# SAFE STORAGE
## of radioactive waste

The National Store Project:
Methods for choosing the right site

**A PUBLIC DISCUSSION PAPER**

July 2001

INDUSTRY SCIENCE RESOURCES

# **Safe storage** of radioactive waste

The National Store Project:
**Methods for choosing the right site**

Persons wishing to comment on any aspect of this publication are invited to make written submissions by 31 August 2001 to:

The Information Officer
National Store Project
Department of Industry, Science and Resources
GPO Box 9839
Canberra ACT 2601

Copies of the discussion paper and information packs on radioactive waste management in Australia can be obtained from the Information Officer at the above address, or the ISR web site:

| | |
|---|---|
| Telephone Tollfree | 1800 682 704 |
| Facsimile | (02) 6213 7567 |
| Email | Repository@isr.gov.au |
| Internet | http://www.isr.gov.au/radwaste.html |



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# Summary


Most Australians benefit either directly or indirectly from the medical, industrial, and scientific use of radioactive materials. However, a small amount of radioactive waste results from the use of these substances. Currently waste producers have the responsibility of managing and storing their own waste in facilities that, while safe, are often not ideal.

In time, Australia will need to develop a national geological repository for the disposal of its intermediate level radioactive waste. Until then, it is necessary to establish a national store in order to ensure that the waste is managed in a safe and responsible manner. This store will be purpose-built for the safe storage of intermediate level radioactive waste for a period of up to at least fifty years until a suitable geological repository is established.

In February 2001, the Minister for Industry, Science and Resources, Senator Nick Minchin, announced that a national store would be established on Commonwealth land to safely and responsibly manage intermediate level radioactive waste produced by Commonwealth agencies and departments.

This paper, prepared by the National Store Advisory Committee, a group of experts appointed to advise on the site selection process, and the Department of Industry, Science and Resources, outlines the issues that should be considered and the proposed methodology that will be used to identify a preferred site for a national store.

The long-term safety of radioactive waste in the store, the operational requirements for transport, safe handling, storage and retrieval of waste packages, the local environment, the security of the facility, and other land uses, are all important considerations in selecting a suitable site.

The following issues should be taken into account when siting the store:

- Geological hazards, such as earthquakes, volcanic activity and landslides;
- Local environmental hazards, such as flooding and fires;
- Natural environmental features, such as surface drainage;
- Access to transport, support facilities and infrastructure;
- Social impacts;
- Sites or areas of special environmental, cultural or historical significance;
- Security; and
- Security of land tenure by the Commonwealth and compatibility with adjacent land use.

A Geographic Information System will be used to assist in assessing the suitability of Commonwealth land for location of a national store. Various themes, relevant to the site selection issues, are suggested for incorporation into the Geographic Information System. These themes are open for public comment and may be modified as a result. Sites on Commonwealth land will then be considered as a result of applying these themes.

A final site will be selected following careful scientific and environmental assessment of suitable land, and further public consultation. The earliest date at which the preferred site for the national store could be announced would be late 2002.

Public comment on this paper is invited, and a paper responding to this comment will be published.

## COMMONLY USED TERMS

### Low level waste

Waste containing low levels of beta and gamma emitting, and normally very low levels of alpha emitting radioactive material. Low level waste is waste that is suitable for near-surface disposal. Shielding is not normally required for handling and transport. It includes items such as wrapping material and discarded protective clothing and laboratory plant and equipment. This category of waste corresponds to Category A, B and C waste in the NHMRC Radiation Health Series, number 35, 1992 (*Code of Practice for Near-Surface Disposal of Radioactive Waste in Australia*) and broadly to short-lived low and intermediate level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994.

### Intermediate level waste

Waste that contains significant levels of beta and gamma and possibly alpha emitting radioactive material. Intermediate level waste is not suitable for near-surface disposal. Australian intermediate level waste consists of historical waste from mineral sands processing, disused sealed sources and industrial gauges, reactor components, irradiated fuel cladding, conditioned waste from the processing of spent fuel and ion-exchange resins and filters (e.g. as a result of reactor operation). This waste sometimes requires shielding during handling and transport. This category of waste corresponds to the long-lived low and intermediate level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994, and Category S waste in the NHMRC Radiation Health Series, number 35, 1992 (*Code of Practice for Near-Surface Disposal of Radioactive Waste in Australia*).

### High level waste

Waste containing high levels of beta and gamma radiation emitters and significant levels of alpha emitters, and generating significant amounts of heat (greater than 2 kilowatts per cubic metre). Such waste requires careful handling, substantial shielding, provision for dissipation of heat generated by the decay of fission products, and long-term immobilisation and isolation from the biosphere. High level waste is generated by nuclear power reactors and some military activities, including nuclear weapons programs. No high level waste is generated in Australia. This category of waste corresponds to the high level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994.

### National low level waste repository

An engineered near-surface underground facility for the disposal of Australia's low level radioactive waste.

### National store

An interim purpose-built above-ground store for the safe storage of intermediate level radioactive waste generated by Commonwealth agencies. The store will be designed to operate for a period of up to at least fifty years until a geological repository has been established.

### National geological repository

An engineered underground facility at depth for the disposal of Australia's intermediate level radioactive waste. Disposal at depths of typically several hundred metres is an internationally accepted method of geological disposal.

An expanded list of commonly used terms is given in a glossary in Appendix 2.

# Introduction

Most Australians benefit either directly or indirectly from the medical, industrial, and scientific use of radioactive materials. However, a small amount of radioactive waste, some of it intermediate level waste, is inevitably generated as a by-product. Individual waste producers currently have the responsibility of looking after their own radioactive waste. As a consequence, waste is often stored in facilities that were not designed for the long term storage of such material, in circumstances that, while safe, are not ideal.

In time, Australia will need to develop a national geological repository deep underground for the disposal of its intermediate level radioactive waste. Because of the complexities involved, the small volume of intermediate level radioactive waste in Australia, and the cost to establish such a facility, the creation of such a repository is a long-term national project. In the mean time, in order to ensure that the existing waste is managed in a safer, more responsible manner than is currently the case, it is necessary to develop a national store.

A national store is also needed to safely manage the small amount of Australian intermediate level radioactive waste that will be returned to the country from 2015 onwards. This waste results from the processing of spent fuel overseas from the existing HIFAR research reactor. There is currently no facility in Australia that is suitable for the safe storage of this waste.

