Australian Government

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

National Report from the Commonwealth of Australia

October 2008

Contents

Section A – Introduction

Focus of this report

This is the third National Report by Australia[1]. The 2005 National Report and Australia's presentation to the Second Review Meeting in 2006 highlighted issues as to how each of the nine Australian jurisdictions within Australia's federal system are complying with the Joint Convention. A challenge identified for Australia in the Rapporteur's Report for Country Group 3 was "ensuring a coherent approach to regulations and waste management practice in view of the complex nature of national and regional legislation". The Second Review Meeting also noted that 'harmonization of legislation between jurisdictions" was a planned measure to improve safety. Australia is continuing to address this challenge through the continued development and application of a National Directory for Radiation Protection (NDRP)[2]. This third National Report includes information on the progress Australian jurisdictions within the Federation have made in the implementation of the NDRP in relation to radioactive waste management.

The 2005 National Report included detailed information relating to the management of radioactive wastes arising from uranium mining. In relation to this information and the proposed expansion of uranium mining in Australia, the Second Review Meeting noted that "remediation of closed uranium mines, especially those where there is high rainfall or where land usage has changed" and "the opening of new mines may place increased demands on the regulatory authorities" would also be future challenges for Australia. This third National Report discusses the application of the recommendations of ICRP 103 in advice on remediation and the development of environmental guidance (based on ICRP 91: *A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species*) to be applied in areas such as uranium exploration and other NORM situations.

The 2005 National Report also outlined the proposal for the establishment of a Commonwealth Radioactive Waste Management Facility for the management of low and intermediate level radioactive waste produced by Commonwealth government agencies. The 2005 National Report also included arrangements for reprocessing of spent fuel from Australia's research reactors. Consequently, the Second Review Meeting noted that the "establishment of facilities for disposal and longer term storage of radioactive waste" as a planned measure and the "establishment of a facility for storage of ILW returned from reprocessing" as a challenge for Australia. Current information is provided in this Report.

The introduction of export control regulations was also noted as a planned measure at the Second Review Meeting. This National Report discusses the implementation of the new regulations.

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1 The Joint Convention entered into force in Australia on 3 November 2003.

2 The aim of the National Directory for Radiation Protection is to provide nationally uniform requirements for the protection of people and the environment against the exposure or potential exposure to ionizing and non-ionizing radiation and for the safety of radiation sources, including provision for the national adoption of codes and standards. The Directory has been developed to address the needs of radiation protection regulators but also benefits other sectors involved in implementing radiation controls such as mine operators and occupational health and safety regulators.

Most Australian jurisdictions do not classify radioactive materials in long-term storage as waste as defined by the Convention. Therefore, the Australian report can only assess its compliance with the Convention in relation to those facilities containing radioactive materials that have been characterised as waste for the purposes of the Convention.

Background

As reported in previous National Reports and Review Meetings, Australia is a federation of seven jurisdictions – the Commonwealth of Australia[3], New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania, and two territories - Northern Territory and the Australian Capital Territory.

Until 1998, in the area of radiation protection, there were six state and two territory regulatory authorities operating within Australia. This gave rise to inconsistencies in radiation regulation outcomes across the jurisdictions. In 1998, the Commonwealth government created a Commonwealth regulator, the CEO of ARPANSA, to regulate the radiation and nuclear safety activities of Commonwealth entities. These entities include the Department of Defence, the Australian Nuclear Science and Technology Organisation (ANSTO) and the Commonwealth Scientific and Industrial Research Organisation **(**CSIRO**)** regardless of which physical jurisdiction the operations are undertaken. In addition, the CEO of ARPANSA was tasked with the function of promoting national uniformity in radiation protection.

