Department of Education Science and Training

National Radioactive Waste Repository

Waste Acceptance Plan

December 2003

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1. Introduction

1.1 PURPOSE AND SCOPE OF DOCUMENT

The Commonwealth Department of Education Science and Training is responsible for the operation of the National Radioactive Waste Repository for disposal of low level and short-lived intermediate level radioactive waste. The facility is located approximately 20 kilometres east of Woomera in South Australia.

This Waste Acceptance Plan (WAP) serves to inform those organisations intending to provide radioactive waste for disposal at this repository of the requirements and criteria that will need to be met by such waste as well as the process to be followed in having the waste accepted for disposal.

The Waste Acceptance Criteria (WAC) contained in Chapter 4 of this document are the technical specifications and procedures applicable to the treatment and transport of waste in preparation for its disposal in the repository as defined by the relevant codes of practice, the environmental regulations, technical and safety requirements, waste characterisation plans, performance assessments and other applicable requirements.

This WAP prescribe the requirements that shall be met before waste can be accepted for final disposal at the Australian National Radioactive Waste Repository, in accordance with the NHMRC Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia [1]. The WAP is consistent with the Australian transport [2, 3] and hazardous waste [4, 5] regulations and the IAEA guidance on waste management, including classification [6 – 8] and transport [9, 10].

1.2 STRUCTURE OF DOCUMENT

This chapter provides introductory information, covering the responsible organisations, the applicable legislation, a description and outline of the function of the repository and the waste categories that can be accepted for disposal.

Chapter 2 describes general administrative requirements applicable to the waste acceptance and transfer process.

Chapter 3 identifies the responsibilities of the Waste Owners who utilise the repository.

Chapter 4 presents the WAC. This chapter defines the physical/chemical, radiological and packaging criteria that must be satisfied for acceptance of waste for disposal in the repository.

Chapter 5 lists the references used in this document.

Chapter 6 provides a glossary of terms used in this document.

Appendix A lists the generic activity concentration limits (the upper limits for disposal), as presented in the NHMRC Code in accordance with the waste classification system contained in the Code, but with several of the activity limits rounded up for simplicity.

However, Activity Limits have also been developed for the suite of radionuclides currently identified to be potentially disposed in the National Radioactive Waste Repository. The activity limits give the maximum inventories that could be disposed in the ANR while still leading to post-closure repository performance that would be assessed as acceptable.

Appendix B lists the technical information to be provided by the Waste Owner on the *Waste Transfer Manifest*.

Appendix C contains forms that are to be used by the Waste Owner and DEST in relation to the process of acceptance and transfer of waste for disposal.

This document contains a series of "Notes" which provide additional explanations, justifications and examples to assist the Waste Owner.

1.3 RESPONSIBLE ORGANISATIONS

DEST has the overall responsibility for operation of the repository as the Department representing the Commonwealth of Australia.

The Repository Operator is the organisation appointed by the Department of Education Science and Training (DEST) as their agent to operate and manage the repository.

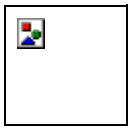
The Waste Owner is that organisation with clear legal responsibility for the waste at the point immediately before it is transferred to DEST for disposal. The Waste Owner may be the organisation responsible for the facility where the unconditioned waste is generated, or the organisation that conditions the waste on behalf of the original waste owner. The Waste Owner is nominated as the "Customer" in the Waste Disposal Contract.

1.4 APPLICABLE LEGISLATION, STANDARDS, CODES AND GUIDES

The following documents contain conditions and requirements applicable to the repository.

Australian Documents

- Commonwealth of Australia. Australian Radiation Protection and Nuclear Safety Agency. Code of Practice for the Safe Transport of Radioactive Material. Canberra. 2001.
- Commonwealth of Australia. Australian Radiation Protection and Nuclear Safety Act. Canberra. 1998.
- Commonwealth of Australia. Australian Radiation Protection and Nuclear Safety Regulations. Canberra. 1999.



- Commonwealth of Australia. National Road Transport Commission and Federal Office of Road Safety. Australian Code for the Transport of Dangerous Goods by Road and Rail, Sixth Edition. Canberra. 1998.
- Commonwealth of Australia. Guide to Controlled and Other Wastes under Australia's Hazardous Waste Act. ISBN 92-0 642 54543X. Canberra. 1998.
- Commonwealth of Australia. Recommendations for Limiting Exposure to Ionizing Radiation and National Standard for Limiting Occupational Exposure to Ionizing Radiation. Canberra. 1995.
- Commonwealth of Australia. National Health and Medical Research Council Recommendations for Limiting Exposure to Ionizing Radiation – Dose Limits. Canberra. 1995.
- Commonwealth of Australia. Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia. Radiation Health Series No. 35. ISBN 92-0 644 28673 3. Canberra. 1992.
- Commonwealth of Australia. Australian Radiation Protection Standards. Canberra. 1991.
- Commonwealth of Australia. Occupational Health and Safety (Commonwealth Employment) Act. Canberra. 1991.
- Commonwealth of Australia. Hazardous Waste (Regulations of Export and Imports) Act. Canberra. 1989.

IAEA Documents

- International Atomic Energy Agency. Regulations for the Safe Transport of Radioactive Material. IAEA Safety Standards Series No TS-R-1 (ST-1, Revised). ISBN 92-0-101194-6. Vienna. 2000.
- International Atomic Energy Agency. The Principles of Radioactive Waste Management. IAEA Safety Series No. 111-F. Vienna. 1995.
- International Atomic Energy Agency. Radioactive Waste Management Glossary. ISBN 92-0-103493-8. IAEA Publication. Vienna. 1993.
- International Atomic Energy Agency. Classification of Radioactive Waste. IAEA Safety Series No 111-G-1.1. ISBN 92-0-101194-6. Vienna. 1993.
- International Atomic Energy Agency. Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material. IAEA Safety Standards Series No TS-G-1.1 (ST-2). ISBN 92-0-111802-3. Vienna. 2002.

1.5 FACILITY DESCRIPTION AND FUNCTION

The National Radioactive Waste Repository is an engineered near surface disposal facility for the controlled and permanent burial of solid radioactive waste. Future retrieval of waste from the repository is not intended.

The disposal structures consist of trenches and large diameter boreholes that provide engineered barriers for waste containment, in addition to those barriers provided by the waste packaging. The filled trenches will be capped with an engineered system to minimise the potential for water infiltration and boreholes will be backfilled with cement grout.

The radioactive waste will generally be contained inside packages, typically standard industrial 200 litre mild steel drums. Other packages may be used if approved by DEST. Packages may contain a cementitious grout for radiation shielding. The packages will be placed inside the trenches and boreholes during the operational lifetime of the repository that is expected to be about 50 years.

The acceptable wastes for disposal at the repository can be described as low level and short-lived intermediate level waste (LILW) defined by IAEA in [8]. The acceptable wastes contain radioactivity above the clearance levels established by the regulatory authorities (exempt wastes) but below that contained in long-lived intermediate wastes.

Category A, B and C wastes (as defined in the NHMRC Code of Practice for Near Surface Disposal [1]) will be accepted for disposal in the national repository as detailed in this WAP.

The acceptable wastes may contain high levels of short-lived radionuclides that will decay significantly during the period of institutional control and low concentrations of long lived radionuclides that will not decay significantly during the institutional control period of the repository.

Activity Limits have been derived which satisfy the specific requirements of the National Health and Medical Research Council code that activity limits be calculated to cover radionuclides present in the inventory, taking account of potential future exposure scenarios relevant to the repository site [11].

2. Waste Transfer Process

2.1 STEPS IN WASTE TRANSFER PROCESS

There are a number of distinct steps involved in the process that results in the transfer of the ownership and responsibility for the radioactive waste from the original Waste Owner to DEST. These are outlined in the following sections.

This process commences with the Waste Owner making an application for waste disposal and completes with DEST (or the Repository Operator as its agent) issuing the *Waste Disposal Certificate* (Appendix C Form 4).

The various steps are presented below, with emphasis on the ramifications of the transfer process on the Waste Owner.

2.2 LODGEMENT OF A WASTE DISPOSAL APPLICATION

DEST will call for applications for waste disposal when it intends to commence the planning of a disposal campaign.

A Waste Owner wishing to have waste accepted for disposal in that campaign shall make a formal application for disposal to DEST. This shall be done by the lodgement of the completed *Waste Disposal Application* form by the Waste Owner. The format of the *Waste Disposal Application* form is contained in Appendix C, Form 1.

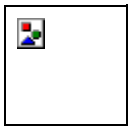
For waste that is not yet conditioned, the Waste Owner shall provide the relevant information to DEST on the *Waste Disposal Application* form to allow the proposed treatment and conditioning methodology to be approved prior to use. If the waste has already been conditioned, the Waste Owner shall provide the relevant information to DEST to allow the product to be assessed and approved.

In submitting this application form the Waste Owner is undertaking to ensure that all waste to be supplied for transport and disposal will conform to the requirements of this WAP.

2.3 ESTABLISHMENT OF A WASTE DISPOSAL CONTRACT

DEST will review the submitted *Waste Disposal Application* form to ensure that the information provided confirms that the waste will meet the requirements of the WAP when provided for transport and disposal, as well as any disposal site authorisations and strategies.

DEST will resolve any unacceptable issues in relation to the application for disposal with the Waste Owner who shall amend its application accordingly.



The Radioactive Waste Disposal Contract formalising the agreement for waste disposal between DEST and the Waste Owner will then be executed containing the WAP and the completed *Waste Disposal Application*.

2.4 PREPARATION OF WASTE FOR TRANSFER

The Waste Owner shall prepare the waste for transfer to DEST as proposed in the *Waste Disposal Application* and in accordance with the WAP.

Any variation proposed in the amount or type of waste or in the type of conditioning or waste characterisation from that stated in the *Waste Disposal Application* will require the approval of DEST.

The Waste Owner shall clearly demonstrate through a process of Quality Assurance that the waste meets the requirements of the WAP.

2.5 DEST VERIFICATION PROCESS

DEST reserves the right to audit the Waste Owner's operations in relation to the waste proposed for disposal in order to receive further assurance that the waste conforms to the requirements of the WAP.

The Waste Owner's waste characterisation and conditioning activities will be subject to a verification programme by DEST to confirm that the waste has been accurately described in the *Waste Disposal Application* (as may have been varied with the agreement of DEST) and that it is being conditioned and characterised in accordance with the WAP.

This will require the Waste Owner to cooperate with DEST in the following manner in order to enable DEST to perform this verification.