The national store will be purpose-built for the interim storage of intermediate level radioactive waste. It will need to be designed to operate for a period of up to at least fifty years until a suitable geological repository is established.

In February 2001, in order to improve overall community safety and confidence, the Minister for Industry, Science and Resources, Senator Nick Minchin, announced that a national store would be established on Commonwealth land to safely and responsibly manage intermediate level waste produced by Commonwealth agencies and departments. These will include, amongst others, the Australian Nuclear Science and Technology Organisation (ANSTO), the Department of Defence, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

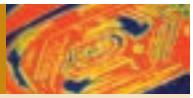
Most of Australia's radioactive waste is low level, and is suitable for near-surface underground disposal in the national low level waste repository. A preferred site and two alternative sites in central-north South Australia for the national low level waste repository are currently undergoing environmental assessment under the *Environment Protection and Biodiversity Conservation Act (Cwlth 1999)*.

The remainder of Australia's radioactive waste consists of a small amount of intermediate level waste. In order to ensure that the process of selecting a suitable site for the above-ground national store for intermediate level waste is completely separate from the process for selecting the near-surface underground national repository for disposal of low level waste, Senator Minchin has ruled out co-location of the two facilities.

Australia does not generate any high level radioactive waste and thus has no need or responsibility to store or dispose of any such material.

This paper provides a report for public discussion on the method that will be used to identify a suitable site on Commonwealth land for an above-ground store for intermediate level radioactive waste produced by Commonwealth agencies. A full definition of commonly used terms and radioactive waste types is given in a glossary in Appendix 2.

# WHAT IS RADIOACTIVITY?



## What is radioactivity?

Radioactivity is the term used to describe the release of energy and subatomic particles as unstable atoms breakdown to form more stable atoms.

Radioactivity is a natural part of our Earth and universe. Naturally occurring radioactive materials are present in the soil and in rocks, in the floors and walls of our homes, schools, and offices, and in the food we eat and drink. There are radioactive gases in the air we breathe. There are even naturally occurring radioactive elements in our muscles, bones and tissues.

The radiation we receive from these radioactive substances forms only part of the overall radiation we receive from the natural environment. Other types of naturally occurring radiation include ultraviolet, infrared and visible light, microwaves and cosmic rays. Radiation from natural sources is called background radiation.

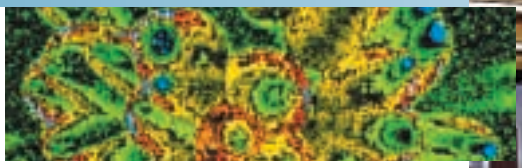
The use of radiation released by radioactive materials has brought tremendous benefits to society.

Radioactive materials play an important part in the diagnosis and treatment of diseases, including cancer. Treatments for cancer include directly irradiating the cancer or using radioactive medicines that concentrate in the tumour and kill the cancer cells. Therapeutic drugs that contain a radioactive material, radiopharmaceuticals, are also important in the diagnosis of many diseases or conditions. They can be injected into the body, inhaled or taken orally to enable imaging of body organs such as the heart, kidneys, liver and lungs.

Another beneficial use of radiation is for sterilisation of medical equipment. Syringes, dressings, surgical gloves, heart valves and surgical instruments can all be sterilised after packaging by using radiation.

In industry, radioactive materials are used in industrial radiography, measuring devices, process control in factories, civil engineering projects, material analysis, and oil and mineral exploration. Industrial radiography is particularly important in the engineering sector as it produces detailed images that are used to inspect metal components and identify cracks and flaws that may lead to structural failure.

Radiation and radioisotopes are also important in agriculture and have been used to improve food crops, animal production and health, preserve food, and control insect pests. They are also used to measure soil moisture, erosion rates, salinity, the efficiency of fertiliser uptake in the soil, and are used in research to help reduce the quantities of pesticides used by farmers.



## THE NATIONAL LOW LEVEL WASTE REPOSITORY PROJECT

### The national low level waste repository project:

A project to find a site for a national repository for Australia's low level radioactive waste commenced in 1992. Social and technical siting criteria published by the National Health and Medical Research Council in the 1992 *Code of Practice for Near-surface Disposal of Radioactive Waste in Australia* were applied to the Australian continent to identify broad areas of potential suitability. In 1994, eight regions that contained large areas of potential suitability were identified.

In 1998, the former Minister for Resources and Energy, Senator Warwick Parer, announced that the central-north region of South Australia had been selected for siting studies for the national repository as, of all the regions identified in the 1994 study, it contained the largest area of suitability.

On 24 January 2001, the Minister for Industry, Science and Resources, Senator Nick Minchin, announced that a preferred site and two alternatives in central-north South Australia were to undergo environmental assessment in order to decide a final site. On 2 March 2001, the Minister for Environment and Heritage, Senator Robert Hill, announced that an Environmental Impact Statement (EIS) would be necessary for the national low level waste repository project.

### The following discussion papers have been issued on the national repository project

- 1992, A Radioactive Waste Repository for Australia: Methods for Choosing the Right Site
- 1993 National Repository Site Selection Study Phase 1. A Report on Public Comment
- 1994 A Radioactive Waste Repository for Australia: Site Selection Study - Phase 2.
- 1995 National Radioactive Waste Repository: Site Selection Study Phase 2, A Report on Public Comment
- 1998 - A Radioactive Waste Repository for Australia. Site Selection Study - Phase 3. Regional Assessment
- 1999 National Radioactive Waste Repository Site Selection Study Phase 3. A Report on Public Comment.

Further information on the national repository project, including copies of all publications, can be obtained on the Department of Industry, Science and Resources website at www.isr.gov.au/resources/radwaste, or by email at Repository@isr.gov.au, or by writing to National Radioactive Waste Repository, Coal and Mineral Industries Division, Department of Industry Science and Resources, GPO box 9839, Canberra, ACT 2601.

# Australia's intermediate level waste inventory

Over the last fifty years Australia has accumulated about 500 cubic metres of intermediate level waste suitable for above-ground storage in a national store (Table 1). This amount of waste would fit into a building the size of an average-sized house.

Typical of the wastes that would be considered for storage in the national store are higher activity disused radiation sources, some radiation gauges used in research, radiotherapy sources, radium needles, and waste from mineral sands processing many years ago. Some operational waste from ANSTO's activities, and conditioned residues from the processing of spent fuel from the existing High Flux Australian Reactor (HIFAR), and, in the future, from the replacement research reactor will also be stored in the national store.