With the establishment of a Commonwealth government regulator, ARPANSA commenced development of a National Directory for Radiation Protection. The National Directory is the principal means for addressing the inconsistencies in radiation protection regulation across all Australian jurisdictions. The National Directory provides an overall agreed framework for radiation safety, including both ionizing and non-ionizing radiation, together with clear regulatory statements to be adopted by the Commonwealth government and the States and Territories. The National Directory is developed by all regulators through the Radiation Health Committee. This Committee, established under the ARPANS Act, includes radiation regulators from each jurisdiction. Proposed additions to the National Directory require final approval from health ministers from each of the jurisdictions before being adopted. In relation to radioactive waste management, codes of practice and safety guides have been developed for inclusion in the National Directory.[4]

Australia has several operational uranium mines, and several mines that are non-operational but are still under regulatory control because of the presence of potentially hazardous waste materials. All operating uranium mines are owned by non-Commonwealth entities and are therefore regulated by the jurisdictions in which they are located – the State of South Australia and the Northern Territory. The national standards developed through the National Directory process which are adopted by jurisdictions to regulate radiation safety for mining operations. In one case ARPANSA regulates an abandoned mine located within a national park controlled by the Commonwealth government.

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[3] Also referred to as the Commonwealth government.

[4] *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005) and *Safety Guide for the Predisposal Management of Radioactive Waste* (2008).

Australia has three research reactors – one newly commissioned (Open Pool Australian Light water (OPAL) reactor) and two that have been permanently shutdown (High Flux Australian Reactor (HIFAR) and MOATA). Each of these facilities are located on the Australian Nuclear Science and Technology Organisation (ANSTO) site and are regulated by the Commonwealth government regulator, the CEO of ARPANSA.

Radioactive waste or material held in State and Territory stores is largely low-level and short-lived intermediate level waste arising from industrial, medical and research practices and includes abandoned sources. Radioactive waste held by Commonwealth government entities is also largely low-level and short-lived intermediate level waste and includes abandoned sources.

Assessment of Australia's compliance with the Joint Convention

The government of Australia and the States and Territories re-confirm that each has in place the framework of appropriate law, the legislative, regulatory and administrative measures, including a system of authorisation, monitoring and inspections, necessary for implementing all obligations under this Convention.

The Australian government is committed to the development of facilities for the long-term management (disposal and/or long-term storage) of radioactive wastes arising from its activities.

Section B – Policies and Practices

Article 32 (1) Reporting

Spent fuel management policy

Australia's policy on spent fuel management is unchanged from the 2005 National Report. Spent fuel is to be transported overseas under the Foreign Research Reactor Spent Nuclear Fuel (FRR-SNF) take back program in the case of US-obligated fuel qualified for that program; or to another country for reprocessing. In the case of reprocessing, the fuel is transported with an agreement that all resulting long-lived intermediate-level radioactive waste will be returned to Australia at a mutually agreed time for storage.

Spent fuel management practices

In Australia, the Commonwealth of Australia is the only jurisdiction that has a requirement to manage spent fuel including the regulation of spent fuel. The current and planned spent fuel management practices for the spent fuel arising from the MOATA, HIFAR and OPAL research reactors are described below.

Shut-down Reactor (MOATA)

The planned spent fuel management practice for MOATA remains as reported in the 2005 National Report.

MOATA was an ARGONAUT type reactor operated by the Australian Nuclear Science and Technology Organization (ANSTO) during the period April 1961 until May 1995, after which time the reactor was permanently shut down and the fuel dry-stored on site. The fuel is of US-origin, and all of the spent fuel has been returned to the US (December 2006) under the Foreign Research Reactor Spent Nuclear Fuel (FRR-SNF) take-back program. Under the provisions of this program, no waste will be returned to Australia.

Shut-down Reactor (High Flux Australian Reactor - HIFAR)

High Flux Australian Reactor *(*HIFAR), a 10 MW research reactor, was shut down in 2007. During its operation, the reactor produced approximately 37 spent fuel elements each year. Once discharged from the reactor, the spent fuel elements were then stored for several years under water, to allow much of the short-lived activity to decay. The fuel elements were then transferred to a dry storage facility, consisting of holes drilled into the bedrock and lined with stainless steel.

Spent fuel from HIFAR has been shipped to the United States, to the BNFL facility at Dounreay, United Kingdom and to the AREVA facility at La Hague, France.