- Allow DEST access to inspect and/or test a waste consignment at any stage prior to transfer of the waste to DEST.
- For waste not conditioned at the date that the contract is executed, provide access to the consignment for inspection by DEST before conditioning is undertaken.
- For waste already conditioned at the date that the contract is executed, provide verification that confirms the identification of the waste type and that the conditioned waste conforms fully to the WAP.

Any discrepancies identified by DEST between the verification results and information provided shall be resolved before DEST will accept the waste for disposal. The Waste Owner shall make verification arrangements before packaging the waste.

Wastes that have been conditioned or part conditioned in advance of the date of execution of the contract may, at the discretion of DEST, be exempted from some of the verification requirements of this WAP. For example, if compliance with the

characterisation requirements necessitates unacceptable doses to the workers, existing information may be deemed to be acceptable.

2.6 WASTE TRANSFER MANIFEST

Following completion of the waste conditioning and packaging the Waste Owner shall prepare a *Waste Transfer Manifest* in the format of Form No. 2, Appendix C. The *Waste Transfer Manifest* shall contain the technical information as listed in Appendix B along with supporting QA documentation and shall cover the full inventory of waste items that are proposed for transfer to DEST in the disposal campaign.

The *Waste Transfer Manifest* shall list each of the separate waste packages using a waste identifier (number and name). The *Waste Transfer Manifest* including supporting Quality Assurance documentation shall be submitted by the Waste Owner to DEST in advance of the date for collection of the waste for transport to the repository. This will allow DEST to finally confirm that the listed waste is acceptable for disposal and to schedule the pick-up of the waste for transport to the repository.

2.7 TRANSFER OF OWNERSHIP OF THE WASTE

The point at which the ownership of the waste transfers from the Waste Owner to DEST is as specified in the Radioactive Waste Disposal Contract. For the majority of waste owners it will occur at the point of collection of the waste by DEST for transport to the repository.

However, for larger Commonwealth waste owners, who have elected to handle the transport of their own waste to the repository themselves (with the approval of DEST), transfer of ownership will occur at the point when they deliver the waste to the repository.

The inventory of the waste transferred in each shipment shall be listed by the Waste Owner on a *Waste Transfer Certificate* that will record the identifier number for each waste item that is being accepted for transport by DEST in that shipment. A copy of the *Waste Transfer Certificate* form is included as Form 3 in Appendix C.

Only waste packages that are listed on the *Waste Transfer Manifest* that was previously submitted by the Waste Owner can be listed on the *Waste Transfer Certificate*. The Waste Owner shall sign the *Waste Transfer Certificate* which will be countersigned by DEST when the waste shipment has been collected, or for a Waste Owner delivering its waste to the repository, when the waste shipment has been unloaded at the repository.

2.8 LOADING THE WASTE FOR TRANSPORT TO THE REPOSITORY

DEST will supply the transport package (expected to be a standard shipping container) and be responsible for the loading and securing of the waste packages within the transport package in preparation for transport to the repository. The Waste

Owner shall assist DEST in the loading and securing of the waste package within the transport package, if such assistance is requested by DEST.

However, larger Commonwealth waste owners, who have elected to handle the transport of their own waste to the repository, (with the approval of DEST) shall supply the transport packages and load and secure the waste packages within the transport packages and transport the waste to the repository and unload it at a location nominated by DEST.

2.9 TRANSPORTATION TO THE REPOSITORY

As stated above, waste shipments will in general be transported to the repository by DEST.

However, larger Commonwealth waste owners may elect to transport their own waste to the repository with the approval of DEST.

2.10 PREPARATION FOR DISPOSAL OF WASTE

Notwithstanding the countersigning of the *Waste Transfer Certificate* by DEST, DEST may check or monitor the waste to further confirm its compliance with the WAP at any stage up until the time that the waste has been buried.

This may include the following receipt monitoring:

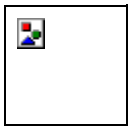
- **Level 1:** Receipt documentation checks, contamination and dose rate measurements, physical inspection, weighing, screening documentation for non conforming chemicals, checking documentation for conformance with the WAP and with the Radioactive Waste Transfer Contract.
- **Level 2:** Non destructive assay (for example, gamma spectroscopy of waste packages).
- **Level 3:** Intrusive sampling and analysis, (that is, sampling the contents of a package drum and analysing the samples for alpha, beta and gamma emitters, chemicals and other substances.)

Any discrepancies discovered between the receipt monitoring results, the information provided by the Waste Owner and the requirements of the WAP shall be resolved to the satisfaction of DEST before the waste is disposed of at the repository.

Any non-conforming wastes shall either be collected by the Waste Owner, or alternatively, DEST may treat the waste to make it conform at the expense of the Waste Owner. The Waste Owner will nominate the approach to be adopted in this situation.

2.11 WASTE DISPOSAL CONFIRMATION

Once the waste has been finally buried in a disposal structure at the repository, and the Waste Owner has met its financial obligations under the contract DEST, will issue



the *Waste Disposal Certificate* to the Waste Owner confirming that the waste disposal action is complete.

A copy of the *Waste Disposal Application* form is included in Appendix C (Form 1).

3. Waste Owner Responsibilities

3.1 GENERAL

The responsibilities of the Waste Owner in relation to the waste transfer process are as specified in this document. They include the proper characterising, segregating, handling, categorising, labelling and packaging of the waste with sufficient accuracy and detail to meet the full requirements of this WAP.

In addition the Waste Owner is responsible for implementation of a number of programmes as outlined below to ensure the development, review, approval and implementation of waste generation planning, characterisation, certification and transfer.

The Waste Owner shall be responsible for any costs incurred as a result of non-conformance with the WAP.

3.2 QUALITY ASSURANCE

The Waste Owner shall develop and implement a Quality Assurance Plan covering waste preparation (and transport operations if applicable) to provide assurance to DEST that any waste transferred to DEST conforms to this WAP.

The Waste Owner shall, on the *Waste Disposal Application* (Appendix C, Form 1), present details of its Quality Assurance Plan with specific reference to providing this Quality Assurance in relation to the waste described on that application.

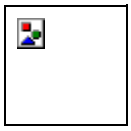
DEST will review this Quality Assurance Plan along with its review of the Waste Disposal Application and will advise the Waste Owner of any amendments to the plan that are necessary. These amendments shall be implemented by the Waste Owner before DEST will accept the Waste Disposal Application.

The Waste Owner shall submit to DEST full records resulting from the application of its Quality Assurance Plan to the process of waste conditioning along with the Waste Manifest.

The arrangements detailed in the Quality Assurance Plan shall include the requirements for a defined and documented periodic review of the arrangements to be performed by the Waste Owner's quality assurance representative. The arrangements shall also describe how proposed changes to the arrangements, if necessary, shall be controlled.

3.3 WASTE MINIMISATION PROGRAM

The Waste Owner shall endeavour to recycle waste, and use disposal in the national repository as a last option.



3.4 WASTE FORECAST

The Waste Owner shall provide an annual forecast of waste arisings to DEST.

3.5 RECORDS

The Waste Owner shall retain records and materials relating to any waste transferred to DEST for a period of at least 10 years after they have been issued with the *Waste Disposal Certificate* (Appendix C, Form 4) covering the waste packages in question.

Records are to include the technical information to be provided on the *Waste Transfer Manifest* as shown in Appendix B.

Materials shall include samples, specimens and inactive and active simulant samples used for waste characterisation. Samples shall be stored under conditions (for example, refrigeration) as agreed with DEST.

The Waste Owner shall provide copies of these records if requested during the waste transfer and acceptance process.

4. Waste Acceptance Criteria

The Waste Acceptance Criteria (WAC) specified below provide the Waste Owner with sufficient information to allow their waste to be generated, conditioned, packaged and transported, such that the disposal package (and its contents) will not compromise the overall safety of the repository.

Waste containing hazardous [4, 5] and radioactive materials will be acceptable for disposal only if the method of disposal meets the regulatory requirements covering both the radioactive and the hazardous components.

Notes are included in the text to provide explanation of the basis of criterion. These notes are included for the ARPANSA licence application only and shall be removed prior to the document being issued for use.

4.1 ACCEPTABLE RADIOACTIVE WASTE CATEGORIES

The categories of radioactive waste that are acceptable for disposal at the repository, provided that they conform to the requirements of this WAP, are defined as Categories A, B and C in the 1992 version of the NHMRC Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia [1]. These waste categories are defined in Appendix A.

The NHMRC Code defines a further category of radioactive waste, Category S, which consists of sealed sources, gauges or bulk waste and which contains radionuclides at higher concentrations than are allowable under Categories A, B or C. Waste that is classified as Category S will not be accepted for disposal at the repository.

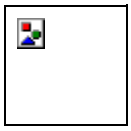
4.2 TYPES OF PROHIBITED WASTE

Wastes that are described below are classified as prohibited wastes and the Waste Owner shall not submit such wastes for disposal. If the Waste Owner is uncertain as to whether a waste item meets the requirements for being classified as prohibited waste then it shall submit all details relating to the waste to DEST for an assessment.

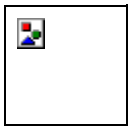
For practical reasons, trace levels of contaminants below a threshold value of 100 parts per million of the contaminant by weight of the waste are considered equivalent to zero content and do not result in the waste being classified as prohibited.

The types of waste which are classified as prohibited are:

- Waste that exceeds the radiological limits defined in Appendix A.



- Waste that contains hazardous materials as listed below. The principal hazardous materials of relevance are:
  - Polychlorobiphenyl (PCB) waste or PCB contaminated items. If the waste is suspected to contain PCBs, the Waste Owner shall substantiate the absence of PCBs to DEST if it wishes to submit this waste for disposal.
  - Infectious waste. (That is, waste that contains or is suspected to contain pathogenic micro-organisms infectious to humans).
  - Putrescible waste. (That is, solid waste (e.g. food remains) that contains organic matter of such a character and proportion as to cause obnoxious odours and to be capable of attracting or providing food for birds or animals.)
  - Waste containing combustible materials. This includes substances, which are not necessarily combustible, but may by yielding oxygen, cause or contribute to the combustion of other materials.
  - Lead and lead compounds. Waste is not classified as prohibited if it contains lead that has been used solely for shielding purposes.
- Waste that contains, or is capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapours, or fumes harmful to the public or workers or disposal facility personnel, or harmful to the long-term structural stability of the disposal site.
- Highly flammable materials, including:
  - Solids that, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction.
  - Self-reactive and related substances that are liable to undergo a strongly exothermic reaction.
  - Desensitised explosives (that is, the explosive properties have been suppressed) but the material may explode if not diluted sufficiently.
  - Substances liable to spontaneous combustion. (That is, substances that are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire).
  - Substances that, in contact with water, emit flammable gases. (That is, substances that by interaction with water are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities).
- Waste that contains material that will readily detonate upon impact, decompose explosively, react violently with water or undergo vigorous exothermic reaction at normal temperatures and pressures or during normal operations for transporting, handling, grouting or disposing of the waste. This includes:



- Waste that has a mass explosion hazard. (A mass explosion is one that affects almost the entire load virtually instantaneously.)
- Waste that has a projection hazard but not a mass explosion hazard.
- Waste that has a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. This includes substances and articles that give rise to considerable radiant heat, or that burn one after another, producing minor blast or projection effects or both.