The different types of waste will be conditioned appropriately for storage in the national store. Conditioning involves those operations that transform radioactive waste into a form suitable for handling, transportation, storage and disposal. The operations may include immobilisation of radioactive waste, placing waste into containers and providing additional packaging. The Australian Radiation Protection and Nuclear Safety Agency's (ARPANSA) Radiation Health Committee is currently developing a *Code of Practice for the Pre-disposal Management of Radioactive Waste*, which will be used to guide the management of radioactive waste in the national store, including requirements for the conditioning of waste.

**Table 1. Current Commonwealth inventory of intermediate level radioactive waste in Australia.**

| SOURCE | TYPICAL WASTE | VOLUME (cubic metres) |
|---|---|---|
| **ANSTO - radioisotope production, reactor operation and research** | Target cans, ion exchange columns, used control arms, aluminium end pieces, some solidified liquid waste | 205 |
| **Historical waste** | Thorium and uranium residues from mineral sands processing | 165 |
| **Other Commonwealth agencies** | Disused sources from medical, Defence and research equipment | 35 |

## INTERNATIONAL RADIOACTIVE WASTE REPOSITORY NOT AN OPTION

There has been media coverage of a proposition by a company called Pangea Resources Australia Pty Ltd, that Australia appeared suitable, both geologically and politically, for the siting of an international high level radioactive waste repository.

The Commonwealth Government has stated that Australia will not accept nuclear waste from other countries. The Minister for Industry, Science and Resources, Senator Nick Minchin has indicated that it is the government's firm policy that each country should look after its own waste. Successive Australian governments have agreed that Australia will not accept the radioactive wastes of other countries.

## Future Generation of Intermediate Level Waste

Estimates of the amount of intermediate level waste that Commonwealth agencies will generate in the foreseeable future are given in Tables 2 and 3. Future waste will include disused sealed sources from medical, industrial and research equipment, target cans, solidified waste from production of radioactive materials used in medicine, conditioned residues from the processing of spent fuel from the HIFAR reactor and replacement research reactor, and waste arising from decommissioning of the research reactors.

The amount of intermediate level radioactive waste generated annually from the replacement research reactor will be broadly similar to that generated by the existing HIFAR reactor.

Spent fuel from HIFAR and the replacement research reactor will not be stored in the national store. The spent fuel has been, and will continue to be, stored temporarily on site at ANSTO then sent overseas for processing and conditioning. Waste from the processing of HIFAR spent fuel will be returned to Australia conditioned in concrete or a vitrified (glass) matrix or as compacted waste in purpose-designed transport and storage containers. Waste from the processing of replacement research reactor fuel will be returned in purpose-designed transport and storage containers conditioned as vitrified (glass) residues and compacted waste. The containers will be appropriate for storage in the national store and will not require additional shielding or remote handling equipment for their management.

**Table 2. Annual amounts of intermediate level radioactive waste expected to be generated by Commonwealth agencies in Australia in the foreseeable future (excluding spent fuel management and decommissioning wastes).**

| SOURCE | TYPICAL WASTE | VOLUME (cubic metres) |
|---|---|---|
| **(HIFAR - current research reactor; RRR - replacement research reactor)** | | |
| **2000-2005** | | |
| ANSTO - radioisotope production, HIFAR operation and research | Target cans, ion exchange columns, used control arms, aluminium end pieces (about 1.5 cubic metres per year), solidified liquid waste from radiopharmaceutical production (about 0.03 cubic metres per year). | 1.5 |
| **After 2005** | | |
| ANSTO - radioisotope production, RRR operation and research | Target cans, ion exhange columns, used control arms, aluminium end pieces (about 1.5 cubic metres per year), solidified liquid waste from radiopharmaceutical production (about 0.12 cubic metres per year). | 1.6 |
| **2000 onwards** | | |
| Other Commonwealth agencies | Sealed sources from medical and research equipment | 1.0 |

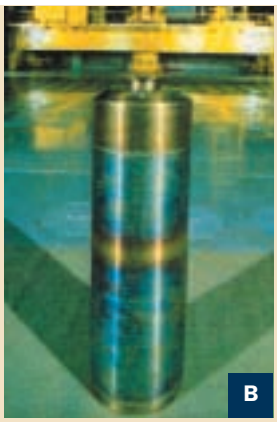
*HIFAR is the existing research reactor that operates at Lucas Heights. The replacement research reactor (RRR) is intended to commence operations at Lucas Heights in 2005.*

**Table 3. Intermediate level waste from decommissioning and spent fuel management.**

| SOURCE | TYPICAL WASTE | VOLUME (cubic metres) | YEAR OF WASTE PRODUCTION |
|---|---|---|---|
| **HIFAR decommissioning** | Core support structure | 5 | 2035 |
| **HIFAR spent fuel** | Packaged conditioned waste in concrete<br>Vitrified (glass) residues and compacted waste | 20<br>6 | By 2020<br>2015 |
| **RRR decommissioning** | Core support structure | Less than 5 | 2075 |
| **RRR spent fuel** | Vitrified (glass) residues and compacted waste | 20 | After 2025 |

*HIFAR is the existing research reactor that operates at Lucas Heights. The replacement research reactor (RRR) is intended to commence operations at Lucas Heights in 2005.*

**A: Examples of vitrified (glass) and cemented waste from the processing of Australian spent fuel overseas. Processing is the chemical procedure that allows the volume of spent fuel to be reduced four-fold and that creates a safe inert waste form suitable for storage and disposal.**


*INNER CANISTERS:*
*Height: 1.34m*
*Diameter: 43cm*

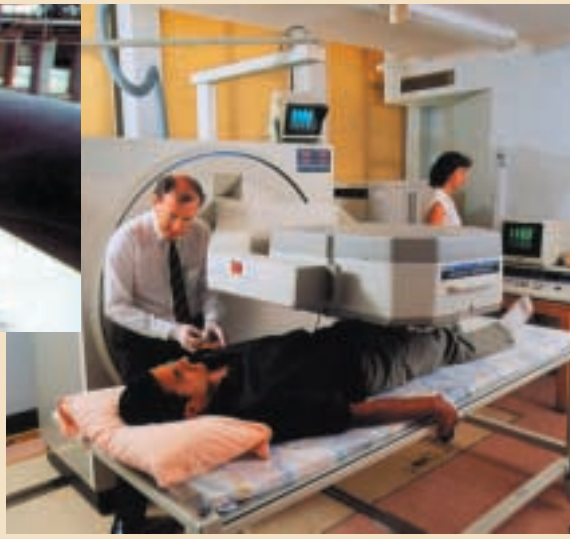
**B: An example of the 'inner' stainless steel canisters that contain conditioned intermediate level waste. For the return shipment to Australia the 'inner' canisters will be loaded into dual-purpose transport and storage containers.**