For spent fuel shipments, spent fuel elements are loaded into licensed transport casks. These casks are drained, vacuum dried and hermetically sealed, tied down in specially strengthened steel ISO containers, and transported by road to the port. Sea transportation is carried out on a dedicated INF-2 classification ship. Waste from spent fuel elements shipped to the US under the FRR-SNF program will not be returned to Australia. It is a contractual requirement with BNFL and AREVA that waste arising from reprocessing of spent fuel elements at their plants

will be returned to Australia as long-lived intermediate-level waste. As at 30 June 2008, ANSTO had shipped a total of 2122 spent fuel elements to Dounreay, the US and COGEMA (France), with 159 HIFAR spent fuel elements to be shipped to the US in early 2009. The shipment of spent fuel was carried out in accordance with the requirements of the IAEA *Regulations for Safe Transport of Radioactive Material*, TS-R-1 and the *International Maritime Dangerous Goods (IMDG) Code*.

OPAL Reactor

The OPAL reactor commenced operation in 2007, and is Australia's only operating reactor, OPAL is a 20MW thermal, open pool light water reactor designed for LEU aluminium-clad fuel. The reactor currently operates on uranium silicide fuel. It is planned that a transition will be made to uranium molybdenum fuel once that fuel is qualified.

Used uranium silicide fuel from the operation of OPAL discharged before 2016 will be returned to the US under the FRR-SNF program. After that period, the spent fuel will be sent to AREVA for reprocessing. If uranium molybdenum fuel has not been qualified by 2016, arrangements are in place with AREVA to process the silicide-type fuel.

As a further back-up option, INVAP (the Argentinean company that constructed the reactor) has given a written guarantee to provide an alternative solution consistent with Australia's requirements, using proven technologies. Argentina has already developed and demonstrated a novel technology for processing aluminium-clad research reactor spent fuel, and has plans to use that technology for managing its own research reactor spent fuel. This option has been made available for the OPAL spent fuel. An agreement with Argentina at inter-governmental level to support these arrangements has been ratified by both governments.

Spent fuel discharged from the reactor core is moved a short distance under water into storage racks in the reactor service pool, adjacent to and connected with the main pool. These racks have the capacity to store, under water, up to 10 years' arisings of spent fuel discharged from the reactor, while retaining sufficient spare space to unload the complete operating reactor core at any time, should this be required. This arrangement has the advantages of minimising handling of the spent fuel, with no movement required outside the immediate vicinity of the reactor for storage purposes and convenient, continuous monitoring of the spent fuel storage conditions. Under this process, the spent fuel is protected by the same structural features as the reactor itself, and is available at all times for visual inspection of its condition.

The reactor service pool has a purpose-built stand to take a spent fuel transport cask. For each fuel shipment, using handling tools, the spent fuel will be moved the short distance from the storage racks underwater and loaded into the transport cask for shipment.

The timing of spent fuel shipments overseas will be determined by a number of factors, including:

- the time required to accumulate a practicable sized shipment;
- the minimum cooling time required for the youngest elements in a shipment, to satisfy shipping cask regulatory criteria; and
- the benefit for radiological safety of minimising the number of such shipment operations.

On the basis of around 20 to 30 spent fuel elements arising per year, it is anticipated that there will be one overseas shipment of spent fuel every five or six years. The first such shipment would be approximately eight years after commencement of reactor operation, given a minimum cooling period of three years and the above-mentioned five or six years to accumulate a sufficient quantity for shipping.

Radioactive waste management policy

In the previous National Report, the stated radioactive waste management policy required that all radioactive waste originating within Australia be stored, or disposed of, in Australia at suitably sited facilities after being categorised in accordance with agreed international practice. This policy included the establishment of a Commonwealth Radioactive Waste Management Facility. Site investigations at four locations in the Northern Territory and community consultations were undertaken during 2006-08.

Australia's national government changed following the November 2007 federal election. The new Commonwealth government is presently reviewing all aspects of its long-term radioactive waste management strategy.

