

### **3. Radioactive Waste Management (RWM) Status in FNCA Countries**

#### **3.1 Radioactive Waste Management (RWM) Status in Australia**

Radioactive waste in Australia is generated by research, industry, medical applications, research reactor operation and radiopharmaceutical production. Australia is developing an integrated waste management strategy for the long-term management of this radioactive waste. Australia is establishing a national near surface repository for disposal of low-level radioactive waste and a national store for the storage of intermediate level radioactive waste produced by Commonwealth agencies. The status of these national facilities is discussed in Section 3.1.5. Australia has no nuclear power plants.

The mining of uranium in Australia produces large quantities of wastes containing elevated levels of naturally occurring radionuclides (NORM). Two uranium mines now operating produce about 10 million tonnes of uranium mill tailings a year (Olympic Dam mine 9.1 Mt in 2001, Ranger mine 1.8 Mt in 2000/01) and these tailings are managed at the mine sites. At the Olympic Dam mine, the coarse fraction of tailings is used underground as backfill, and the fine tailings material, still containing potentially valuable minerals (rare earths etc.) is emplaced in tailings dams. At the Ranger mine, tailings were emplaced in an engineered dam on the lease until 1996, but are now all deposited into a worked out pit. Although uranium mill tailings are controlled by different regulations, the requirements for their disposal are consistent with criteria for near surface disposal of radioactive wastes.

Technologically enhanced naturally occurring radioactive materials (TENORM) are also produced by mineral sands operations, copper smelter wastes, scale from oil and gas, etc. In general, mining wastes are dealt with at the mine sites, and are regulated under mining regulations.

##### **3.1.1 RWM Policy**

Australia has a federal system of government and the regulation of radioactive waste management and disposal comes under both Commonwealth (federal) and State/Territory regulation. The States and Territories are responsible for monitoring the use, transport and disposal of radioactive materials under their control in accordance with State and Territory acts and regulations, which are administered by State or Territory radiation safety authorities. Similarly, the Commonwealth Government is responsible for managing radioactive materials in organisations under its control. Commonwealth organisations including contractors handling radioactive materials are regulated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), which is part of the Health and Ageing Portfolio.

##### **3.1.2 RWM Legislation and Regulation**

The use of radiation, radioactivity and nuclear activities by the Commonwealth Government are regulated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). ARPANSA regulates all Commonwealth entities (including Departments, Agencies and Bodies Corporate) involved in radiation or nuclear activities or dealings. This includes regulating the management and storage of radioactive waste at Commonwealth agencies such as the Australian

Nuclear Science and Technology Organisation (ANSTO), the Commonwealth Science Industry and Research Organisation (CSIRO) and Department of Defence. ARPANSA will also regulate the proposed national repository for the near surface disposal of radioactive waste.

The proposed national radioactive waste repository (for low level and short-lived intermediate level waste) and the proposed national store (for long-lived intermediate level waste) are both Commonwealth projects, and as such will be regulated by ARPANSA. ARPANSA is tasked with promoting uniformity of radiation protection and nuclear safety policy and practices across all jurisdictions (Commonwealth, the States and the Territories).

In the States and Territories, the uses of radiation and radioactivity are regulated by Environmental Protection Authorities and Health Departments in each state unless it arises from the activities of a Commonwealth agency, in which case it is regulated by ARPANSA.

The following Federal, State and Territory Acts and Regulations relate to the use, transport and disposal of radioactive waste:

- Australian Radiation Protection and Nuclear Safety Act 1998
- Australian Radiation Protection and Nuclear Safety Regulations 1999
- New South Wales Radiation Control Act 1990
- New South Wales Radiation Control Regulation 1993
- The ACT Radiation Act 1983
- Northern Territory Radiation (Safety Control) Act 1999
- Northern Territory Radiation (Safety Control) Regulations 1997
- Queensland Radiation Safety Act 1999
- Queensland Radiation Safety Regulation 1999
- Queensland Radiation Safety (Radiation Safety Standards) Notice 1999
- South Australian Radiation Protection and Control Act 1982
- South Australian Ionising Radiation Regulations 2000
- Tasmanian Radiation Control Act 1997
- Tasmanian Radiation Control Regulations 1994
- Tasmanian Radiation Control Amendment Regulations 1999
- Western Australian Radiation Safety Act 1975
- Western Australian Radiation Safety (General) Regulations 1983
- Western Australian Radiation Safety (Qualifications) Regulations 1980
- Western Australian Radiation Safety (Transport of Radioactive Substances) Regulations 1991
- Victorian Health (Radiation Safety) Regulations 1994
- Victorian Health (Radiation Safety) (Amendment) Regulations 1997