## AUSTRALIA'S RESEARCH REACTOR

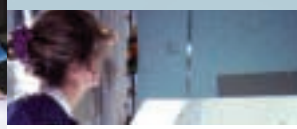
Australia obtains substantial benefits from the High Flux Australian Reactor (HIFAR), which the Australian Nuclear Science and Technology Organisation (ANSTO) operates at Lucas Heights. HIFAR is a small, scientific research reactor and not a commercial nuclear power plant. The research reactor is a source of neutrons, and Australia benefits from the use of these neutrons in areas as diverse as medicine, the environment, agriculture, industry, mining, science and education. In medicine, for example, ANSTO uses HIFAR to produce about 350,000 patient doses of radioactive materials (radiopharmaceuticals) each year. Over 180 nuclear medicine departments and clinics across Australia use these nuclear medicines for detection and treatment of illnesses such as cancer and heart diseases. ANSTO is currently progressing plans for the establishment of a replacement research reactor to replace HIFAR. It is planned that the replacement research reactor would commence operations in 2005, subject to the successful completion of the review and approval processes.

The beneficial uses of radioactivity inevitably generate radioactive waste. With careful scientific planning radioactive waste can be safely managed and disposed of without placing an undue burden on future generations.

**An expert using a radioactive source and detecting equipment to identify cracks and flaws and check the integrity of a pipeline.**



**Preparing for a nuclear medicine scan. ANSTO produces about 350,000 of radiopharmaceuticals each year.**



# The National Store Project

## Background

In November 1996, in its response to a Senate Select Committee inquiry into radioactive waste, the Federal Government made an in-principle decision to establish an above-ground national store for Australia's radioactive waste that was not suitable for under-ground disposal in the national repository for low level waste.

In August 2000, the Minister for Industry, Science and Resources, Senator Nick Minchin, indicated that there would be a nationwide search for a site for a national store for intermediate level waste.

Senator Minchin outlined a siting process that would involve:

- Development of selection criteria that would be used to identify potentially suitable sites;
- Identification of potentially suitable sites; and
- Public comment at various stages of the process.

The Minister indicated that an expert advisory committee, the National Store Advisory Committee (NSAC), would advise on the process, and that the earliest a preferred site for the store could be announced would be late 2002. He sought the views of states and territories on the proposal.

On 8 February 2001, Senator Minchin, announced that the Federal Government would establish a safe, purpose-built facility on Commonwealth land for the safe storage of national, intermediate level waste produced by Commonwealth agencies.

Senator Minchin indicated that there would be a transparent, nationwide search for a suitable site based on scientific and environmental criteria. In order to ensure that the process of selecting a site for the national store is completely separate from the process for selecting the national low level waste repository, Senator Minchin ruled out co-location of the two facilities.

The Minister's decision to site a national store for the waste generated by Commonwealth agencies resulted from lack of unanimity among states and territories about the desirability of a national store for all of Australia's intermediate level waste. The Minister indicated that he had taken the decision because the Federal Government has an important responsibility to manage intermediate level waste generated by its own agencies. Senator Minchin said that individual states and territories will now have to decide whether to build their own storage facilities, or negotiate with the Federal Government for access to the national store.

## Licensing and safety

The national store will be Commonwealth-owned, and operated by the Department of Industry, Science and Resources, or its successors. The facility will be regulated by the Commonwealth regulator for radioactive materials and radiation safety, ARPANSA.

The function of the national store will be to provide for the safe and secure storage of intermediate level radioactive waste so that people and the environment are protected from radiological hazards for a period of up to at least fifty years. Safe storage of waste depends on the siting, design, construction, operation and maintenance of the facility. The overall safety of the national store will depend on a multi-barrier system that includes waste conditioning and packaging, the storage facility and site specific properties relevant to safety. The overall safety depends on the sum of all the barriers. A safety assessment will be carried out, taking all the elements of the multi-barrier system into account, in order to demonstrate compliance with the relevant national standards for the protection of humans and the environment.

**Radiopharmaceuticals are essential in diagnosing and treating many serious illnesses.**

## WHO IS RESPONSIBLE FOR RADIOACTIVE WASTE IN AUSTRALIA?

Radioactive waste in Australia is produced by government agencies and departments such as ANSTO, CSIRO and the Department of Defence, by hospitals, and by private industry. Responsibility for the management of the waste lies with the waste producers.

The States and Territories are responsible for monitoring the use and transport of radioactive materials, and the storage and disposal of radioactive waste under their control in accordance with state and territory acts and regulations, administered by state or territory radiation safety authorities.

The Commonwealth Government is responsible for managing radioactive material and radioactive waste held by organisations under its control, including departments, agencies and bodies corporate.

Commonwealth organisations handling radioactive materials or radioactive waste, including contractors, are regulated by the recently created Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), a part of the Health and Aged Care Portfolio. ARPANSA is a Federal Government agency charged with responsibility for protecting the health and safety of people, and the environment, from the harmful effects of ionizing and non-ionizing radiation.

The national low level waste repository and the national store for intermediate level waste will be Commonwealth facilities, and as such will be regulated by ARPANSA.

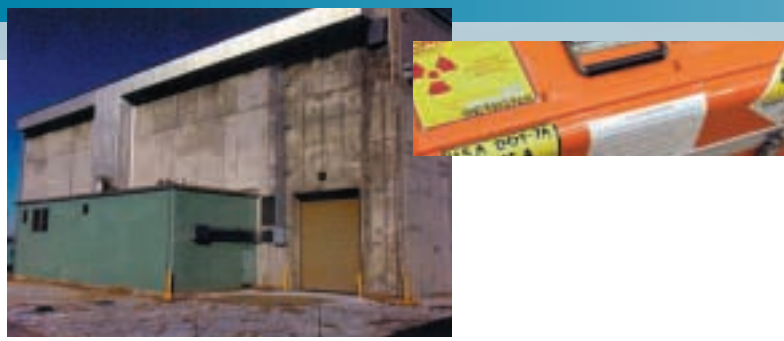
Further information on Australian radiation and nuclear safety regulations, can be obtained on the ARPANSA website at www.arpansa.gov.au, or by email at arpansa@health.gov.au, or by writing to ARPANSA, Sydney Offices, PO Box 655, Miranda, NSW, 1490.