- Radioactive gases packaged at pressures exceeding 1.5 atmospheres (152 kilopascals absolute pressure) at 20° C. It is desirable to have no gaseous waste. That which does exist inside containers should be at as low a pressure as possible.
- Unstabilised organic liquids (including sorbed organic liquids) exceeding 1% of the waste by weight. (It is desirable to have no organic liquids. However, where this is not possible, a 1% by weight limitation is allowed without the waste being classified as prohibited.)
- Unstabilised chelating compounds exceeding 1% of the waste by weight. (It is desirable to have no chelating agents. Where this is not possible, a 1% by weight limitation is allowed without the waste being classified as prohibited.)
- Wastes generated outside Australia.

Note 1: *The 1% weight limitations specified above are used throughout Europe and the US. They are convenient low numbers, not based on a rigorous scientific assessment.*

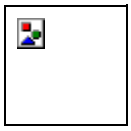
4.3 PHYSICAL AND CHEMICAL CRITERIA

The Waste Owner shall ensure that the waste conforms to the following physical/chemical criteria set out in Sections 4.3.1 to 4.3.5 inclusive before it is submitted to DEST for disposal.

4.3.1 Liquids and Liquid-Containing Waste

The criteria to be satisfied for liquids and liquid containing waste are:

- The free-standing liquid content of the waste shall be minimised and less than 1% by volume. (Values greater than this may be accepted, subject to the approval of DEST).
- Liquid waste is solidified, for example by fixing in a solid matrix (e.g. cement) and the resultant product will not result in release of liquids under applied loads of up to 400 kN/m2.



Note 2: *400 kN/m2 is based on loads experienced during high force waste compaction, which may not be relevant in this context, but is a useful rule of thumb.*

After solidification, the final package for disposal complies with the stability requirements for the particular category of waste, contained in Section 2.6.5 of the NHMRC Code [1].

Toluene, xylene, dioxane and scintillation liquids that exhibit hazardous properties, or other organic liquids or solids with similar chemical properties, are excluded from the waste except as specified below:

- Liquid concentrations do not exceed 1% by weight of the waste, or
- The waste consists of containers that once held any of the above liquids and which have been treated, or
- The waste consists of ash and/or residues from treatment of these wastes.

4.3.2 Waste Containing Organic Liquids

The criteria to be satisfied for waste containing organic liquids are:

Waste containing chelating agents, ion exchange materials, complexing agents or other organic liquids is treated or conditioned to reduce the possible long-term effects of leaching by water.

4.3.3 Gas Generation

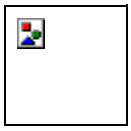
The criteria to be satisfied for waste with the potential for gas generation are:

- The waste does not contain or is not capable of generating gaseous materials in quantities which might lead to the release of harmful vapours or fumes, or cause an explosive hazard, during transportation, handling, treatment, conditioning and disposing of the waste.
- Pressurised gas receptacles, including cylinders and aerosol cans that contain compressed gases are treated, prepared or made safe, by a method approved in advance by DEST.

4.3.4 Other Criteria

Other criteria to be satisfied by the waste are:

- Waste containing pyrophoric material is treated, conditioned or packaged to render it non-flammable. DEST shall approve the process of making the material inert.
- Waste containing asbestos is treated, conditioned or packaged in accordance with procedures that shall be approved by DEST.
- Oil, regardless of waste form (including solidified oil), is not present. (Waste containing incidental or trace amounts of absorbed oil may be acceptable, provided prior approval has been obtained from DEST)



- Waste containing inorganic acids, alkalis and corrosive salts, in sufficient quantities to cause degradation of, or reaction with the waste matrix or packaging is (as far as is practicable) treated to neutralise them and thereby to nullify the chemical effect of these materials.
- Waste is, as far as is practicable, free of biological materials or is treated to destroy the relevant micro-organisms. (Plants, animals and by-products are considered biological material. Glassware and other containers that once contained these materials may also be considered biological.)
- Waste contaminated with toxic, pathogenic (e.g. hospital wastes) or infectious material is treated to minimise both the potential hazard to disposal site personnel and the long-term health risks to members of the public.

Where materials are added to the waste, the quantity of non-waste materials present in a consignment is minimised. (In particular, it is not acceptable to purposely dilute waste or add shielding materials for the sole purpose of achieving compliance with these criteria).

4.3.5 Precedence of Requirements

Where two or more similar requirements or limits occur in the acceptance criteria, all requirements and limits shall be met for the waste to be acceptable to DEST. If it appears that one requirement or limit is less restrictive than others, the more restrictive one shall be met.

4.4 PHYSICAL AND CHEMICAL CHARACTERISATION

The Waste Owner shall determine the physical and chemical characteristics of the waste with sufficient accuracy and detail to properly categorise and manage the waste in accordance with applicable regulations, including these WAC.

4.4.1 Waste Knowledge Requirements

The Waste Owner shall possess sufficient knowledge to demonstrate to DEST that the waste does not fall within the category of prohibited waste as defined within these WAC, to ensure that the waste can be safely managed, and to allow necessary segregation for treatment, storage and/or disposal.

The minimum level of acceptable knowledge shall include quantified data that allows a waste category to be assigned, and data that address any acceptance criteria necessary for proper management of the waste.

Analytical data and/or knowledge of the waste shall be sufficient to determine whether the waste meets the WAC.

Where in the view of DEST the available information does not qualify as acceptable knowledge, or is not sufficient to characterise a waste for management, then sampling, analysis and testing shall be undertaken by the Waste Owner to provide

supplementary information. These could include application of the following on a periodic basis:

- Visual inspections of waste package contents.
- Non destructive assay of waste packages (e.g. X-radiography, gamma spectroscopy, dose rate measurements).
- Waste package sampling and analysis for radioactive and non radioactive constituents.

4.4.2 Types of Acceptable Knowledge

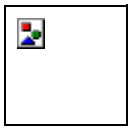
Acceptable knowledge requirements can be met using one or more of the following:

- Mass balance from a controlled process that has a specified output for a specified input (e.g. the residual activity inside a vial from which known quantities have been removed).
- Manufacturer's certification (e.g. radioactive source certificates, Material Safety Data Sheets on unused chemical products.)
- Analytical data on the waste or on waste from a similar process (e.g. the radionuclide concentrations obtained from sampling and analysis).
- Test data from simulant samples (that is, samples made up to the same specification as the waste and used for experimental purposes).

In addition, information in support of acceptable knowledge can be obtained from the following:

- Interview information.
- Logbooks.
- Procurement records.
- Qualified analytical data.
- Procedures and/or methods.
- Process flow charts.
- Inventory sheets.
- Vendor information.
- Mass balance from an uncontrolled process (e.g. clean up after a spill).
- Mass balance from a process with variable inputs and outputs (e.g., washing/cleaning methods).

If DEST considers that the information is sufficient to quantify constituents of regulatory concern and determine waste characteristics, the information is considered acceptable knowledge.



4.5 RADIOLOGICAL CRITERIA

The Waste Owner shall ensure that waste conforms to the following radiological criteria set out in Sections 4.5.1 to 4.5.4 inclusive before it is submitted to DEST for disposal.

4.5.1 Activity Concentration Limits

Waste is categorised according to the scheme shown in Table 1 – Waste Categories, in Appendix A. Table 2 – Generic Activity Concentration Limits (Upper Limits for Disposal) presents the generic activity limits for the Waste Categories A, B and C as presented in the NHMRC Code, but with several of the activity limits rounded up for simplicity.

Radioactive waste in Category A or B, which has been packaged, treated or conditioned, shall have the activity concentration calculated by averaging the activity of the waste over the whole conditioned package or container.

Radioactive Category C bulk waste may, with the approval of DEST, have the radionuclide activity concentrations averaged over the volume of the disposal structure into which the Category C waste is to be placed.

Note 3: *For example, assume that a hypothetical package of Category B waste consists of 2 x 10^9 Bq of Cs-137 inside a 205 litre drum with a gross weight of 100 kg. The Cs-137 activity concentration is given by:*

2 x 10^9/100 = 2 x 10^7 Bq per kg.

If the waste inside the 205 litre drum is now conditioned (i.e. cement has been added) and then overpacked inside a 400 litre drum, and the combined gross weight is now 250 kg, the Cs-137 activity concentration is given by:

2 x 10^9 /250 = 8 x 10^6 Bq per kg.

Note 4*: For example, assume a hypothetical Category C bulk waste consists of 2 x 10^9 Bq of natural thorium inside a package with a gross weight of 1000 kg. The thorium activity concentration is given by:*

2 x 10^9/1000 = 2 x 10^6 Bq per kg.

If the waste is placed inside a trench and grout is added, to bring the total mass of the disposal structure to 2000 kg, the thorium activity concentration is given by:

2 x 10^9/2000 = 1 x 10^6 Bq per kg.

In exceptional circumstances, DEST may accept some individual waste packages as Category C, provided that the activity concentrations of radionuclides do not exceed the limit by more than a factor of 10. If this provision is used, the Waste Owner shall cooperate with DEST to ensure that the concentration of each radionuclide when averaged over the volume of the disposal structure does not exceed the limit

applicable to that radionuclide. This may be achieved by the inclusion of inactive material with similar properties to that of the waste.

Specific Activity Limits for the repository have been derived (refer Appendix 1, Tables 3, 4 and 5 and [11]) which satisfy the specific requirements of the National Health and Medical Research Council code that activity limits be calculated to cover radionuclides present in the inventory, taking account of potential future exposure scenarios relevant to the repository site.

The activity limits derived relate only to requirements for the post-closure safety of the repository. There are also limits pertaining to the transport and handling of waste packages during the operational phase of the repository lifetime.

Activity limits have been developed for

1. The repository as a whole;
2. Individual 200 L containers, into which the waste is packaged;
3. Individual small sealed sources.

The specific activity limits for the whole repository (Appendix A, Table 3) were determined on the basis that the assessed risk would not exceed 10^{-6} y^{-1}, the performance measure for the repository as a whole. The activity limits for a single container and a sealed source were derived on the basis that the assessed dose would not exceed 100 mSv y^{-1}.

