent, slag, ash or deposit in the stack for analysis.

4.4 Sewerage

Radioactive waste suitable for disposal to sewerage should be restricted to aqueous solutions of radioactive materials and macerated biological material where this is acceptable to the sewerage authorities.

Before disposal of radioactive waste to the sewerage system, the user shall advise the statutory authority of the maximum activities of each radionuclide which it is envisaged will be disposed of by this method. Unless the statutory authority deems otherwise a user may discharge as liquid effluent into an approved sewerage system an activity of each radionuclide not exceeding twenty times the current Annual Limit on Intake by Ingestion for radiation workers recommended by the International Commission on Radiological Protection, during any period of seven days. Users wishing to discharge more than this activity shall first obtain the approval of the relevant authority.

The statutory authority will advise the user of the acceptability of his proposals and whether any limits will be imposed on such releases. The user shall comply with any limits so imposed.

If the statutory authority requires that liquid radioactive waste should first be discharged into a holding tank, alternative methods of disposal should be proposed by the user for approval by the statutory authority in the event that the contents are too active to release into the sewerage system when the tank is full. Usual requirements for a holding tank are given in Annexe D.

The statutory authority may require the user to have a competent sewerage authority periodically check the plumbing system used for the disposal of radioactive materials to sewerage to ensure that it remains leak-free. In some circumstances, the statutory authority may require the sewerage lines to be appropriately labelled.

The user should retain such records of radioactive materials discharged to sewerage as may be required by the statutory authority.

4.5 Disposal to atmosphere

Where a user wishes to discharge radioactive gases to the atmosphere he shall advise the statutory authority of the proposed activities to be discharged and the route by which discharge will take place. Where the statutory authority considers that, under some circumstances, discharges could lead towards the creation of a health hazard, it will impose appropriate conditions to prevent such an occurrence. Even where the discharges are considered to be non-hazardous, the user shall ensure that the effluent system remains leak-free so that the radioactive gases cannot escape into working areas. Effluent systems for radioactive gases should be made available to the statutory authority for inspection.

4.6 Interim storage

It is often necessary to store radioactive materials to allow them to decay to activities such that they are suitable for disposal by burial, incineration or release to the sewers. These materials which may be solid or be bulk liquid in closed containers should be kept in secure stores, the requirements for which are given in Annexe E. Each container shall be clearly labelled with a description of the radioactive contents, the activity when stored, the anticipated date when it may be released from the store and the name of the person responsible for placing it in the store. An accurate inventory of all containers and their contents in the store at any time shall be maintained.

4.7 Materials of long-half-life

It is not desirable that radioactive materials of long-half-life, which are no longer required by the user and which are too active for disposal, be stored by the user. With change of staff and possible movement of the user to other premises, the existence of the material may be forgotten in the longer term and it could become a danger to other persons, especially if its markings are missing or obscured. When they are no longer required, sources of long half-life should be returned to the supplier whenever possible.

If it is known when putting a radioactive source into storage that it will not have decayed within five years to an activity that it can be disposed of by burial, incineration or release to the sewers, details of the source shall be registered with the statutory authority. If the statutory authority cannot provide alternative safe storage, the registration of the source will provide some safeguard against its being misplaced or overlooked.

5. Miscellaneous

5.1 Radiation labels

When a radioactive source is being used or transported its container should be clearly marked with the appropriate radiation labels and warning signs. However, most packages

of radioactive material which qualify for disposal by the user can also be placed in the category of 'Items exempt from specified prescriptions' as defined in 'Code of Practice for the Safe Transport of Radioactive Substances (1982)'. As such, all radiation labels should be removed from the outer layer of packaging or, where this is not feasible, the source should be enclosed in an opaque package not bearing such labels. The same rules apply also to empty containers and cardboard packaging materials which may bear radiation labels denoting their previous contents, but which are not contaminated with radioactive materials.