## Design Considerations

The national store represents an interim step in Australia's long-term radioactive waste management plan. In time, Australia will need to develop a national geological repository for the disposal of its intermediate level waste. It is expected that due to the issues involved, there will be an extended period of time before a such a disposal facility could be established. The national store will therefore be designed to operate for up to at least fifty years, in order to ensure that waste can be safely and responsibly managed.

The national store and support facilities will fit on land the size of an average suburban block. The facility will be designed to ensure the safe storage, security and monitoring of the waste, and will be surrounded by a buffer zone.

In order to maximise safety and efficiency throughout the waste management cycle, waste will be stored in the national store in a form most likely suitable for future disposal.



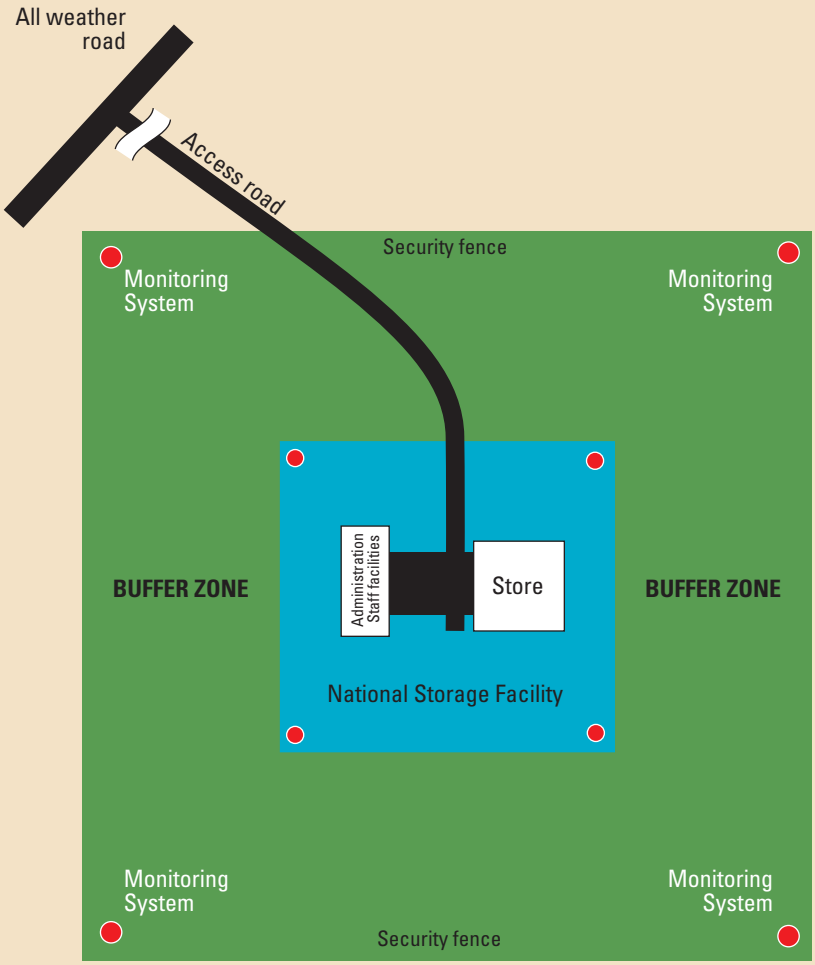
**An intermediate level waste storage facility.**

## CONCEPTUAL DESIGN OF THE NATIONAL STORE

The national store will be surrounded by a buffer zone and will include: storage facilities for intermediate level radioactive waste; a building for administration and staff facilities; an access road from the nearest significant transport route; electrical power and freshwater supply; security fencing; and a security monitoring system.

The storage facility itself will be a specially constructed above-ground building that is designed to safely store the radioactive waste for a period of up to at least fifty years. The radioactive waste will be contained by a series of barriers in order to prevent release of radioactive material into the environment and protect against inadvertent intrusion by people or wildlife.

An environmental monitoring system, including monitoring of groundwater, external gamma radiation, and concentrations of radioactive material in the air, soil and vegetation will be established in the area surrounding the store.




*General overview of the elements that could be used in the design of the store. Note: Environmental and security monitoring system control points are represented by red dots.*

**Spent fuel being packed and loaded for transport.**

As only a small amount of intermediate level waste is produced by Commonwealth agencies annually, transport to the national store will be infrequent, perhaps only once every few years. Transporting of radioactive waste to the national store will be undertaken by road. All radioactive waste will be transported in accordance with the *Code of Practice for the Safe Transport of Radioactive Substances (1990) or the Code of Practice for the Safe Transport of Radioactive Materials*, which is expected to be adopted in the near future, and relevant state and territory regulations.

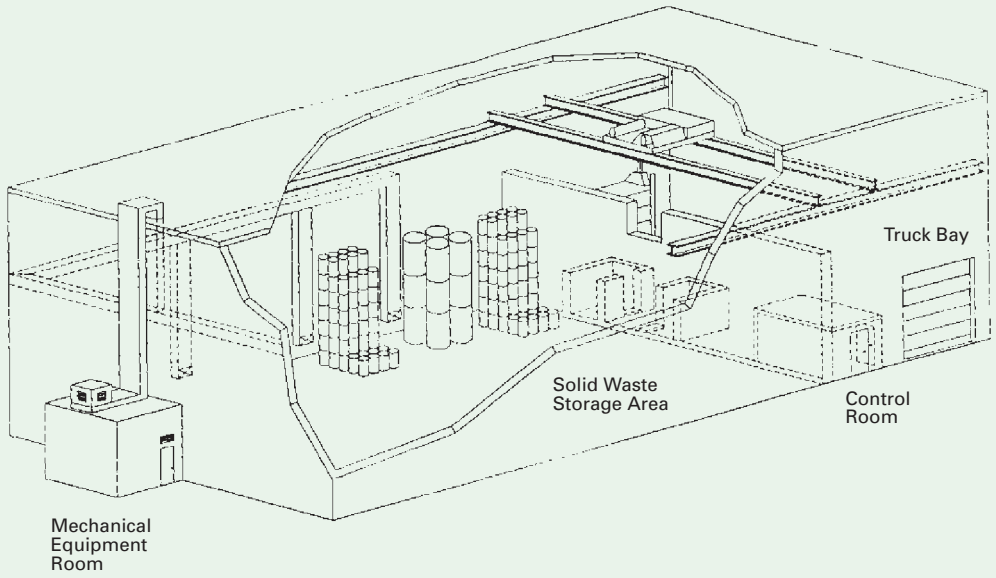
The national store will comply with the relevant national regulations for the storage of radioactive waste, which are consistent with international standards. It will be designed taking into consideration the specifics of the chosen site. The waste will be stored in accordance with the *Code of Practice for the Pre-disposal Management of Radioactive Waste*, currently being developed by ARPANSA's Radiation Health Committee.