The activity limits for each radionuclide give the maximum inventory of that radionuclide that could be safely disposed in the repository by itself. The activity limit for the combined inventory of all radionuclides is such that the sum of the ratios of the disposed inventory of each radionuclide to its activity limit is less than one.

The specific activity limits for the 200 L drums (Appendix A, Table 4) were derived by considering only those scenarios in which individuals are potentially exposed to the contents of a limited number of drums, rather than to the contents of the whole repository. The specific activity limits for the sealed sources (Appendix A, Table 5) were derived on the basis of three specific scenarios for exposure following human intrusion into the repository that recognised the nature of the sources.

With waste containing a mixture of radionuclides, the activity concentration of radionuclides in the waste package is to satisfy the following summation rule:

$$\Sigma \, C_i / L_i \leq 1$$

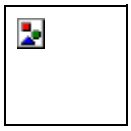
where:

Ci is the activity concentration of radionuclide i in the waste package; and

Li is the activity concentration limit for radionuclide i (taken from Appendix A).

4.5.2 Qualification on Activity Limits for 200L Drums

As noted above, the specific activity limits for the 200 L drums (Appendix A, Table 4) are based on the long-term safety of a container following burial. However, in general



the activity limits of the drums will be limited to lower levels to enable their safe transport and handling.

4.5.3 Waste Mixtures

Waste classification for waste overpacks that contain two or more inner packages is determined for each inner container and the most restrictive classification indicated on the overpack.

4.5.4 External Contamination Limits on Waste Packages

Non fixed contamination on accessible external surfaces of waste packages is kept as low as practicable. They shall not exceed the limits of 4 Bq/cm^2 for gamma emitters and low toxicity alpha emitters and 0.4 Bq/cm^2 for all other alpha emitters when averaged over any area of 300 cm^2 of any part of the surface. For returnable overpacks, these criteria also apply to the outside of the inner package.

Note 5: *These limits are taken from Section 508 of Schedule A of the Code of Practice for the Safe Transport of Radioactive Material (2001) [2] which adopts (with some modifications and clarifications) the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material [9]. The Code [2] is applicable throughout the whole of Australia. The list of Australian competent authorities is provided in Annex A of the Code [2].*

4.5.5 Radiation Limits on Waste Packages

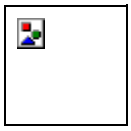
External radiation levels from the waste packages comply with applicable health physics regulations for the safe handling of the waste.

Radiation levels do not exceed 2 milliSievert per hour (2mSv/h) on contact with the waste package.

Note 6: *Application of the 2 milliSievert per hour limit is also consistent with the transport regulations [2]. Section 572 of the Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material [10] states that in most cases the radiation level at any point on the external surface of a package is limited to 2 mSv/h. The limit may only be exceeded (up to 10 mSv/h) if a number of other specified conditions are met.*

4.6 RADIOLOGICAL CHARACTERISATION

The Waste Owner shall determine the radiological characteristics of the waste with sufficient accuracy and detail to properly categorise and manage the waste in accordance with applicable regulations, including the WAC.



4.6.1 Identification of Major Radionuclides

The Waste Owner has the responsibility to identify the major radionuclides in the waste.

For the purposes of the radiological criteria in this document, major radionuclides are defined as those radionuclides that meet any of the following conditions.

- Any radionuclide present at a concentration exceeding 1% of its respective limit (see Appendix A for the limits).
- Waste containing more than 1 gram of fissile material.
- Any radionuclide that accounts for more than 1% of the total radiological activity of the waste. However, a radionuclide in concentration less than 37 kBq per cubic metre, and not otherwise reportable, is exempt from reporting.

Note 7: *The 1% activity and activity concentration limits specified above are based on US practice. The limits are specified by the US NRC (Nuclear Regulatory Commission). The limit of 37 kBq per cubic metre is approximately that used in a number of countries in Europe and the US as the free release limit.*

4.6.2 Radionuclide Inventory

The Waste Owner shall establish the radionuclide inventory of the waste, using methodologies capable of identifying and quantifying the major radionuclides present.

The radionuclide characterisation methodologies shall provide adequate sensitivity and accuracy to ensure that the waste is correctly categorised. The methods shall be documented clearly and approved by DEST. Documentation of the method shall include a detailed description of the method, the radionuclides identifiable by the method, and a discussion of precision, accuracy, quality assurance, and quality control methods.

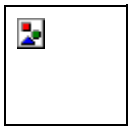
4.7 PACKAGING CRITERIA

The Waste Owner shall ensure that waste conforms to the following packaging criteria set out in Sections 4.7.1 to 4.7.4 inclusive, before it is submitted to DEST for disposal.

In addition the Waste Owner shall ensure that the waste packages submitted to DEST meet all of the requirements of the following standards:

- Code of Practice for the Safe Transport of Radioactive Material (2001) [2]
- Code for the Transport of Dangerous Goods by Road and Rail (1998) [3].

Note 8: *The waste packaging terminology utilised by the IAEA [4] is used in this document and the relevant definitions are provided in the Glossary. As an aid to understanding, an example is provided below of the use of the IAEA waste packaging terminology.*



A hypothetical drum of conditioned waste can include the waste form (e.g. the cemented waste) and any waste containers (e.g. small cans which hold the cemented waste) and internal barriers (e.g. absorbing materials, liners). If the drum is put into a secondary external container (i.e. an overpack), the filled overpack becomes the waste package. The drum is relegated to being the waste container. If the drum is not put into an overpack, the drum remains the waste package.

If the drum is put into a full height ISO container for transport to the repository, the ISO container becomes the transport package and the drum is again relegated to being the waste container. When the transport package (ISO container) arrives at the repository, the drum is unloaded and if no overpack is required, the drum becomes the disposal package. If the drum is put into an overpack for disposal, the filled overpack becomes the disposal package. The drum is relegated to being the disposal container. The empty ISO container is now a transport container.

4.7.1 Waste Form Stability

Waste is in a form that will minimise settlement and subsidence of the disposal structures to the maximum extent feasible and void spaces within the waste containers are be minimised.

The following waste forms will be considered to meet the above criteria:

- Containerised waste that fills at least 90 percent of the internal volume of the container. To calculate the volume of void spaces in the waste, only voids exceeding 5 centimetres in all dimensions need be considered. Any void fillers, other than cement or sand, shall be approved by DEST before use.
- Containerised soil and soil-like solids, sorbed liquids, and compacted waste in 205 litre drums that fill at least 90 percent of the volume of the container.
- Non-containerised waste that will not subside in the disposal environment (e.g., rocks, dirt, building rubble, activated metal).
- Waste that has been stabilised in concrete or other stabilisation media approved by DEST.

4.7.2 Waste Container Construction

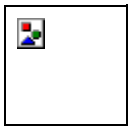
Waste containers are non-flammable or constructed of fire-retardant materials.

Standard industrial 205 litre drums made of mild steel with a lid held on by a band secured with a bolt or a clip are acceptable disposal containers.

Outer containers are in good condition, with no visible cracks, holes, bulges, substantial corrosion, or other damage that could compromise integrity.

All exterior surfaces of wooden packages are treated with a fire-retardant material having a maximum flame-spread index of 25 when tested to ASTM Standard Test Method for Surface Burning Characteristics of Building Materials (ASTM E-84-96).

Waste containers are not made of cardboard.



Containers and sacrificial rigging only contain lead that has been used solely for shielding purposes.

4.7.3 Waste Packaging

Waste containers shall conform to the following packaging criteria and requirements unless approval for alternatives has been obtained from DEST.

Category A Waste

It is anticipated that the waste container is generally a mild steel drum with a capacity of 205 litres. Some of the drums will be conditioned (by addition of cement grout) prior to transportation to the repository. The main transport package will be an ISO standard shipping container.

Category A waste is packaged as follows:

- Inside 205 litre metal drums or other standard waste containers approved by DEST.
- The permissible mass of any other waste container as approved by DEST.
- Compressed inside the waste container by a method approved by DEST.

Category B Waste

It is anticipated that the waste container is generally a mild steel drum with a capacity of 205 litres. The majority of the drums will be conditioned (by addition of cement grout) prior to transportation to the repository. The drums which contain sealed sources may need concrete shielding and separate inner containers. The main transport package will be an ISO standard shipping container.

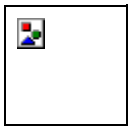
Category B waste is packaged as follows:

- Inside 205 litre metal drums or other standard waste containers approved by DEST.
- According to a procedure approved by DEST.
- Where relevant, the waste package is vented through a suitable filter, to minimise pressure build-up. (If a build up of flammable gases is anticipated with time, carbon-filtered vents can be incorporated into waste drums to allow the flammable gases to escape while retaining the radioactivity.)

Category C Waste

It is anticipated that the waste container is generally mild steel drums with a capacity of 205 litres. These may be conditioned (by addition of cement grout) prior to transportation to the repository. The drums which contain sealed sources may need concrete shielding and separate inner containers. The main transport package for the drums will be an ISO standard shipping container. The transport package for bulk waste will be determined on a case-by-case basis.

Category C waste is packaged as follows:



- Inside 205 litre metal drums or other standard waste containers approved by DEST.
- The permissible mass of any other waste container as approved by DEST.

Bulk Waste

It is anticipated that the nature of the bulk waste will vary therefore no specific waste container is prescribed. The transport package for bulk waste will be determined on a case-by-case basis.

Large individual items or bulk soils for which conditioning would prove to be impractical is acceptable for disposal, provided the following requirements have been met:

- The waste is packaged to a methodology approved by DEST.
- Bulk waste items with a gross weight greater than 1.2 tonnes is individually approved by DEST.

4.7.4 Container Labelling

Individual waste containers (e.g. drums) are labelled in such a way as to provide traceability back to the point of generation.

Each container has its unique identifier (a 7 digit sequential number to a system as defined by DEST) clearly and permanently displayed on the top and side surfaces with a minimum character height of 24 mm.

4.8 TRANSPORT PACKAGES

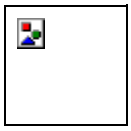
4.8.1 Supply and Loading of Transport Packages

In general, DEST will supply the transport package and will be responsible for the loading and securing of the waste packages within the transport package in preparation for transporting the waste to the repository. In this situation, the Waste Owner shall assist DEST in the loading and securing of the waste packages within the transport package, if such assistance is requested by DEST.

Subject to the approval of DEST, major Commonwealth Waste Owners may undertake the transportation of their waste to the repository. Such Waste Owners will be responsible for supplying the transport package, for the loading and securing of the waste packages within the transport package and for the transport and unloading of the waste packages at the repository.

4.8.2 Securing Waste inside Transport Packages

Waste containers inside the transport package shall be secured in such a manner that they can be readily retrieved by routine mechanical handling equipment without damage and loss of containment.