5.2 Users outside the metropolitan area

Because the usage of radionuclides outside metropolitan areas is far less than within them and as the population density is lower, the effects of an accidental release of radioactive material into the environment would tend to be less. Nevertheless, the conditions laid down for the storage and disposal of radioactive waste should be followed by the user unless he has obtained prior approval from the statutory authority to act otherwise.

There should be close consultation between the statutory authority and the local government authority on all matters connected with radioactive waste disposal especially where a proposed method of disposal is less stringent than would be allowable in the metropolitan area. For example, the disposal of radioactive waste by incineration might safely be carried out using a less-sophisticated burner at a locality remote from a centre of population if an incinerator meeting the strict conditions of the statutory authority's requirements is not available.

5.3 The keeping of records

In order that an overall picture of the usage of radionuclides may be available to the statutory authority, it is necessary for records covering purchase, use and disposal of radionuclides to be kept by the user and be available for inspection by the statutory authority. Records covering the disposal of radionuclides should specify the radionuclide, its estimated activity, the physical nature of the discharged material, the date of disposal and the method of disposal, together with any other details specified by the statutory authority. The statutory authority may, at its discretion, specify that certain of these records be forwarded to it on a regular basis. The user shall obtain from the statutory authority details of the records to be kept, their format and the frequency with which such records are to be supplied to it.

6. References

IAEA (1982) Basic safety standards for radiation protection (1982 edition), IAEA Safety Series No 9, International Atomic Energy Agency, Vienna (1982).

ICRP (1965) Recommendations of the International Commission on Radiological Protection, ICRP Publication 9, Pergamon Press, Oxford (1965).

ICRP (1979-82) Annals of the International Commission on Radiological Protection, ICRP Publication 30, Pergamon Press, Oxford (Several volumes published between 1980 and 1982).

Department of Home Affairs and Environment (1982) Code of Practice for the safe transport of radioactive substances, AGPS, Canberra (1982).

National Health and Medical Research Council (1980) Recommended radiation protection standards for individuals exposed to ionising radiation, AGPS, Canberra (1981).

ANNEXE A

Statutory Authorities

Advice and assistance on various aspects of radioactive waste management is available from the following authorities:

1. Australian Capital Territory
   Consultant, Radiation Safety
   Capital Territory Health Commission
   P.O. Box 825
   CANBERRA CITY A.C.T. 2601 Telephone: (062) 47 2899

2. New South Wales
   Officer-in-Charge
   Radiation Health Services
   Department of Health
   P.O. Box 163
   LIDCOMBE N.S.W. 2141 Telephone: (02) 646 0222

3. Northern Territory
   Director
   Occupational and Environmental Health
   N.T. Department of Health
   G.P.O. Box 1701
   DARWIN N.T. 5794 Telephone: (089) 80 2911

4. Queensland
   Director
   Division of Health and Medical Physics
   Department of Health
   535 Wickham Terrace
   BRISBANE QLD 4000 Telephone: (07) 224 5611

5. South Australia
   Senior Health Physicist
   Occupational Health and Radiation Control Branch
   South Australian Health Commission
   G.P.O. Box 1313
   ADELAIDE S.A. 5001 Telephone: (08) 218 3211

6. Tasmania
   Health Physicist
   Division of Public Health
   Department of Health Services
   P.O. Box 191B
   HOBART TAS. 7001 Telephone: (002) 30 6421

7. Victoria
   Senior Scientific Officer
   Radiation Safety Section
   Health Commission of Victoria
   555 Collins Street
   MELBOURNE VIC. 3000 Telephone: (03) 616 7777

8. Western Australia
The Secretary
Radiological Council
Radiation Health Branch
Health Department of Western Australia
Verdun Street
NEDLANDS W.A. 6009 Telephone: (09) 380 1122

ANNEXE B

SEGREGATION OF RADIOACTIVE WASTE BY THE USER

The user of radioactive material should pay special attention to the management of working areas in which unsealed radioactive material is used in view of the potential hazards of mishandling such material. A clean, well-ordered working environment, a well-instructed and disciplined staff and clear labels on cupboards, equipment and receptacles for radioactive waste are desirable elements in good management.