## Siting Requirements

Safe storage of waste depends in part on the siting, design, construction, operation and maintenance of the facility. The siting and design features of the storage facility will need to take into account several safety related factors including:

- The waste characteristics including the physical and chemical form of the waste, and the radionuclide content;
- How the waste is conditioned and the possible requirement for repackaging from transport containers;
- The building structures required for the facility;
- The waste handling operations;
- The expected duration of storage;
- The need to maintain an inventory and the need to retrieve the waste at some stage; and
- Any facilities required to treat and package waste to meet the established storage criteria.

**Schematic diagram of an interim intermediate level radioactive waste storage facility.**



**Environmental monitoring.**

## Site Selection Considerations

The site for the national store will be selected to meet safety, operational, environmental impact and security objectives that are suitable for Australia and consistent with international standards. The main technical emphasis in site selection is to consider to what extent the location or features of the site will impact on the following factors:

- Safety of the radioactive waste in the storage facility;
- Operational requirements for safe transport, handling, storage and retrieval of waste packages;
- The safety of humans and the environment;
- Security of the facility; and
- Other land uses.

Specific siting issues that will need to be addressed are listed in the terms described above.

**1. Safe storage of the radioactive waste**

The following should be considered in the siting and design of the store:

- Geological hazards, such as earthquakes, volcanic activity, and landslides;
- Local environmental hazards, such as flooding and fires; and
- Local environmental conditions that facilitate the safe storage of radioactive waste and the construction of the store, for example, surface drainage features.

**2. Operational considerations**

The site should have:

- Good road access under all weather conditions;
- Reasonable access to support facilities; and
- Communications, power and water available.

**3. Environmental and social impacts**

The following should be considered in the siting and design of the store:

- Social impacts, including proximity to population centres;
- Sites or areas of special environmental, cultural or historical significance; and
- Adjacent land use.

**4. Security**

The site should allow:

- Maintenance of an appropriate level of security; and
- The inclusion of a buffer zone.

**5. Alternative land use or ownership**

The following should be taken into account in the siting of the store:

- Security of land tenure by the Commonwealth; and
- Compatibility with adjacent land use.

The specific siting issues will be used to help identify the most suitable site for a national store. The physical conditions presented by the recommended site will be considered in the safety assessment and will influence the overall design of the storage facility.

# Assessment methodology

The Bureau of Rural Sciences (BRS) has developed the ASSESS system to assist in assessing the suitability of Commonwealth land for location of the national store. ASSESS is a Geographic Information System (GIS), which is a computer-based suite of software and hardware used to organise and manage spatial information. Within this system different information layers, or "themes", will be combined together to assess the overall suitability of an area against the combined information. The themes currently considered relevant to the site selection process for the national store are outlined below.

Some themes can be directly correlated to the site selection considerations, outlined in section 3.5, and will provide an excellent representation of suitability. Others are less directly relevant and will be used as surrogates in the absence of directly relevant data.

Individual themes that relate to the *safe storage of radioactive waste* are:

- Recent volcanic rocks;
- Regolith, or weathered surface materials;
- Earthquake risk;
- Faults;
- Relief and landform; and
- Creeks, lakes and swamps.

Individual themes that deal with *operational* requirements are:

- Cities and towns; and
- Transport routes.

Individual themes relevant to *environmental and social impacts* are:

- Cities and towns;
- Heritage areas; and
- Rare or threatened plants.

Individual themes that relate to *security* are:

- Cities and towns; and
- Transport routes.

The sources of the information and the basis for classifying each theme in terms of suitability are presented in Appendix 1.

The next stage of the study will involve revising the themes taking public comment into account, and then assessing the suitability of Commonwealth land. Data for each theme will be classified according to potential suitability, combined and overlaid on areas of Commonwealth land.

## Call for Public Comment

An important component of the national store project is public consultation. Persons wishing to comment on any aspect of this publication are invited to make written submissions by 31 August 2001 to:

The Information Officer
National Store Project
Department of Industry, Science and Resources
GPO Box 9839
Canberra ACT 2601

A paper responding to public comment will be published, and views expressed will be taken into account in the next stage of the project.

# Appendix 1

## INFORMATION RESOURCES AND THEME DESCRIPTIONS

The suggested site selection themes, while associated with safety, are essentially a planning tool for the Australian site selection study for the national store. The physical conditions of the final site and the facility design will be considered together to ensure public and environmental safety while also facilitating the safe long-term storage of the radioactive waste.

## THEMES

**Geology – volcanism, recent volcanic rocks**

*Source:*
Geology dataset, 1:2,500,000 scale; AGSO, 1999.

*Ranking:*

1. Suitable: Non-volcanic and extremely old volcanic rocks.
2. Intermediate: Not used in this theme.
3. Unsuitable: Recent volcanics (2 – 0 million years).

*Rationale:*
Given there are no active volcanoes on the Australian continent this theme will be used to help identify areas where volcanic activity has occurred in the recent past and thus areas of possible future activity. It should be noted that it is widely considered that there is a very low probability of the resumption of volcanic activity on mainland Australia.

**Regolith - weathered surface material**

*Source:*
Regolith Terrain Map of Australia, 1:5,000,000 scale; BMR, 1986.

*Ranking:*

1. Suitable: Erosional, low-moderate relief, weathered, fine-grained materials.
2. Intermediate: Erosional/depositional, moderate-high relief, variably weathered, stony.
3. Unsuitable: Erosional, mountains, minor weathering; or depositional, plains with water courses, flood plains, coastal plains, salt lakes, alluvial plains, swamps, dune fields; or bare rock.