Large heavy items shall be secured inside the transport package by bracing, blocking, or other means to prevent damage to the waste containers during handling and transportation. When shielding is used to reduce the surface dose rate of a waste container, the shielding and waste shall be secured to prevent shifting during handling and transportation.

All waste containers shall be configured for safe unloading by forklift or crane. Waste containers that will be unloaded by crane shall be equipped with a lifting system designed for the safe lifting of the fully loaded package. For waste packages that have special loading or unloading requirements, information on these requirements shall be provided to DEST prior to loading for transportation to the repository.

4.8.3 Type of Transport Packages

Waste will be transported in transport packages that conform to the Code of Practice for the Safe Transport of Radioactive Material (2001) [2].

It is anticipated that the main transport package will be a standard shipping container typically a mild steel ISO freight container of 2.4 m x 2.4 m x 6.1 m. Depending on the design, this will allow up to between 50 and 100 x 205 litre drums to be accommodated for transport to the repository as an IP-2 package under Paragraphs 521-525 of the IAEA Transport Regulations [9].

All transport packages shall be classified and marked in accordance with the applicable Transport Codes [2]. The waste category will be durably and legibly marked on the transport package.

All transport packages shall be vented during the thirty days prior to the handover date of the waste to DEST.

4.8.4 Contamination and Radiation Limits for Transport Package

Transport packages shall be as free as reasonably practicable from non-fixed contamination. The contamination shall not exceed the limits of 4 Bq/cm^2 for gamma emitters and low toxicity alpha emitters and 0.4 Bq/cm^2 for all other alpha emitters when averaged over any area of 300 cm^2 of any part of the surface.

The external radiation levels shall comply with the values given in the Code of Practice for the Safe Transport of Radioactive Material (2001) [2]. These levels vary with the transport package type. For example, the external radiation level at the surface of an IP-2 transport package should not exceed 2 mSv/h if not transported under exclusive use and 10 mSv/h under exclusive use, provided other specified conditions are met.

5. References

1 Commonwealth of Australia. Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia. Radiation Health Series No. 35. ISBN 92-0 644 28673 3. Canberra. 1992.

2 Commonwealth of Australia. Australian Radiation Protection and Nuclear Safety Agency. Code of Practice for the Safe Transport of Radioactive Material. Canberra. 2001.

3 Commonwealth of Australia. National Road Transport Commission and Federal Office of Road Safety. Australian Code for the Transport of Dangerous Goods by Road and Rail, Sixth Edition, 1998.

4 Commonwealth of Australia. Guide to Controlled and Other Wastes under Australia's Hazardous Waste Act. ISBN 92-0 642 54543X. Canberra.1998.

5 Commonwealth of Australia. Hazardous Waste (Regulations of Export and Imports) Act, 1989.

6 International Atomic Energy Agency. The Principles of Radioactive Waste Management. IAEA Safety Series No. 111-F. Vienna. 1995.

7 International Atomic Energy Agency. Radioactive Waste Management Glossary. ISBN 92-0-103493-8. IAEA Publication. Vienna. 1993.

8 International Atomic Energy Agency. Classification of Radioactive Waste. IAEA Safety Series No 111-G-1.1. ISBN 92-0-101194-6. Vienna. 1993.

9 International Atomic Energy Agency. Regulations for the Safe Transport of Radioactive Material. IAEA Safety Standards Series No TS-R-1 (ST-1, Revised). ISBN 92-0-101194-6. Vienna. 2000.

10 International Atomic Energy Agency. Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material. IAEA Safety Standards Series No TS-G-1.1 (ST-2). ISBN 92-0-111802-3. Vienna. 2002.

11 Activity Limits for the Post-closure safety of the National Radioactive Waste Repository. SERCO, July 2003.

6. Glossary of Terms

Accuracy	A quantitative measure of the magnitude of error. Accuracy measures how close to a true or accepted value a measurement lies.
Activity	Of an amount of a radioactive nuclide in a particular energy state at a given time, the quotient of dN by dt, where dN is the expectation value of the number of spontaneous nuclear transitions from that energy state in the time interval dt: A = dN/dt (The unit is s-1.) The name for the unit of activity is Becquerel (Bq): 1 Bq = I s-1. Although Becquerel is a synonym for reciprocal second, it is to be used only as a unit for activity of a radionuclide.
Activity concentration	The radiological activity (disintegrations per unit of time) of a radionuclide per unit mass or volume of that nuclide. (Units: e.g. Bq per gram or Bq per litre).
Alpha emitter	A radioisotope that emits an alpha particle when it decays.
Audit	A documented activity undertaken to determine by investigation, examination and evaluation of objective evidence that there is adequate adherence to established procedures, instructions, specifications, codes, standards, administrative or operational programme requirements and other applicable documents.
Backfill	The material used to refill excavated portions of the repository after waste has been emplaced.
Barrier	A physical obstruction that prevents or delays the movement (i.e. migration) of radionuclides or other material between components in a waste repository. In general a barrier can be an engineered barrier which is constructed or a natural barrier which is inherent to the environment of the repository.
Biodegradation	The metabolic breakdown of materials and their components into simpler components by other living organisms.
Borehole	A cylindrical excavation, usually made by a rotary drilling devices or jackhammers. Boreholes can be drilled during site investigation and testing and will also be used for waste emplacement in the repository.
Bulk waste	Large bulk items that cannot be sized reduced and are not containerised for disposal.
Category A waste	Refer to Appendix A.

Category B waste	Refer to Appendix A.
Category C waste	Refer to Appendix A.
Category S waste	Refer to Appendix A.
Cement	Substances used for bonding or setting to a hard material.
Certification	A signed document which states that all of the relevant requirements have been met.
Chelating agent	Chemicals which can bind with metals to produce stable chelate-metal complexes. Examples are amine polycarboxylic acids (e.g., EDTA, DPTA), hydroxy-carboxylic acids, and polycarboxylic acids (e.g., citric acid, carbolic acid, and glucinic acid).
Clearance levels	A set of values, established by the regulatory body, expressed in terms of activity concentrations and/or total activities, at or below which sources of radiation can be released from nuclear regulatory control.
Combustible waste	Any waste that does not meet the definition of non-combustible waste.
Complexing agent	Chelating agents or monodentate organic ligands.
Compressible waste	Soft wastes that can be relatively easily reduced in volume.
Conditioning	Those operations that produce a waste package suitable for handling, transportation, storage and/or disposal. Conditioning may include the conversion of the radioactive waste to a solid waste form, encapsulation in a stable matrix such as concrete, enclosure of the radioactive waste in containers, and if necessary, providing an overpack.
Consignment	A transport package or a disposal package and its contents of waste.
Contact handled	Packaged waste whose external surface dose rate does not exceed 2 milliSieverts per hour (2 mSv/h) and does not exceed 1 mSv at 30 cm. Packages larger than 205 litres could have a dose rate on normally non-accessible surfaces that exceeds 2 mSv/h as long as all accessible surfaces do not exceed 2 mSv/h when in storage.
Container	Any portable device in which a material is stored, transported, treated, disposed, or otherwise handled.
Containment	Methods of physical structures that prevent the dispersion of radionuclides.

Contamination	The presence of radioactive substances in or on a material or in the human body or other place where they are undesirable or could be harmful.
Corrective action	An action which usually must be applied or taken within a relatively short period of time, to produce a specific or desired affect.
Criteria	Conditions on which a decision or judgement can be based. They may be qualitative or quantitative and should result from established principles and standards.
De-sensitised explosives	Materials for which the explosive properties have been suppressed.
Disposal	The emplacement of waste in an approved specified facility without the intention of retrieval.
Disposal package	A waste package used for disposal.
Disposal structure	A trench, borehole or other form of excavation which is designed to contain the radioactive waste. It may be constructed from natural as well as manufactured materials.
Dose rate	Radiation levels as a function of time. (Units: e.g. milliSieverts per hour (mSv/h)
Exclusive use	A transportation term which has the following conditions: A single consignor must make the shipment and must have, through arrangements with the carrier, sole use of the conveyance or large freight container; and second, that all initial, intermediate and final loading and unloading of the consignment is carried out only in strict accordance with directions from the consignor or consignee.
Exemption or exempt	A designation, by the regulatory body, for sources of radiation that are not subject to nuclear control because they present such a low radiological hazard; principles for exemption are presented in IAEA Safety Series 89. Under this designation, a distinction can be made between sources which never enter the regulatory control regime (control is not imposed) and sources which are released from regulatory control (control is removed), in both cases because the associated radiological hazards are negligible. The latter is especially pertinent to radioactive waste management, where sources of radiation are released from nuclear regulatory control in accordance with established clearance levels.
Exothermic	A reaction in which heat is given off as in a fire, or in the combination of water and a chemical such as sodium hydroxide.
Flammable liquid	A liquid having a flash point of not more than 60.5° C or any material in a liquid phase with a flash point at or above 37.8° C that is intentionally heated and offered for transportation at or above its flash point in a bulk packaging.

Flammable solid	Any of the following types of materials: wetted explosives, self-reactive materials that are liable to undergo a strongly exothermal decomposition caused by excessively high temperatures or contamination, or readily combustible solids that might cause a fire through friction.
Free standing liquid	That liquid which is present as a separate phase.
Gamma emitter	A radioisotope that emits gamma radiation when it decays.
Gross weight	The tare weight of a container plus the weight of its contents.
Half life	The time required for the activity of a radionuclide to decrease by radioactive decay to one half of its initial value.
Hazardous waste	In Australia: Waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention; or Wastes that belong to any category contained in Annex I to the Basel Convention, unless they do not possess any of the characteristics contained in Annex III to the Convention.
Infectious waste	Any waste that contains or is suspected to contain pathogenic micro-organisms infectious to humans, including: cultures and stocks of infectious agents, human blood and body fluids, contaminated animal carcasses, body parts, bedding exposed to infectious agents, and human pathological waste. Waste that has been treated by heat (e.g., incineration, autoclaving) or chemical disinfectants to destroy pathogenic organisms is not considered infectious waste.
Infiltration	A generally slow entry of water, made available at the ground surface. It can refer to the entry of rain water in the surface soils or the penetration of water from a water bearing stratum into the repository.
Institutional control	Control of the repository by an authority or institution designated under the laws of the country or state. This control may be active (e.g. monitoring, surveillance, remedial work) or passive (e.g. land use control).
Ion exchange materials	Ion exchange is the process in which ions are exchanged between a solution and an insoluble solid, usually a resin (i.e. the ion exchange material). It can be used to separate radioactive isotopes.
Long lived waste	Radioactive waste containing long lived radionuclides having sufficient radiotoxicity in quantities and/or concentrations requiring long term isolation from the biosphere. The term “long lived radionuclide” usually refers to half lives greater than 30 years.