**Australian Commonwealth, State and Territory Regulatory Authorities**

Commonwealth	Chief Executive Officer Australian Radiation Protection and Nuclear Safety Agency MIRANDA NSW 1490
Australian Capital Territory	Director Radiation Safety Section ACT Department of Health, Housing and Community Care CANBERRA ACT 2601
New South Wales	Manager Radiation Control Section Environment Protection Authority SYDNEY SOUTH NSW 1232
Northern Territory	Senior Policy Officer – Radiation Health Radiation Health Section Territory Health Services CASUARINA NT 0811
Queensland	Director Radiation Health Department of Health FORTITUDE VALLEY QLD 4006
South Australia	Manager Radiation Section Environmental Health Branch Department of Human Services ADELAIDE SA 5000
Tasmania	Senior Health Physicist Health Physics Branch Dept of Health and Human Services HOBART TAS 7001
Victoria	Chief Radiation Officer Radiation Safety Unit Department of Human Services Melbourne VIC 3001
Western Australia	Secretary Radiological Council NEDLANDS WA 6009

**Regulation**

**Codes of Practice**

*Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores (1982)*. This code covers the on-site disposal of bulk waste from the mining and mineral processing of uranium and thorium ores, and is currently under review.

*Code of Practice on the Management of Low-Level Radioactive Waste by the User (1986)*. This code allows small amounts of waste below defined limits to be disposed of by the user to municipal waste land-fills, to the sewer or to the air. It is currently under revision.

*Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992)*. This code established the requirements for site selection, design criteria and operational requirements for a near surface facility in Australia

*Code of Practice and Safety Guide on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (expected 2002)*. The provisions of the Code are intended to apply to the on-site management of bulk quantities of radioactive waste arising from any phase of operation in the mining and mineral processing industries. The major activities covered will be those involved in the mining and processing of uranium- and thorium-bearing ores. The provisions of the Code may also be applied to other mining or mineral processing facilities where significant quantities of uranium and thorium and their decay products occur in the minerals or appear in waste streams. This may include the mining and processing of phosphate ores, tin, tantalum, and other non-ferrous ores, coal, and oil and gas extraction. This code will replace the 1982 Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores.

*Code of Practice for the Pre-disposal Management of Radioactive Waste* (in preparation). This Code will cover the treatment, conditioning & packaging, storage, and transport of radioactive waste.

### **3.1.3 Criteria Used to Define and Characterise Radioactive Waste**

The classification of radioactive waste and requirements for site selection, design criteria and operational requirements for a near surface facility in Australia are specified in the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* issued by the National Health and Medical Research Council (NHMRC 1992). Three categories of radioactive waste (A, B and C) are defined in the Code as suitable for near-surface disposal and one category (S) as unsuitable. The minimum cover thickness for Category A material is 2 m between the top of the waste and the top surface of the cover, and for Category B and C materials the minimum cover thickness is 5 m. The generic concentration limits for these categories is listed in Table 3.1-1.

Generic activity limits are provided in the Code for a remote and arid site where groundwater pathways for release of radionuclides are insignificant and could be ignored, Table 3.1-1. The significance of the groundwater pathway will have to be assessed for any selected site and if significant could lead to modification of the limit values. The generic limits in Table 3.3-1 were derived from an evaluation of potential intruder such as road construction, house building, residential use, livestock grazing and archaeological excavation scenarios which might arise after the institutional control period.