National guidance

Since the last National Report, Australia has progressed the development of national guidance relating to radioactive waste management. This guidance has been developed as part of the National Directory for Radiation Protection process, where standards are developed, referenced in the National Directory and adopted by Australian regulators. In the case of the proposed Code of Practice for Predisposal Management, a cost benefit analysis found that the proposed Code would have duplicated many of the measures currently in place through a variety of legislation and other national standards. The accompanying safety guide however was regarded by regulators as providing guidance specific for the majority of low and intermediate level wastes currently awaiting disposal in Australia and was therefore accepted.

Nationally, radioactive materials and radioactive wastes are subject to the same legislative and regulatory requirements. In addition, all jurisdictions apply the provisions of *Recommendations for Limiting Exposure to Ionizing Radiation (*ARPANSA 1995) which is consistent with ICRP60. The Recommendations are referenced in the *National Directory for Radiation Protection* (ARPANSA 2004) for national adoption. Amongst other requirements, the *Recommendations* require organisations and employers to have and maintain a radiation management plan.

Radioactive waste arising from uranium mining is subject to the provisions of the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005).

Some waste at abandoned mine sites has also been regulated according to the ARPANSA *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)*. Some aspects of the Code were also used for the remediation of the Maralinga Nuclear Test Site. A technical report that describes the methodology used to calculate the activity concentrations in the Code is in the process of being prepared for publication.

Radioactive waste is also regulated in accordance with *Code of Practice for the Disposal of Radioactive Wastes by the User* (NHMRC 1985). Australian regulators are in the process of replacing the 1985 Code with a new schedule in the *National Directory for Radiation Protection* (ARPANSA 2004) which will update levels by introducing disposal limits for radionuclides that were not in use at the time of writing the 1985 Code and bringing other provisions up to date in terms of current exposure models. The proposed schedule also includes discharge limits to air and water which were not part of the 1985 Code. Discharge limits currently included in legislation vary considerably between jurisdictions.

Recently, a *Safety Guide for the Predisposal Management of Radioactive Waste* has been published by ARPANSA. As a guidance document, the safety guide will not be referenced in the National Directory for Radiation Protection for national adoption. As a result, the use of the guidance will be up to individual regulators and licensees. It is expected that licensees would use this Safety Guide when developing their radiation management plans for waste.

Planning has commenced for the development of guidance for the remediation of, and the development of environmental guidance to be applied in, areas such as uranium exploration, other NORM situations and radioactive waste disposal. This guidance will be based on ICRP 91: *A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species*. The guidance will be particularly relevant with the expected expansion in uranium mining in Australia.

State and Territory policies

In relation to regulating producers of radioactive waste, Australian regulators have a number of policies aimed at minimising and controlling waste. These have included:

- periodic inspections of licensees premises containing waste inventories;
- the use of trusts to fund continued storage of radioactive material where licensees become bankrupt;
- in situ management of wastes arising from uranium mining;
- inclusion of proposed disposal arrangements with licence applications to acquire a new source;
- approvals for relocation of sources;
- no retention of radioactive waste by licensees or disposal as soon as possible;
- on-going use of sources that remain in sound physical condition;
- use of third parties to assist with meeting disposal requirements, prepartion of management plans;
- sustainable management of radioactive waste using national exemption limits, IAEA principles and providing guidance to assist licensees in acquiring the necessary knowledge and skills to manage waste;
- minimal retention periods of sealed sources after they are no longer required;
- maintaining records of radioisotope use and disposal;
- development of management plans that include waste disposal; and

- assessment of the ability of the operator to adequately manage radioactive wastes as part of the licensing process.

Radioactive waste management practices

Radioactive waste management practices have not changed since the last National Report. The 2005 National Report stated that audits of all radioactive wastes within a number of jurisdictions would be undertaken in accordance with a national protocol developed in 2004. ARPANSA undertook an audit of Commonwealth waste holdings in 2005 and Tasmania has indicated that an audit will be undertaken in the future.