Low and intermediate level waste (LILW)	Radioactive wastes in which the concentration of or quantity of radionuclides is above clearance levels established by the regulatory body, but with a radionuclide content and thermal power below those of high level waste. Low and intermediate level waste is often separated into short lived and long lived wastes. Short lived waste may be disposed of in near surface disposal facilities. Plans call for the disposal of long lived waste in geological repositories.
Major radionuclides	Those radionuclides in a waste that contribute significantly to the overall hazards of the waste, including criticality and human exposure by various pathways, as the waste is managed.
Material Safety Data Sheet	Manufacturer supplied information on the physical characteristics, safety, health and reactivity data of chemicals.
Matrix	A non-radioactive material used to immobilise waste.
National repository	An engineered near surface underground facility for the disposal of Australia's short lived low level and intermediate level radioactive waste.
Near surface disposal	Disposal of waste, with or without engineering barriers, on or below the ground surface, where the final protective covering is of the order of a few metres thick, or in caverns a few tens of metres below the earth's surface.
Near surface repository	A nuclear facility for waste disposal located at or within a few tens of metres from the Earth's surface. Such a repository is suitable for the disposal of short-lived low and intermediate level wastes.
Non-combustible waste	Containerised waste that shows no evidence of combustion or decomposition on exposure to 538° C for 10 minutes, or waste that has been stabilised by grouting or disposal.
Non-conformance	A deficiency in characteristics, documentation or procedure that renders the equality of an item, process or service unacceptable or indeterminate.
Non-conforming waste packages	Waste packages that do not meet the waste acceptance criteria.
Organic liquid	A chemical compound which has carbon-carbon chemical bonds and is a liquid at standard temperature and pressure. Typical organic liquids include organic solvents, petroleum oils and synthetic oils.
Overpack	A secondary (or additional) external container for waste.
Packaging	The preparation of radioactive waste for safe handling, transportation, storage and disposal by means of enclosing the waste form in a suitable container.
Performance assessment	An analysis to predict the performance of a system or subsystem, followed by comparison of the results of such analysis with appropriate standards or criteria.

Periodic review	A formal evaluation of the status and adequacy of systems, carried out on a periodic basis.
Polychlorinated biphenyl (PCBs)	Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances that contains such substance.
Precision	Precision is a measurement of how closely analytical and test results can be duplicated.
Putrescible waste	Solid waste (e.g. food remains) that contains organic matter of such a character and proportion as to cause obnoxious odours and to be capable of attracting or providing food for birds or animals. It does not include wood and paper.
Pyrophoric material	A liquid or solid that, even in small quantities and without an external ignition source, can ignite within 5 minutes after coming in contact with air.
Quality assurance	All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.
Radioactive waste	Material that contains radionuclides at concentrations or activities greater than clearance levels set by the regulatory body, which shall be managed for its radioactive content, and for which no use is foreseen.
Radioactivity	Property of certain nuclides to undergo spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation, such as alpha particles, beta particles and gamma rays.
Radiolysis	Chemical decomposition of materials induced by ionising radiation.
Radionuclide	Any nuclide which is unstable and undergoes natural radioactive decay.
Receipt monitoring	Testing and Monitoring carried out on receipt of the waste. It can include three levels of monitoring: Level 1: Receipt documentation checks, contamination and dose rate measurements, physical inspection, weighing, screening documentation for non conforming chemicals, checking documentation for conformance with the WAC, checking documentation for conformance with the waste disposal agreement. Level 2: Non destructive assay (e.g. gamma spectroscopy of waste drums). Level 3: Intrusive sampling and analysis (i.e. sampling the contents of the drum and analysing the samples for alpha, beta and gamma emitters, chemicals etc.)

Records	A set of documents, including reports, instrument charts, certificates, log books, computer printouts, magnetic tapes and computer discs. They should be organised in such a way that they provide a complete and objective representation of the waste.
Repository	A nuclear facility where radioactive waste is emplaced for disposal. Future retrieval of waste from the repository is not intended.
Scintillation liquids	Liquids used in liquid scintillation counters in laboratories.
Segregation	An activity where waste or materials (radioactive and exempt) are separated or are kept separate according to radiological, chemical and/or physical properties which will facilitate waste handling and/or processing. It may be possible to segregate radioactive from exempt material and thus reduce the waste volume.
Shielding	A material interposed between a source of radiation and persons, or equipment and other objects, in order to absorb radiation and thereby reduce radiation exposure.
Short lived waste	Radioactive waste which will decay to a level which is considered to be insignificant, from a radiological viewpoint, in a time period during which institutional control can be expected to last. Radionuclides in short lived waste will generally have half-lives shorter than about 30 years.
Simulant	Active or non-active samples of substances made up to the specification of the waste.
Solidification	Immobilisation of gaseous, liquid or liquid-like materials by conversion into a solid waste form, usually with the intent of producing a physically stable material that is easier to handle and less dispersible. Calcination, drying, cementation, bituminisation and vitrification are some of the typical ways of solidifying liquid radioactive waste.
Solidified radioactive waste	Liquid waste that has been converted into a solid waste form.
Specific activity	(1) The activity of a radioisotope per unit mass of a material in which the radioisotope occurs. (2) The activity of a radioisotope per unit mass of a material consisting of only that isotope.
Specifications	Detailed requirements to be satisfied by a product, a service, a material or process, indicating the procedure by means of which it may be determined whether the specified requirements are satisfied.

Spontaneously combustible material	A pyrophoric or self-heating material.
Stabilisation	Any technique that reduces the solubility and mobility of dangerous waste constituents and/or radionuclides by bonding or chemically reacting with the stabilising material.
Storage	The holding of waste for a temporary period, at the end of which the waste is treated, disposed, or stored elsewhere.
Testing	The examination, review, analysis or investigation of the capability of an item to meet specified requirements by subjecting the item to a set of physical, chemical, environmental and/or operational conditions.
Toxic	Having the properties to cause or to significantly contribute to death, injury, or illness of humans or wildlife.
Transport container	A reusable container into which waste packages are placed for transport, the whole then qualifying as a transport package under the IAEA Transport Regulations [9]. For example, an empty ISO is a transport container. An ISO filled with waste is a transport package.
Transport package	The complete assembly of the radioactive material and its outer packaging as defined in the IAEA Transport Regulations [9]
Transportation	Operations and conditions associated with and involved in the movement of radioactive material by any mode, on land, water or in the air. The terms 'transport' and 'shipping' are also used.
Waste acceptance criteria	The technical specifications and procedures applicable to the treatment, transport and disposal of waste.
Waste category	Waste classified in accordance with the Scheme contained in the NHMRC Code of Practice of the Near Surface Disposal of Radioactive Waste in Australia [1].
Waste characterisation	The determination of the physical, chemical and radiological properties of the waste to establish the need for further adjustment, treatment, conditioning, or its suitability for further handling, processing, storage or disposal.
Waste container	The vessel into which the waste form is placed for handling, transportation, storage and/or eventual disposal; also the outer barrier protecting the waste from external intrusions. The waste container is a component of the waste package. Note that the waste container remains in direct contact with the waste form; and is disposed of along with the waste form.
Waste disposal application form	See Appendix C, Form 1.
Waste disposal certificate	See Appendix C, Form 4.

Waste form	The waste in its physical and chemical form after treatment and/or conditioning (resulting in a solid product) prior to packaging. The waste form is a component of the waste package.
Waste minimisation	Reduction of waste with regard to its quantity and activity to a level as low as reasonably achievable. Minimisation as a practice includes reduction at source, recycling and re-use and treatment.
Waste owner	The organisation with clear legal responsibility for the waste at the point when it is transferred to DESTfor disposal. The waste owner could be the waste generator, (the responsible organisation for the facility where the unconditioned waste is generated), the organisation that conditions waste on behalf of the original waste owner, or the organisation with the responsibility to look after the waste.
Waste package	The product of conditioning that includes the waste form and any containers and internal barriers (e.g. absorbing materials and liner), as prepared in accordance with requirements for handling, transportation, storage and/or disposal.
Waste stream	A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties.
Waste transfer certificate	See Appendix C, Form 3.
Waste transfer manifest	See Appendix C, Form 2.
Waste treatment	Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are volume reduction, removal of radionuclides from the waste and change of composition. After treatment the waste may or may not be immobilised to achieve and appropriate waste form.

Appendix A

Waste Categories and Activity Concentration Limits

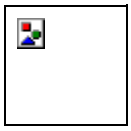


Table 1 - Waste Categories

Category A waste	Solid waste with radioactive constituents, mainly beta or gamma emitting radionuclides, whose half-lives are considerably shorter than the institutional control period. The radioactivity will decay substantially during this period. Long lived alpha emitting radionuclides should only be present at very low concentrations. This waste is predominantly compressible and lightly contaminated items such as paper, cardboard, plastics, rags, protective clothing, glassware, laboratory trash or equipment, certain consumer products and industrial tools or equipment. It may also comprise lightly contaminated bulk waste from mineral processing or lightly contaminated soils. **Disposal of Category A waste at the national repository is permitted.**
Category B waste	Solid waste and shielded sources with considerably higher activities of beta- or gamma-emitting radionuclides than Category A waste. Long-lived alpha-emitting radionuclides should be at relatively low levels. This waste typically includes gauges and sealed sources used in industry and medical diagnosis and therapy and small items of contaminated equipment. **Disposal of Category B waste at the national repository is permitted.**
Category C waste	Solid waste containing alpha-, beta- or gamma-emitting radionuclides with activity concentrations similar to those for Category B. This waste will typically comprise bulk materials, not able to be packaged. Examples are wastes arising from the processing of radioactive minerals, significantly contaminated soils or large items of contaminated equipment (e.g. redundant spent fuel flasks). **Disposal of Category C waste at the national repository is permitted.**
Category S waste	Sealed sources, gauges or bulk waste which contain radionuclides at higher activity concentrations than those specified under Categories A, B or C. **Disposal of Category S waste at the national repository is not permitted.**

Table 2 – Generic Activity Concentration Limits (Upper Limits for Disposal)

Radionuclide Group	Activity Concentration Limit (Bq per kg)		
	Cat. A	Cat. B	Cat. C
Tritium	10^{11}	10^{13}	10^{13}
Carbon-14	10^{7}	10^{8}	10^{8}
Alpha emitting radionuclides (including U-238, Pu-239, Am-241)	10^{5}	10^{7}	10^{7}
Thorium (natural)	10^{4}	Not applicable	10^{6}
Radium-226, Uranium (natural)	10^{4}	10^{6}	10^{6}
Beta/gamma emitters with half lives greater than 5 years	10^{9}	10^{9}	10^{9}
Beta/gamma emitters with half lives less than or equal to 5 years (including Co-60)	10^{9}	10^{9}	10^{9}

Note: The above activity concentration limits are based on:

1. An institutional control period of 200 years.
2. A minimum depth of cover of 2 metres for Category A wastes and 5 metres for Category B and C wastes.
3. The transport limits for beta/gamma emitters with half-lives ≤ 5 years.
4. Generic Activity Limits for the Waste Categories A, B and C as presented in the NHMRC Code, but with several of the activity limits rounded up for simplicity.