*Rationale:*
Analysis of regolith or weathered surface material will be used to indicate whether the present landscape is erosional or depositional, and thus to infer whether a site may be subject to regional flooding.

**Earthquake risk**

*Source:*
Geohazard Risk Contour Map, 1:1,000,000 scale; AGSO, 1998.

*Ranking:*

1. Suitable: Low frequency; acceleration less than 0.05 metres per second squared
2. Intermediate: Intermediate frequency; acceleration greater than 0.05 metres per second squared and less than 0.10 metres per second squared
3. Unsuitable: High frequency; acceleration greater than 0.10 metres per second squared

*Rationale:*
The earthquake risk theme will be used to identify areas where earthquake activity could result in damage to normal buildings and thus complex engineering would be required to develop a national store. The earthquake hazard maps represent the best estimates for maximum ground acceleration possible sometime in the next 500 years, with a ten percent probability of this happening within 50 years.

**Faults**

*Source:*
The Geology of Australia – 1976, 1:2,500,000 scale, BMR 1976.

*Ranking:*

| | |
|---|---|
| 1. Suitable: | Greater than 2.5 km from a major fault. |
| 2. Intermediate: | Not used in this theme. |
| 3. Unsuitable: | Less than 2.5 km from a major fault. |

Rationale:
This theme will be used to help identify areas close to major faults that should be avoided in order to ensure the integrity, and simplify the design of the national store.

**Relief and landform**

*Source:*
Relief and Landform Map of Australia; 1:5,000,000 scale, CSIRO, 1969.

*Ranking:*

| | |
|---|---|
| 1. Suitable: | Areas of low relief; or moderate relief dissected plateau; or scattered linear dunes. |
| 2. Intermediate: | Moderate relief; or high relief dissected plateaus. |
| 3. Unsuitable: | High relief; or tidal zones; or densely spaced linear sand ridges. |

*Rationale:*
This theme will be used to help define areas that maybe subject to flooding and landslides and thus require costly, complex engineering to ensure the integrity of the national store.

**Creeks/streams/lakes**

*Source:*
Hydrography dataset, 1:2,500,000 scale, AUSLIG, 1987.

*Ranking:*

| | |
|---|---|
| 1. Suitable: | More than 2.5 km from water feature. |
| 2. Intermediate: | Not used in this theme. |
| 3. Unsuitable: | Less than 2.5 km from water feature. |

*Rationale:*
The creeks, streams and lakes theme will be used to highlight areas close to major drainage systems that would require extensive earthworks to ensure the integrity of the storage facility.

**Cities and towns**

*Source:*
1:2,500,000 scale Master Names File (1987), Census 96 figures, ABS and 1:250,000 scale Built-Up Areas, AUSLIG, 1999.

*Ranking:*

| | |
|---|---|
| 1. Suitable: | Greater than 1.5 km from the nearest residence. |
| 2. Intermediate: | Not used in this theme. |
| 3. Unsuitable: | Less than 1.5km from the nearest residence. |

*Rationale:*
This theme addresses several overarching issues that need to be considered in the siting of a store including 'operational considerations', 'environmental and social impacts', and 'security'. The theme will be used to help define areas with adequate existing infrastructure to support the operation of the store and sites that can be easily monitored to ensure security. This theme will also be used to help define areas with current, adjacent and likely future land use that is not compatible will the national store.

**Transport routes**

*Source:*

Roads, 1:250,000 scale, AUSLIG, 1999.

*Ranking:*

1. Suitable: Less than 25 km from an all weather road.
2. Intermediate: Between 25 and 100 km from an all weather road.
3. Unsuitable: Greater than 100 km from an all weather road.

*Rationale:*

This theme addresses several issues that need to be considered when siting the national store including 'security' and 'operational considerations'. The theme will be used to help define areas that have transport infrastructures that will simplify store operations.

**Heritage**

*Source:*

National Estate Registered Areas, 1:100,000 and 1:250,000 scale, AUSLIG, for the Australian Heritage Commission, 1999.

*Ranking:*

1. Suitable: Greater than 1.5 km from a registered area.
2. Intermediate: Not used in this theme.
3. Unsuitable: Less than 1.5 km from a registered area.

*Rationale:*

This theme will be used to help identify areas of special environmental, cultural or historical significance that should be avoided when siting the national store.

**Location of rare or threatened plants**

*Source:*

Rare or Threatened Australian Plants, scale unknown but derived from point data, ERIN, 1992.

*Ranking:*

1. Suitable: No rare or threatened plants.
2. Intermediate: Not used in this theme.
3. Unsuitable: Known rare or threatened plants.

*Rationale:*

This theme will be used to help identify areas that contain rare or threatened plants.

**Landuse**

*Source:*

1996/97 Landuse of Australia, version 2 dataset, 1:1,000,000 scale; NLWRA 2001.

*Ranking:*

1. Suitable: Other.
2. Intermediate: Not used in this theme.
3. Unsuitable: Urban, water bodies, national parks.

*Rationale:*

This theme will be used to help define areas with current, adjacent and likely future land use that is not compatible will the national store.

# Appendix 2

## GLOSSARY

**Buffer zone**

A zone of restricted access, which is controlled by the store operator, between the operational site boundary and any structure within the facility, to ensure that there is a sufficient distance between the facility and any area accessible to members of the public.

**Conditioning**

The processes that are carried out to change the characteristics of the waste to produce a safe and convenient waste package for handling, transport, storage or disposal. The process of producing a solid waste form may involve a matrix material such as concrete or glass, incineration or compaction to minimise the waste volume.

**Disposal**

Placement of radioactive waste in a purpose-built facility in a manner such that there is no intention of retrieval and no need for any further actions to ensure future safety.

**Geographic information system (GIS)**

A computer-based suite of software and hardware used to organise and manage spatial information.

**High level waste**

Waste containing high levels of beta and gamma radiation emitters and significant levels of alpha emitters, and generating significant amounts of heat (greater than 2 kilowatts per cubic metre). Such waste requires careful handling, substantial shielding, provision for dissipation of heat generated by the decay of radioactive material, and long-term immobilisation and isolation from the biosphere. High level waste is generated by nuclear power reactors and some military activities, including nuclear weapons programs. No high level waste is generated in Australia. This category of waste corresponds to the high level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994.