Low and intermediate level radioactive waste continues to be stored in state and territory government regulators at over one hundred locations around Australia in both rural areas and urban centres.

Although all Australian regulators have small stores of abandoned sources, legacy wastes or wastes that have arisen within their jurisdiction, many individual producers currently have responsibility for managing their own radioactive waste. As a result, most users of radioactive materials are encouraged to return disused sources to the supplier. If this is not possible, licensees are expected to store their radioactive waste until it decays to a point at which it is no longer radioactive, or to arrange for it to be lawfully disposed of overseas. In the case of Western Australia, a near-surface and bore-hole waste facility at Mt Walton East is available for users of radioactive materials regulated by the Western Australian regulator. The licence conditions issued for the Mt Walton East Intractable Waste Disposal Facility include the restriction that only waste generated within Western Australia may be disposed at the site.

In South Australia, options for the establishment of a interim store and repository for low level and intermediate level radioactive waste at approved sites are being investigated. For very low level waste generated in the uranium mining process, a waste management plan is required as part of the application to the regulator.

Across Australia, the re-entry or transit of sealed sources is permitted, for ultimate return to the supplier and in some instances for recycling or disposal to a licensed waste disposal facility.

The Australian Nuclear Science and Techology Organisation (ANSTO) manages wastes arising from its research reactor operation, radio-isotope production and research activities according to nationally and internationally accepted criteria. ANSTO is taking steps to condition waste and reduce volumes by releasing decayed material that is below exemption criteria and by super-compaction of some drummed low-level waste.

Criteria used to define and categorize radioactive waste

As identified in the previous National Report, Australia does not have a nationally endorsed radioactive waste classification system. Australia is in the process of developing such a system that will take into account the approval of the new IAEA safety guide on waste classification. The 2007 IRRS mission to the Commonwealth of Australia also recommended the development of a national classification system for radioactive waste. The system will be supported by a policy document and specific guidance.

A categorisation of radioactive waste based on arisings typical to Australia has also been developed as part of the *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA 2008). The six categories are as follows:

- Devices containing low levels of long-lived alpha emitters (dials and luminous devices containing radium and smoke alarms containing americium)
- Devices containing higher levels of long-lived alpha emitters (radium needles and tubes, neutron sources)
- Disused sealed sources of low radioactivity (<100MBq) and gaseous tritium light sources
- Disused sealed sources of higher radioactivity (>100 MBq)
- Laboratory waste
- Residues from industrial processing and waste from remediation of contaminated sites

Currently, in most cases, wastes are categorised for management purposes as long-lived or short-lived, liquid or solid, and sealed or unsealed. In some jurisdictions, waste is regulated according to whether it complies with the *Code of Practice for the Disposal of Radioactive Waste by the User* (NHMRC 1985) (very low-level waste) or if not, then under a special licence.

There is no national standard on criteria for clearance in Australia. Exposures that are unamenable to control are excluded**.** If solid waste falls below exemption criteria, it can be cleared. Uniform provisions for exemptions, based on international guidance from the International Atomic Energy Agency (BSS 115), have been adopted by all jurisdictions as part of the *National Directory for Radiation Protection* (ARPANSA 2004). However, the provision in the National Directory did not explicitly deal with bulk quantities of raw material, as might be encountered in the mining industries. An amendment to ensure application of exemptions to bulk quantities of raw material has been proposed for adoption in the National Directory.

Section C – Scope of Application

Article 3

Spent fuel at reprocessing facilities

As stated in the previous national report, no reprocessing facilities exist or are proposed in Australia. The discussion of management of spent fuel in this report does not include reprocessing activities. In addition, regulatory legislation (the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth)) prohibits the Commonwealth government regulator from licensing the construction or operation of reprocessing facilities[5].

Waste containing Naturally Occurring Radioactive Material

As reported in the previous national report, NORM waste from abandoned uranium mining operations has been declared as radioactive waste for the purposes of this Convention. Information on NORM waste activities as reported in the previous report has been included at Annex D. The management of wastes arising from operating uranium mines is discussed under the relevant articles.