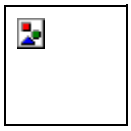
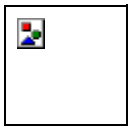


Table 3 – Specific Activity Limits for the Whole Repository

Radionuclide	Activity Limit (Bq)
H_3	$2.14\ 10^{25}$
C_14	$7.88\ 10^{12}$
Sr_90	$7.24\ 10^{18}$
Be_10	$8.01\ 10^{15}$
Co_60	$3.64\ 10^{25}$
Ni_63	$4.17\ 10^{18}$
I_129	$1.85\ 10^{12}$
Ba_133	$4.53\ 10^{20}$
Cs_137	$6.61\ 10^{16}$
Eu_152	$1.04\ 10^{19}$
Eu_154	$2.01\ 10^{21}$
Ho_166m	$6.75\ 10^{12}$
Tl_204	$4.21\ 10^{33}$
Bi_207	$9.10\ 10^{15}$
Po_210	$1\ 10^{99}$
Pb_210	$1.44\ 10^{18}$
Ra_226	$1.61\ 10^{12}$
Ra_228	$2.99\ 10^{24}$
Ac_227	$1.40\ 10^{17}$
Th_228	$7.01\ 10^{45}$
Th_229	$1.57\ 10^{13}$
Th_230	$1.13\ 10^{12}$
Th_232	$1.42\ 10^{12}$
Pa_231	$6.44\ 10^{12}$
U_233	$1.53\ 10^{13}$
U_234	$1.77\ 10^{12}$
U_235	$5.42\ 10^{12}$
U_236	$1.45\ 10^{14}$
U_238	$1.12\ 10^{12}$
Np_237	$8.79\ 10^{12}$
Pu_238	$4.93\ 10^{15}$
Pu_239	$7.44\ 10^{13}$
Pu_240	$8.04\ 10^{13}$
Pu_244	$1.56\ 10^{13}$
Am_241	$3.94\ 10^{14}$
Ag_108m	$6.86\ 10^{14}$
Cm_244	$2.89\ 10^{16}$
Cm_248	$2.32\ 10^{13}$
Cf_252	$2.92\ 10^{18}$

Note that the "proportion of limit" is the ratio of the design inventory to the activity limit. The "excess capacity" is the ratio of the activity limit to the design inventory, and

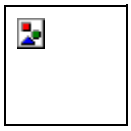


provides a measure of the additional capacity of the repository to store additional quantities of a given radionuclide.

The allowed activity limit for Po-210 is greater than 1 10^{99} Bq. This limit is labelled as "1 10^{99}".
Radionuclides whose design inventory is greater than 1% of the activity limit are shaded.

Table 4 – Specific Activity Limits for a Single 200 L Container

Radionuclide	Activity Limit (Bq)
H_3	1.43 10^{20}
C_14	6.90 10^{13}
Sr_90	5.60 10^{13}
Be_10	1.06 10^{13}
Co_60	2.82 10^{20}
Ni_63	1.18 10^{15}
I_129	3.13 10^{11}
Ba_133	3.50 10^{15}
Cs_137	5.11 10^{11}
Eu_152	8.06 10^{13}
Eu_154	1.55 10^{16}
Ho_166m	1.87 10^{9}
Tl_204	3.25 102^{8}
Bi_207	7.04 10^{10}
Po_210	1 10^{99}
Pb_210	1.11 10^{13}
Ra_226	1.55 10^{9}
Ra_228	2.32 10^{19}
Ac_227	5.88 $10^{1}1$
Th_228	5.43 $10^{4}0$
Th_229	2.32 10^{9}
Th_230	1.49 10^{9}
Th_232	1.00 10^{9}
Pa_231	8.10 10^{8}
U_233	2.61 10^{9}
U_234	2.34 10^{9}
U_235	7.93 10^{8}
U_236	6.47 10^{10}
U_238	1.47 10^{9}
Np_237	2.26 10^{9}
Pu_238	2.50 10^{10}
Pu_239	4.75 10^{9}
Pu_240	4.82 10^{9}
Pu_244	4.68 10^{9}



Am_241	$8.12\ 10^{9}$
Ag_108m	$5.31\ 10^{9}$
Cm_244	$1.60\ 10^{12}$
Cm_248	$1.57\ 10^{9}$
Cf_252	$1.98\ 10^{14}$

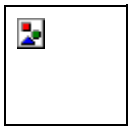
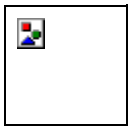


Table 5 – Specific Activity Limits for Sealed Sources

RN	Half Life (y)	Maximum for E1 (Bq)	Maximum for E2 (Bq)	Maximum for E3 (Bq)	Activity limit at 2252 (Bq)	Activity limit at 2052 (Bq)	Activity limit at 2002 (Bq)
H_3	$1.24\ 10^{1}$	N/A	$1.20\ 10^{16}$	$2.02\ 10^{14}$	$2.02\ 10^{14}$	$1.51\ 10^{19}$	$2.51\ 10^{20}$
Be_10	$1.60\ 10^{6}$	N/A	$8.93\ 10^{13}$	$9.70\ 10^{11}$	$9.70\ 10^{11}$	$9.70\ 10^{11}$	$9.70\ 10^{11}$
C_14	$5.73\ 10^{3}$	N/A	$5.39\ 10^{14}$	$6.17\ 10^{12}$	$6.17\ 10^{12}$	$6.32\ 10^{12}$	$6.36\ 10^{12}$
Sr_90	$2.91\ 10^{1}$	$2.37\ 10^{14}$	$1.95\ 10^{13}$	$4.39\ 10^{10}$	$4.39\ 10^{10}$	$5.13\ 10^{12}$	$1.69\ 10^{13}$
Co_60	5.27	$1.60\ 10^{8}$	$1.01\ 10^{14}$	$9.70\ 10^{7}$	$9.70\ 10^{7}$	$2.58\ 10^{19}$	$1.85\ 10^{22}$
Ni_63	$9.60\ 10^{1}$	N/A	$2.40\ 10^{15}$	$2.55\ 10^{13}$	$2.55\ 10^{13}$	$1.08\ 10^{14}$	$1.55\ 10^{14}$
Ag_108m	$1.27\ 10^{2}$	$2.47\ 10^{8}$	$8.45\ 10^{13}$	$1.63\ 10^{8}$	$1.63\ 10^{8}$	$4.85\ 10^{8}$	$6.38\ 10^{8}$
I_129	$1.57\ 10^{7}$	$1.63\ 10^{10}$	$8.68\ 10^{13}$	$2.87\ 10^{10}$	$1.63\ 10^{10}$	$1.63\ 10^{10}$	$1.63\ 10^{10}$
Ba_133	$1.07\ 10^{1}$	$9.98\ 10^{8}$	$3.13\ 10^{14}$	$7.94\ 10^{8}$	$7.94\ 10^{8}$	$3.20\ 10^{14}$	$8.07\ 10^{15}$
Cs_137	$3.00\ 10^{1}$	$7.09\ 10^{8}$	$8.01\ 10^{13}$	$4.60\ 10^{8}$	$4.60\ 10^{8}$	$4.68\ 10^{10}$	$1.48\ 10^{11}$
Eu_152	$1.33\ 10^{1}$	$3.51\ 10^{8}$	$7.44\ 10^{13}$	$2.24\ 10^{8}$	$2.24\ 10^{8}$	$7.37\ 10^{12}$	$9.93\ 10^{13}$
Eu_154	8.80	$3.28\ 10^{8}$	$5.90\ 10^{13}$	$2.05\ 10^{8}$	$2.05\ 10^{8}$	$1.42\ 10^{15}$	$7.30\ 10^{16}$
Ho_166m	$1.20\ 10^{3}$	$2.30\ 10^{8}$	$2.60\ 10^{13}$	$1.53\ 10^{8}$	$1.53\ 10^{8}$	$1.71\ 10^{8}$	$1.77\ 10^{8}$
Tl_204	3.78	$3.54\ 10^{11}$	$8.01\ 10^{15}$	$3.49\ 10^{11}$	$3.49\ 10^{11}$	$2.98\ 10^{27}$	$2.86\ 10^{31}$
Po_210	$3.79\ 10^{-1}$	$4.71\ 10^{13}$	$7.27\ 10^{11}$	$3.30\ 10^{9}$	$3.30\ 10^{9}$	$1\ 10^{99}$	$1\ 10^{99}$
Ra_226	$1.60\ 10^{3}$	$2.32\ 10^{8}$	$3.29\ 10^{11}$	$1.39\ 10^{8}$	$1.39\ 10^{8}$	$1.51\ 10^{8}$	$1.55\ 10^{8}$
Ra_228	5.75	$4.30\ 10^{8}$	$1.95\ 10^{11}$	$2.50\ 10^{8}$	$2.50\ 10^{8}$	$7.38\ 10^{18}$	$3.06\ 10^{21}$
Ac_227	$2.18\ 10^{1}$	$1.02\ 10^{9}$	$5.68\ 10^{9}$	$3.54\ 10^{8}$	$3.54\ 10^{8}$	$2.06\ 10^{11}$	$1.01\ 10^{12}$
Th_230	$7.70\ 10^{4}$	$2.58\ 10^{11}$	$3.13\ 10^{10}$	$3.53\ 10^{9}$	$3.53\ 10^{9}$	$3.53\ 10^{9}$	$3.54\ 10^{9}$
Th_232	$1.41\ 10^{10}$	$3.01\ 10^{11}$	$2.84\ 10^{10}$	$3.21\ 10^{9}$	$3.21\ 10^{9}$	$3.21\ 10^{9}$	$3.21\ 10^{9}$
Pa_231	$3.28\ 10^{4}$	$8.40\ 10^{9}$	$2.23\ 10^{10}$	$1.62\ 10^{9}$	$1.62\ 10^{9}$	$1.63\ 10^{9}$	$1.63\ 10^{9}$
U_233	$1.59\ 10^{5}$	$3.05\ 10^{11}$	$3.26\ 10^{11}$	$2.82\ 10^{10}$	$2.82\ 10^{10}$	$2.82\ 10^{10}$	$2.82\ 10^{10}$
U_234	$2.45\ 10^{5}$	$2.31\ 10^{11}$	$3.32\ 10^{11}$	$2.95\ 10^{10}$	$2.95\ 10^{10}$	$2.95\ 10^{10}$	$2.95\ 10^{10}$
U_235	$7.04\ 10^{8}$	$2.23\ 10^{9}$	$3.68\ 10^{11}$	$1.95\ 10^{9}$	$1.95\ 10^{9}$	$1.95\ 10^{9}$	$1.95\ 10^{9}$
U_236	$2.34\ 10^{7}$	$2.55\ 10^{11}$	$3.59\ 10^{11}$	$3.16\ 10^{10}$	$3.16\ 10^{10}$	$3.16\ 10^{10}$	$3.16\ 10^{10}$
U_238	$4.47\ 10^{9}$	$1.82\ 10^{10}$	$3.91\ 10^{11}$	$7.94\ 10^{9}$	$7.94\ 10^{9}$	$7.94\ 10^{9}$	$7.94\ 10^{9}$