**IAEA**

The International Atomic Energy Agency, an autonomous intergovernmental organisation founded in 1957 in accordance with a decision of the General Assembly of the United Nations. Its statutory mandate is to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world and to ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose. Its activities include, issuing safety standards for the management and disposal of radioactive waste, application of safety standards through advisory services, assistance missions on request of Member States, and the coordination of research and development and special projects that have regional or global interest.

**Intermediate level waste**

Waste that contains significant levels of beta and gamma and possibly alpha emitting radioactive material. Intermediate level waste is not suitable for near-surface disposal. Australian intermediate level waste consists of historical waste from mineral sands processing, disused sealed sources and industrial gauges, reactor components, irradiated fuel cladding, and waste from the processing of spent fuel and ion-exchange resins and filters (e.g. as a result of reactor operation). This waste sometimes requires shielding during handling and transport. This category of waste corresponds to the long-lived low and intermediate level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994, and Category S waste in the NHMRC Radiation Health Series, number 35, 1992 (*Code of Practice for Near-Surface Disposal of Radioactive Waste in Australia*).

**Low level waste**

Waste containing low levels of beta and gamma emitting and normally very low levels of alpha emitting radioactive material. Low level waste is waste that is suitable for disposal in the national low level waste repository. Shielding is not normally required for handling and transport. It includes items such as wrapping material and discarded protective clothing and laboratory plant and equipment. Disposal in near-surface structures is commonly practised overseas. In some cases, the level of radioactivity is below the limit that regulations set as radioactive material. This category of waste corresponds to Category A, B and C waste in the NHMRC Radiation Health Series, number 35, 1992 (*Code of Practice for Near-Surface Disposal of Radioactive Waste in Australia*) and broadly to short-lived low and intermediate level waste as defined in the IAEA Safety Guide, number 111-G-1.1, 1994.

**Monitoring**

The methodology and practice of measuring levels of radioactivity and radiation either in the environment, in environmental samples or en route to the environment.

**National low level waste repository**

An engineered near-surface underground facility for the disposal of Australia's low level radioactive waste.

**National store**

An interim purpose-built above-ground store for the safe storage of Australia's intermediate level radioactive waste. The store will be designed to operate for a period of up to at least fifty years until a national geological repository has been established.

**National geological repository**

An engineered underground facility at depth for the disposal of Australia's intermediate level radioactive waste. Disposal at depth of typically several hundred metres is an internationally accepted method of geological disposal.

**NHMRC**

The National Health and Medical Research Council. Its principal function is to advise the Australian community on matters relating to the achievement and maintenance of high standards of individual and public health through appropriate legislation, administration and practices, and to encourage health and medical research to achieve those standards.

**Radioactive waste**

Waste materials that contain radioactive substances at concentration above exempt levels for which no further use is envisaged.

**Radioactive waste management**

All activities, administrative and operational, that are involved in the handling, treatment, conditioning, transportation, storage and disposal of the waste.

**Regolith**

The layer of rock or blanket or unconsolidated rocky debris of any thickness that overlies bedrock and forms the surface of the land.

**Retrieval**

Includes the recovery of waste packages from storage either for inspection purposes or for subsequent disposal.

**Spent fuel**

Irradiated fuel not intended for further reactor service but that still contains useful material.

**Storage**

The emplacement of waste in a facility with the intent and in such a manner that it can be retrieved and be disposed of at a later time. Storage of radioactive waste may take place between and within the basic waste management steps. Storage may be used to facilitate the next step or to act as a buffer between and within steps. The intention of storage is to isolate the radioactive waste, provide environmental protection and facilitate control.

# Appendix 3

## ADVERTISEMENT REQUESTING PUBLIC COMMENT

INDUSTRY SCIENCE RESOURCES

PUBLIC DISCUSSION PAPER

### SAFE STORAGE OF RADIOACTIVE WASTE - THE NATIONAL STORE PROJECT: METHODS FOR CHOOSING THE RIGHT SITE

A discussion paper of a project to identify a suitable site for a national store for intermediate level radioactive waste generated by Commonwealth agencies is available for public comment.

The project to find a site for a national store for intermediate level waste is separate to the national repository project to site a facility for the disposal of low level radioactive waste in central-north South Australia.

The Government has ruled out co-location of the national store with the national low level waste repository.

*Safe Storage of Radioactive Waste - the National Store Project: Methods for Choosing the Right Site* has been prepared by the Department of Industry, Science and Resources. It describes the issues that will be considered and the proposed methodology that will be used to assess individual potential sites for a national storage facility.

Persons or organisations wishing to comment on the paper are invited to make written submissions by 31 August 2001 to:

The Information Officer
National Store Project
Department of Industry, Science and Resources
GPO Box 9830
CANBERRA ACT 2601

Copies of the discussion paper and information packs on radioactive waste management in Australia can be obtained from the Information Officer at the above address, or the ISR project web site:

| | |
|---|---|
| Telephone Tollfree | 1800 682 704 |
| Facsimile | 02 6213 7567 |
| Email | Repository@isr.gov.au |
| Internet | http://www.isr.gov.au/radwaste.html |

## DISTRIBUTION OF THE ADVERTISEMENT

**Major daily newspapers**

- The Australian
- Australian Financial Review
- Northern Territory News
- Sydney Morning Herald
- The Age
- The Canberra Times
- The Courier Mail
- The Mercury
- The West Australian
- Adelaide Advertiser

**Rural press**

- Countryman (WA)
- Country Life (QLD)
- Stock Journal (SA)
- The Land (NSW)
- The Weekly Times (VIC)

# Glossary

## GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| ABS | Australian Bureau of Statistics |
| AGSO | Australian Geological Survey Organisation |
| AUSLIG | Australian Surveying and Land Information Group |
| ANSTO | Australian Nuclear Science and Technology Organisation |
| ASSESS | A System for SElecting Suitable Sites |
| ARPANSA | Australian Radiation Protection And Nuclear Safety Agency |
| BMR | Bureau of Mineral Resources |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| ERIN | Environmental Resource Information Network |
| GIS | Geographic Information System |
| HIFAR | HIgh Flux Australian Reactor |
| IAEA | International Atomic Energy Agency |
| RRR | Replacement Research Reactor |
| NHMRC | National Health and Medical Research Council |
| NLWRA | National Land and Water Resources Audit |