**Table 3.1-1. Generic Concentration Limits for Disposal of Radioactive Wastes at an Arid Remote Site [NHMRC 1992]**

Radionuclide	Category	100 y control	200 y control
Tritium	Category A	500 MBq/kg	100,000 MBq/kg
	Category B&C	10,000 MBq/kg	5,000,000 MBq/kg
Carbon-14	Category A	10 MBq/kg	10 MBq/kg
	Category B&C	50 MBq/kg	50 MBq/kg
$\alpha$ -emitters (inc. $^{238}\text{U}$ , $^{239}\text{Pu}$ , $^{241}\text{Am}$ )	Category A	0.1 MBq/kg	0.1 MBq/kg
	Category B&C	10 MBq/kg	10 MBq/kg
Ra-226, U*	Category A	0.005 MBq/kg	0.005 MBq/kg
Ra-226	Category B	0.5 MBq/kg	0.5 MBq/kg
Ra-226, Th-232, U*	Category C	0.5 MBq/kg	0.5 MBq/kg
$\beta/\gamma$ emitters with half-life > 5 y	Category A	0.5 MBq/kg	5 MBq/kg
	Category B&C	100 MBq/kg	1000 MBq/kg
$\beta/\gamma$ emitters with half-life = 5 y	Category A	1000 MBq/kg	1000 MBq/kg
	Category B&C	no limit**	no limit**

Notes: U\* is uranium in secular equilibrium with progeny

\*\* in practice consideration of surface dose rates from waste packages during transport and handling will lead to more restrictive values

ARPANSA regulations define exclusion values for all radionuclides which are based on the IAEA Basic Safety Standards. At this time, the States and Territories each have their own definition of what constitutes a radioactive substance, but there is now a desire to move to a uniform set of regulations

### 3.1.4 Main Radioactive Waste Management Facilities

Location	Main Purpose	Essential Features
ANSTO, Lucas Heights, NSW	Treatment and Packaging	Management of waste from research reactor operation, radiopharmaceutical production, research and development
ANSTO Lucas Heights, NSW	Storage	1320 m <sup>3</sup> low level waste 370 m <sup>3</sup> intermediate level waste
Mt Walton East Intractable Waste Facility, WA	Disposal	Near surface disposal of low level radioactive waste generated in the State of Western Australia
Woomera Protected Area, SA	Storage	Storage of low level and intermediated level waste owned by Department of Defence
Woomera Protected Area, SA	Storage	Storage of 2010 m <sup>3</sup> contaminated soil owned by CSIRO
Esk Storage Facility, Qld	Storage	Storage of radioactive waste (sources and low volume material) generated in the State of Queensland.
Others	Storage	Over 100 locations around the country where low level, short-lived and/or long-lived intermediate level radioactive waste is stored
National Repository (under development near Woomera), SA	Disposal. Preferred site and alternatives selected, and an Environmental Impact Statement being prepared.	A national facility for the near surface disposal of low level and short-lived intermediate level radioactive waste.
National Storage Facility	Storage. Site selection process has commenced.	A national facility sited on Commonwealth land for the storage of intermediate level waste generated by Commonwealth agencies

#### 3.1.4.1 Australian Nuclear Science and Technology Organisation (ANSTO)

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's centre for nuclear science and technology. ANSTO has a 10 MW heavy water research reactor (HIFAR), a medical cyclotron and associated radiopharmaceutical production facilities. The existing research reactor will be replaced by a multipurpose 20 MW research reactor in 2005. Most of the radioactive waste that has been generated at Lucas Heights over more than 40 years is still stored at Lucas Heights.

Recent developments in radioactive waste management at ANSTO include:

- improved facilities for storage and characterisation of solid low-level radioactive waste,
- on-line monitoring of intermediate level liquid wastes,
- commissioning of a hot cell process to solidify intermediate level liquid waste generated during the production of molybdenum-99,
- construction of a new waste packaging and treatment building, and

- tests using a pilot plant to demonstrate a membrane-based (reverse osmosis) process for treating waste water.

#### **3.1.4.2 National Repository for Disposal of Low Level Radioactive Waste**

In 1992, the Commonwealth Government established a project to select a site and establish a national near-surface repository for the disposal of low-level and short-lived intermediate-level radioactive wastes. The criteria for site selection were based on *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992)* issued by the National Health and Medical Research Council.