In relation to abandoned tailings in the South Alligator region of the Northern Territory, the licence holder (Parks Australia North) is continuing to plan for the design of a new underground containment facility for radiologically contaminated materials in accordance with criteria endorsed by ARPANSA. NORM wastes that are not part of the nuclear fuel cycle have not been included in this report.

Spent fuel and radioactive waste from military or defence programs

As previously reported, Australia has no spent fuel within military or defence programmes. Radioactive waste managed within military programmes has not been declared as radioactive waste for the purposes of this Convention.

[5] The *EPBC Act 1999* (Cth) requires that the Minister for the Environment must not approve the taking of an action involving the construction of a facility for the reprocessing of spent fuel (Part 10, Subdivision C, 146M)

Section D – Inventories and Lists

Article 32 (2)

List of spent fuel management facilities

ANSTO facilities for the storage of spent fuel from the HIFAR reactor consist of:

- an inspection and loading pond for spent fuel;
- ponds for wet storage of spent fuel (used for long term cooling of spent fuel). Following the completion of cropping of the remaining HIFAR spent fuel elements, the cropping facility was decommissioned in May 2007; and
- a dry storage facility, comprised of 50 storage holes with capacity for 1100 spent fuel elements. As all HIFAR spent fuel stored in the dry storage facility has been removed, the dry storage facility is no longer used to store spent fuel.

The spent fuel management facilities for the OPAL reactor have been described earlier in this report.

The licence issued by the Commonwealth government regulator for ANSTO's fuel operations requires monitoring and inspection of all spent fuel facilities.

Spent fuel inventory

Material description	*Number**	*Mass of Uranium (total) kg*
HIFAR spent fuel elements	159	82
OPAL spent fuel elements	32	12

***** As at 31/8/2008

Inventory of HIFAR spent fuel elements that have been sent abroad for reprocessing and for which there is a contractual requirement for the return of waste to Australia (as at 31/8/2008)

Location	*Number*	*Mass of Uranium (total) kg*
UKAEA, Dounreay, Scotland, UK	114	16
COGEMA, La Hague, France	1288	198

In addition, 150 spent fuel elements were sent to the UKAEA in 1963 and 570 spent fuel elements have been sent to the USA under the Foreign Research Reactor Spent Nuclear Fuel (FRR-SNF) program for which there is no requirement for the return of waste to Australia.

Radioactive waste management facilities

Other than upgrading of a storage facility for New South Wales and a recent disposal campaign in Western Australia, there have been no changes to existing management facilities.

As previously reported, ANSTO operates several facilities for managing liquid and solid radioactive waste arising from its routine operations. Different facilities are used, depending on radiation levels and the method of ultimate disposal, where this can be anticipated. ANSTO's storage facilities are considered to be for medium-term storage. Some higher-activity waste undergoes treatment and conditioning during its period of management. For example, intermediate-level liquid waste is treated and solidified for interim storage.

ANSTO has a facility for the management of radioactive waste originating from its activities. The process components of that facility are:

- low level solid waste store;
- decontamination centre;
- low level solid waste compaction facility;
- low level liquid waste treatment facility;
- intermediate level liquid waste storage and treatment facility;
- Hot Cells facility;
- intermediate level solid waste store facility; and
- waste treatment and packaging facility.

ANSTO also has responsibility for a disposal facility called the Little Forest Burial Ground, which is a secure, shallow land burial site used by the former Australian Atomic Energy Commission for the disposal of some wastes (both radioactive and non-radioactive) up until 1968.

The Australian Radiation Protection and Nuclear Safety Agency operates a small waste store located at its Yallambie, Victoria premises.

The Commonwealth Scientific and Industrial Research Organisation has a number of small stores for waste at its laboratories around Australia (Black Mountain, TFT Belmont, Clayton, North Ryde, University of Queensland - Gatton, Armidale - NSW, Rockhampton, Parkville, Aspendale, Pullenvale, Lucas Heights, Gungahlin Site, Woodville).