Np_237	$2.14\ 10^{6}$	$1.69\ 10^{9}$	$6.25\ 10^{10}$	$1.19\ 10^{9}$	$1.19\ 10^{9}$	$1.19\ 10^{9}$	$1.19\ 10^{9}$
Pu_238	$8.77\ 10^{1}$	$2.21\ 10^{11}$	$2.84\ 10^{10}$	$3.22\ 10^{9}$	$3.22\ 10^{9}$	$1.56\ 10^{10}$	$2.32\ 10^{10}$
Pu_239	$2.41\ 10^{4}$	$5.03\ 10^{11}$	$2.60\ 10^{10}$	$2.95\ 10^{9}$	$2.95\ 10^{9}$	$2.97\ 10^{9}$	$2.97\ 10^{9}$
Pu_240	$6.54\ 10^{3}$	$2.31\ 10^{11}$	$2.60\ 10^{10}$	$2.95\ 10^{9}$	$2.95\ 10^{9}$	$3.01\ 10^{9}$	$3.03\ 10^{9}$
Pu_244	$8.26\ 10^{7}$	$1.17\ 10^{9}$	$2.84\ 10^{10}$	$6.26\ 10^{8}$	$6.26\ 10^{8}$	$6.26\ 10^{8}$	$6.26\ 10^{8}$
Am_241	$4.32\ 10^{2}$	$1.23\ 10^{10}$	$3.26\ 10^{10}$	$3.35\ 10^{9}$	$3.35\ 10^{9}$	$4.61\ 10^{9}$	$5.00\ 10^{9}$
Cm_244	$1.81\ 10^{1}$	$2.35\ 10^{11}$	$5.48\ 10^{10}$	$6.20\ 10^{9}$	$6.20\ 10^{9}$	$1.31\ 10^{13}$	$8.87\ 10^{13}$
Cm_248	$3.39\ 10^{5}$	$3.45\ 10^{11}$	$8.68\ 10^{9}$	$9.79\ 10^{8}$	$9.79\ 10^{8}$	$9.80\ 10^{8}$	$9.80\ 10^{8}$
Cf_252	2.64	$3.33\ 10^{11}$	$1.56\ 10^{11}$	$1.46\ 10^{10}$	$1.46\ 10^{10}$	$9.74\ 10^{32}$	$4.94\ 10^{38}$

Note: E1, E2 and E3 refer to the exposure scenario assessed

2252 = time after 200 years of institutional control

2052 = time at closure

2002 = time at which the already existing component of the design inventory is defined.

The allowed activity limits for Po-210 at 2002 and 2052 are greater than $1\ 10^{99}$ Bq. These limits are labelled as "$1\ 10^{99}$".

Appendix B

Waste Transfer Manifest Contents

Waste Transfer Manifest Contents

Below is a list of technical information that the waste owner would be required to provide to DEST. The list is not exhaustive.

Physical and Chemical Information

1 Description of the originating process.

2 Description of the waste including the category, approximate composition of metals, soil, plastic, rubble, rubber, wood and other materials.

3 Quantities (volumes, weights, density).

4 Proportion of radioactive contaminant.

5 Quantities of any moisture, oil and grease, ion exchange materials, complexing agents, putrescible materials, acids/alkalis in the waste.

6 Confirmation of the absence of prohibited materials.

7 Quantities of types of added void fillers, sorbents, stabilisation and solidification agents.

8 The composition and properties (e.g. pH, water content, hardness) of any conditioning and capping materials.

9 The ratio by weight of the original waste to any resultant conditioned product.

10 Statement of homogeneity within any resultant conditioned product.

11 Demonstration of compliance with the WAC.

Radiological Information

12 Method of radioactivity assessment including the attribute which is actually measured (e.g. the dose rate), how this measurement is used to give the activity, consideration of potential errors, confirmation that any computer codes have been verified and validated.

13 Radionuclide content (radioisotopes present, activities of radioisotopes that contribute more that 1% of total activity and exceed exemption levels, total alpha, beta and gamma content, activity concentration).

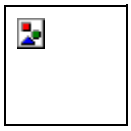
14 Physical form, certification number, manufacturers details of any radioactive sources.

15 Uranium content.

16 Demonstration of compliance with radionuclide disposal limits.

Packaging Information

17 Waste container (e.g. 205 litre drum) details, including type, construction, dimensions, number, manufacturer's drawings.



18 Transport container (e.g. ISO container) details, including type, construction, number

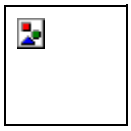
19 Fixed contamination levels on outer surfaces of transport containers.

20 Confirmation that the fixed contamination levels on outer surfaces of transport containers are within permissible limits.

21 Dose rates at contact and at 1 metre.

Appendix C

Waste Transfer Forms



Form 1

WASTE DISPOSAL APPLICATION
NATIONAL RADIOACTIVE WASTE REPOSITORY

WASTE OWNER

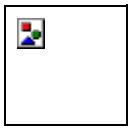
Waste Owner	
Address	
Tel	Fax
Contact Officer - Name	Contact Officer - Position
Tel	Fax
Email	

DESCRIPTION OF WASTE FOR DISPOSAL

Waste Description
Key Radioisotope(s)
Types of Radiation Emitted
Current Activity
Current Form of Waste
Proposed Form of Waste at Disposal
Volume of Waste / Number of Packages for Disposal

PRESENT LOCATION OF WASTE

Address



COMPLIANCE WITH RADIOLOGICAL CRITERIA

At disposal, will the waste comply with the WAC	Yes/ No
What Quality Assurance Process / Documentation will be provided	

CONDITIONING

What conditioning (if any) will be undertaken on the waste
Who will undertake the conditioning

PACKAGING

Current packaging	
Packaging proposed at disposal	
Does the packaging meet the WAC	Yes/ No
Does the packaging meet the Transport Code	Yes/ No
Does the packaging meet the Australian Dangerous Goods Code	Yes/ No

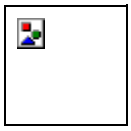
ALTERNATIVES TO DISPOSAL AT NRWR

Return to supplier
Transfer to new user
Transfer to re-processor
Disposal at landfill

OTHER DETAILS

Any additional comments

Authorised Officer	Date



Form 2

WASTE TRANSFER MANIFEST
NATIONAL RADIOACTIVE WASTE REPOSITORY

Disposal Approval No

WASTE OWNER

Waste Owner	
Address	
Tel	Fax
Contact Officer - Name	Contact Officer - Position
Tel	Fax
Email	

DESCRIPTION OF WASTE FOR DISPOSAL

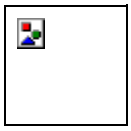
Waste Description
Key Radioisotope(s)
Types of Radiation Emitted
Current Activity
Current Form of Waste
Volume of Waste / Number of Packages for Disposal:

PRESENT LOCATION OF WASTE

Address:

COMPLIANCE WITH APPLICABLE LAWS

Has the waste been conditioned in accordance with all Applicable Laws and Regulations as defined in the Contract	Yes/ No



COMPLIANCE WITH RADIOLOGICAL CRITERIA

Does the waste comply with the NRWR WAC	Yes/ No
Is documentation of compliance with WAC attached	Yes/ No

PACKAGING

Does the packaging meet the WAC	Yes/ No
Does the packaging meet the Transport Code	Yes/ No
Does the packaging meet the Australian Dangerous Goods Code	Yes/ No

APPROVAL FOR DISPOSAL FROM STATE REGULATOR/ARPANSA

Has a disposal permit been issued by the State Regulator / ARPANSA If so please attach.	Yes/No

OTHER DETAILS

Any additional comments:

WASTE OWNER

The Waste Owner warrants:

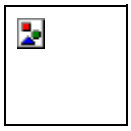
1. All particulars of this Waste Transfer Manifest are true and correct.
2. The waste has been conditioned in accordance with the QA Plan.

Authorised Officer - Waste Owner	Date:

DEST CONCURRENCE

Concurrence by DEST that the waste is adequately documented and suitable for disposal at the NRWR.

Authorised DEST Officer	Date:



Form 3

WASTE TRANSFER CERTIFICATE
NATIONAL RADIOACTIVE WASTE REPOSITORY

This certificate confirms that on the date below, the Commonwealth of Australia accepted ownership of the following items for disposal at the National Radioactive Waste Repository under waste disposal contract No …….

Disposal Approval No

WASTE OWNER

Organisation	
Address	
Tel:	Fax:

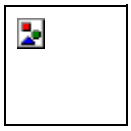
PACKAGES

List of Packages	Package Identifier

WASTE TRANSFER

Waste Owner's Nominee	
Tel	
Email	
Signature	
Date	

DEST's Nominee
Tel
Email
Signature
Date



Form 4

WASTE DISPOSAL CERTIFICATE
NATIONAL RADIOACTIVE WASTE REPOSITORY

This certificate confirms that the following items have been permanently disposed of at the National Radioactive Waste Repository under waste disposal contract No……..

Disposal Approval No

WASTE GENERATOR

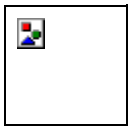
Organisation	
Address	
Tel:	Fax:

PACKAGES

List of Packages	Package Identifier

WASTE DISPOSAL

DEST's Nominee
Tel
Email
Signature
Date



GHD Pty Ltd ABN 39 008 488 373

59 Cameron Avenue Belconnen ACT 2617
PO Box 36 Belconnen ACT 2616 Australia
T: (02) 6253 1999 F: (02) 6253 1911 E: cbrmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
	T Ryan	G Chamberlain				
1	T Ryan	G Chamberlain		T Ryan		