In February 2001, the Government announced selection of a preferred site and two alternate sites for the National Repository for the near surface disposal of low level radioactive waste. All three sites have low annual rainfall, high pan evaporation and highly saline and low productivity aquifers. A full environmental impact assessment will be carried out for the repository, including preparation of an Environmental Impact Statement (EIS). The draft EIS, to be completed in 2002, will be open for public comment, including public submissions, meetings with consultative groups, and information days. The siting, construction and operation of the repository will be licensed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The Australian national radioactive waste repository will be a near surface facility for disposal of low-level radioactive waste. The low generation rate of radioactive waste in Australia means that the repository will not be able to operate continuously. The repository will operate for short campaigns, beginning with an initial campaign to receive all existing wastes, and then smaller campaigns separated by extended periods, perhaps up to five years, of inactivity. At the end of each campaign, the facility will be temporarily secured so that all radioactive waste is effectively contained, human and animal intrusion prevented and ingress of rainwater prevented. Monitoring and surveillance will continue during the closed periods.

#### **3.1.4.3 National Storage Facility for Intermediate Level Waste**

For some radioactive waste, the concentrations of long-lived radionuclides are too high for near surface disposal. Under the Australian classification system, intermediate level waste unsuitable for near surface disposal is known as Category S wastes. The Category S wastes include numerous radium sources, wastes from the production of molybdenum-99 and in the future wastes that will be returned from the overseas reprocessing of the ANSTO research reactor spent fuel.

In February 2001, the Minister for Industry, Science and Resources announced that the Federal Government will establish a safe, purpose-built facility on Commonwealth land for the storage of long-lived intermediate level waste (Category S) produced by Commonwealth agencies. The Minister ruled out co-location of the national store with the national repository. An expert committee, the National Store Advisory Committee, has been appointed to advise on the site selection process. In July 2001 a discussion paper: on “Safe-storage of radioactive waste: the national store project: methods for choosing the right site” was released for public comment.

### 3.1.5 Inventory of Radioactive Wasted (RW)

Australia has about 3,700 m<sup>3</sup> of low-level and short-lived intermediate level radioactive waste considered suitable for disposal in a near-surface repository. This includes soil lightly contaminated with uranium mill tailings, contaminated or activated items such as paper, cardboard, plastic, rags, protective clothing, laboratory waste from research, production of radiopharmaceuticals and research reactor operation, solid residues for the treatment of low level liquid waste and some gauges and sealed sources. The low level and short-lived intermediate level waste is currently stored at over 100 locations around the country. The annual generation rate of low and short-lived intermediate level radioactive waste suitable for the repository is about 40 m<sup>3</sup> per year on an annual basis. In addition there will be between 500 and 2500 m<sup>3</sup> of low level and short lived intermediate level waste from decommissioning the HIFAR research reactor. .

#### Current inventory of low level radioactive waste in storage and expected to be disposed of in the national near-surface repository

Source	Typical Waste	Volume (m <sup>3</sup> )
CSIRO	Slightly contaminated soil from research into ore processing	2010
ANSTO	Operational waste including clothing, paper and glassware	1320
Department of Defence	Contaminated soils from land remediation, sealed sources, gauges, electron tubes and equipment	210
Other	Spent sealed sources, and miscellaneous laboratory waste (numerous locations around Australia)	160

#### Estimates of current inventory of intermediate level radioactive waste in Australia

Source	Typical Waste	Volume (m <sup>3</sup> )
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 concentrates from mineral sands processing	165
Other Commonwealth agencies	Disused sources from medical, Defence and research equipment	35
States/Territories	Disused sources from medical, industrial and research equipment	100



### **3.1.6 Nuclear Facilities being Decommissioned and the Status of Decommissioning Activities at those Facilities.**

The 100 kW research reactor Moata was shutdown in May 1995, with the fuel, the cooling system and electric systems removed. A decommissioning plan has been prepared and agreed to by the regulator (ARPANSA). Timing of dismantling has not yet been decided.

The 10 MW research reactor HIFAR will be shutdown in 2006. The decommissioning proposal is based on removal of the fuel and heavy water followed by 30 years care and maintenance before decommissioning. Decommissioning will be licensed by ARPANSA