Stores for Commonwealth radioactive waste are located on the Woomera Prohibited Area, Woomera, South Australia. Large quantities of contaminated soil are stored at Evatts Field and other low-level waste and some intermediate level waste is stored on a temporary basis in a concrete bunker. The intermediate level waste is predominantly disused watches, compasses, old medical sources and irradiation sources. The bunker has concrete blast walls on 3 sides with raised earthen mounds on 2 of these sides. Other wastes, contaminated soil and treated ore wastes, are stored in drums in a large hangar.

There is a non-operational store for radioactive materials collected from the community, hospitals, industry and educational institutions in New South Wales. Security arrangements for this store have been significantly upgraded over the last two years. The store is a registered premise under the provisions of the *Radiation Control Act 1990* (NSW).

There is an Interim Storage facility for radioactive materials seized and abandoned in Victoria.

There is a small store operated by the Tasmanian government for waste generated in Tasmania. Other storage facilities are all small scale and operated by licence holders.

The current storage facility for radioactive waste generated in the Northern Territory is a secure room at Royal Darwin Hospital. Sources held at a secure compound at Mt Todd Mine rehabilitation site, were disposed of in 2007 in accordance with the relevant legislation (*Radiation (Safety Control) Act 1978 (NT)*).

Waste management structures from current mining operations and past practices include:

Mining operation	***Waste structures***
ERA Ranger Mine (NT)	Tailings dam, evaporation ponds, and solid waste disposal stockpiles.
Beverley Uranium Project (SA)	Evaporation ponds, a liquid waste re-injection well and a solid waste disposal pit.
Honeymoon Uranium Project (not in operation) (SA)	Evaporation pond, a liquid waste re-injection well and a solid waste storage area.
Olympic Dam Uranium Project (SA)	Tailings dams, associated evaporation ponds and a solid waste disposal pit.
Port Pirie Plant (SA)	Uranium and thorium tailings dams
Radium Hill Mine (SA)	Tailings dam incorporating a low-level waste repository

The purpose-built radioactive waste facility owned by the Queensland State Government is a store only. Queensland's radioactive waste store is operated by Queensland's radiation regulatory authority under the scrutiny of the Queensland Radiation Advisory Council, an independent ministerial advisory body, and the Management Advisory Committee, a public interface committee which advises the Queensland Minister. The purpose of the store is to provide safe and secure storage for radioactive substances which have outlived their useful service and which cannot be disposed of at this time. The facility is located in South East Queensland, in the Shire of Esk.

Certain requirements must be met before radioactive material may be accepted for storage at Queensland's radioactive waste store. Only those materials that are acceptable for storage may be accepted by the regulatory body for storage.

Suitable radioactive substances that may be accepted for storage in Queensland's radioactive waste store are those that:

- are solid or sealed;
- are currently held in storage by a responsible person pending disposal;
- have been used in Queensland for the majority of their recommended working life;
- cannot be returned to the manufacturer or supplier, and
- are in containment approved by the regulatory authority.

Additionally, any radioactive material, including orphan sources taken into custody by regulatory inspectors pursuant to the provisions of the *Radiation Safety Act 1999* (QLD) is to be accepted into the store.

Radioactive materials that will **not** be accepted into the store are:

- unsealed liquid radioactive material
- radioactive material requiring heat dissipation
- critical mass quantities of fissionable materials
- radioactive material not in containment approved by the regulatory authority
- large volumes of radioactive material (eg. contaminated soil or sand arising from mining and milling of radioactive ores)
- quantities of corrosive, oxidising or pyrophoric materials which could present a hazard to the safe operation of the store
- medical waste which may be contaminated with pathogens
- radioactive waste from other jurisdictions.

Once an item of radioactive waste is accepted, possession of, and all responsibility for the waste, is transferred to the State of Queensland.