In planning the working environment, the user should take into account the range of radioactive waste likely to be produced, including the radionuclides which will be disposed of and the physical form and volume of each type of waste. Liquid waste which must be incinerated and that which must be stored should be specified and segregated from that which may be discharged directly to the sewerage system. Solid waste for disposal at the tip should be segregated from that to be incinerated and from that which may require storage.

Where liquid radioactive waste is being produced regularly at activities which may conceivably exceed those which may be discharged directly to the sewers, sinks connected to a delay tank system should be provided and labelled; these sinks should be restricted to uses involving radioactive waste products. Where the volume of liquid radioactive waste is small, a labelled screw top container in the working area may be adequate. Similarly, one or more fume cupboards should be reserved for work which might involve the release of radioactive gaseous products.

Receptacles should be provided for the receipt of various types of radioactive solid waste and these should be clearly and appropriately labelled and placed near to where the materials are being handled. The contents of the solid waste receptacles should be packaged for storage or disposal as soon as practicable and the activity and nature of the radioactive materials should be recorded so that the requirements of the relevant paragraphs of the Code of Practice for the Safe Transport of Radioactive Substances (1982) can be determined. The use of a plastic garbage bag as the inner liner of the solid waste receptacle is strongly recommended for waste destined for the municipal tip or incinerator, as this can be tied when nearly full and, when placed inside a second garbage bag, becomes a durable package suitable for transport and ultimate disposal.

In the hospital environment, bed linen which may be contaminated with radioactive materials should remain segregated from other linen and laundered separately under instructions provided by the radiation safety officer which comply with the requirements of the statutory authority. Any linen and similar material for disposal which is also radioactive shall remain segregated from non-active waste and be appropriately disposed of as radioactive material. Toilets used by patients being treated with radioiodine should be clearly marked and only used by those patients. The effluent from these toilets should be connected to a holding tank system and be monitored before discharge to the sewerage system.

ANNEXE C

GUIDELINES FOR THE PACKAGING AND TRANSPORT OF RADIOACTIVE WASTE

C.1 Form of packaging for transport and disposal

Packaging of radioactive waste material for transport shall be secure and so designed that the package can be easily handled. The outer layer shall be of such material as to avoid, as far as practicable, the collection and retention of water and finished so that it may be easily decontaminated. When a package requires no visible labelling implying that its contents are radioactive the outer layer of packaging should be opaque.

Radioactive waste material for disposal shall be packaged in closed drums, opaque plastic bags or multi-layer paper bags on the premises of the user before transport. All three forms of packaging are acceptable for disposal at municipal tips. Opaque plastic bags or multi-layer paper bags are suitable for disposal in incinerators. Closed drums or other containers with solid walls may be suitable for storage. Where possible, the packaging material should be chosen such that it remains the packaging in which the radioactive material is ultimately disposed of by whatever method is chosen.

In the case of disposal at a tip, any movement of radioactive contaminants from the tipping site after disposal would be in the ground water. It is important that this movement be delayed as long as possible to allow maximum radioactive decay. To achieve this and to minimise the risk of accidental rupture of the packaging, there shall be at least two complete layers of packaging between the radioactive waste material and the exterior of the package, one layer of which shall be waterproof.

Suggested forms of packaging are:

(a) For soft materials such as paper, cardboard and textiles, and light solid objects including empty vials and disposable syringes (but not needles or other objects with sharp edges or points);

(i) Materials contained in a plastic garbage bag (which may have been the liner of a waste receptacle in the working area) and the whole placed in a plastic garbage bag in a clean area of the user's premises. Both bags are to be securely closed.

OR (ii) Materials placed in a multilayer paper bag having a plastic inner liner and the bag securely closed.

(b) Syringe needles, pipette tips and any other sharp objects:

Be adequately protected by means of an impenetrable sleeve or container so that they will not puncture the outer package. Then, depending on the size of the containment, it may be treated as in (a) above or (c) below.

(c) For all materials regardless of size and weight:

Materials placed in a metal drum having a large plastic bag as a liner and a lid which can be sealed in position.

C.2 Radiation and contamination limits

The dose-rate at the surface of the package containing waste material for disposal at a tip or incinerator shall be not more than 5 μSv/h and the maximum non-fixed external contamination shall be 4 Bq/cm^2 or, for alpha-emitters having a half-life greater than 10 days, 0.4 Bq/cm^2. If any of these limits is exceeded, the statutory authority should be consulted for advice. One method of ensuring that contamination is eliminated, is to enclose the package in a clean plastic garbage bag before being transported. Higher values of the surface dose-rate are permissible for packages containing waste material to be placed in a store; the statutory authority should be consulted for advice on this.

C.3 Labelling of waste for transport

A package with a surface dose-rate of not more than 5 μSv/h and otherwise meeting the requirements of 'Items exempt from specific prescriptions' in Section III of the Code of Practice for the Safe Transport of Radioactive Substances (1982) should contain no visible labelling implying that it is radioactive. However, an inner layer of packaging should be labelled so that the word 'Radioactive', or the appropriate logo, is visible when the outer packaging is opened. The vehicle transporting such waste should not bear any sign or notice stating that it is carrying radioactive material. However, it is suggested that a metal warning notice should be contained in the cab of the vehicle which would be visible if the vehicle were to be involved in an accident and the driver incapacitated and unable to advise anyone of the nature of his load. The notice should give the name of the user and/or the statutory authority. If the package contains waste material that does not comply with the exemption requirements, then the package and its labelling should comply with specific requirements given in the Code of Practice.

ANNEXE D

Requirements for a Tank for Holding Liquid Radioactive Waste

Holding tanks are usually constructed in sets of two or more so that one may be filling while the contents of a full one is being sampled, analysed and discharged. Before a tank designed to temporarily hold liquid radioactive waste is constructed, the appropriate statutory authority shall be consulted. The tank shall meet the following general requirements.

(a) It shall be leak-free and so constructed that it can be expected to remain leak-free.

(b) It shall have visual indicators of the volume of the contents at any time and have warning devices which operate when the tank is almost full so that the effluent may manually or automatically be switched to fill a second tank.

(c) It shall be enclosed in a secondary enclosure of sufficient volume to hold the contents if at any time there should be a loss of tank contents.

(d) It shall have facilities which allow easy withdrawal of representative samples of the contents.

(e) It shall have a trapdoor to allow visual inspection for the build-up of any internal deposits on the base and sides and to allow access for clearing, should this become necessary. (The incorporation of mechanical agitators to keep the contents in motion during sampling and discharge will reduce the incidence of deposits.)

(f) If the tank holds human or animal wastes, appropriate provision shall be made for sanitary control.

ANNEXE E

Requirements for a Store for Radioactive Waste

A store designed to temporarily hold radioactive waste shall meet the following requirements.

(a) It shall have signs which clearly identify the purpose for which the store is used and appropriately advise all persons who may enter it, including firefighting personnel.

(b) It shall be adequately shielded to protect all persons outside the store from doses which exceed those specified in current regulations.

(c) It shall be secure against unauthorised entry.

(d) It shall be sited so as to minimise the risk of flood and other natural and man-made hazards. However, if the store cannot be guaranteed against accidental flooding from such causes as burst water pipes or leaking roofs, provision shall be made for all materials to be stored above floor level and an automatically operated sump and pump system installed with sufficient output capacity to counteract any conceivable flooding.

(e) Provision shall be made for bulk liquid waste in glass, plastic or metal containers to be stored in trays having sufficient volume to hold any liquid released through breakage or rupture of the container.

(f) If the store is likely to hold any volatile radionuclides, an air extraction system shall be installed which can be switched on from outside before a person enters the store. The point of discharge for the extraction system should be well away from any occupied area and remote from any air conditioning intake. An extraction system which is automatically switched on by the opening of the door should be considered.

(g) The inside of the store shall be of such materials and so designed as to allow for easy decontamination.