The essential features of the facility include:

- all radioactive material is contained to minimise the risk of damage or dispersal of contents;
- radiation levels are kept to a minimum by keeping the material in appropriately shielded containers;
- regular inspections of the store are made to ensure that the radioactive material remains safely stored, equipment is operating correctly, and to record the radiation levels in and around the store;
- the design and operation of the store is to ensure that no person receives a radiation dose greater than 10μSv per week at and beyond the boundary of the site;
- radiation detectors located inside the store are used to continuously monitor radiation levels; and
- adequate security is provided at the store.

Western Australia has the Mt Walton East Intractable Waste Disposal Facility for the permanent disposal of intractable (chemical and radiological) waste generated within Western Australia. This facility lies about 75km northeast of Koolyanobbing and approximately 53km north of Jaurdi Station homestead. Access to the site is by a 100km dedicated unsurfaced road that extends northward from the Boorabbin siding on Great Eastern Highway. It is located on land within the Shire of Coolgardie. The main purpose of the facility is as a permanent disposal site for intractable (chemical as well as radioactive) waste generated within Western Australia. It is a site of 'last resort' and the applicants must demonstrate to the site operator that other avenues of waste disposal/management have been attempted prior to applying for disposal at the site.

The Mt Walton East Intractable Waste Disposal Facility site was chosen based on criteria detailed in the report Site Investigations for Repositories for Solid Radioactive Waste in Shallow Ground, Technical Report Series No 216, International Atomic Energy Agency (1982). The site became operational in 1991. All aspects of the design, operational requirements, duties and responsibilities must comply with the Radiation Safety (General) Regulations and the *Code Of Practice For The Near-Surface Disposal Of Radioactive Waste In Australia* (NHMRC 1992).

The Western Australian regulator operates a radioactive waste store. The store is situated on the Queen Elizabeth II (QEII) Medical Centre Site. The store's main purpose is for interim storage of radioactive substances that have no further use prior to disposal at the Mt Walton East Intractable Waste Disposal Facility. The freestanding store has been constructed with a vented central well for storage of higher activity sources as well as a vented central area for storage of sources that do not require additional shielding. The stores construction is a concrete floor with double brick walls. The store is located within a fenced locked compound and is linked to the 24 hour security of the QEII Medical Centre site.

Radioactive waste management inventory

Australia has approximately 4000 m^3 of low-level and short-lived intermediate-level radioactive waste within civilian programmes in the form of conditioned waste requiring disposal. This total consists of the following volume approximations[6]:

- 2010 m^3 of slightly contaminated soil from ore-processing research;
- 1600 m^3 of operational waste stored at the ANSTO site;
- 390 m^3 of miscellaneous waste including spent sealed sources used in gauges, smoke detectors, medical equipment and luminous signs; and
- 20 m^3 of miscellaneous waste in interim storage at Woomera.

It should be noted that these figures are estimates of waste volumes for disposal. Waste already disposed of at the Mt Walton East facility in Western Australia is not included in the above volume estimates.

The current estimated inventory of long-lived intermediate-level radioactive waste in the jurisdiction of the Commonwealth government consists of an approximate waste volume of 535 m^3. Approximately[7]:

- 235 m^3 of this is in the form of reactor target cans, ion-exchange columns, used control arms, aluminium end pieces and some solidified liquid waste;
- 165 m^3 is historical waste in the form of thorium and uranium residues arising from mineral sands processing; and

6 http://www.ret.gov.au/resources/radioactive_waste/radiation_radioactive/Pages/AmountsofRadioactiveWasteinAustralia.aspx

7 http://www.ret.gov.au/resources/radioactive_waste/radiation_radioactive/Pages/AmountsofRadioactiveWasteinAustralia.aspx

- 135 m^3 is disused sources from medical and research equipment.

Refer to Annex A for tables of the total activity of each radionuclide in waste and materials stored in facilities in Australia and waste disposed of in Western Australia's Mt Walton East facility. It should be noted that these tables have not incorporated sources of unknown activity, sources of unknown radionuclide and sources for which a range of activities was recorded. Where the activities of waste with mixed radionuclides could be attributed to each individual nuclide, this was undertaken. Inventories of radioactive waste in storage at ANSTO's radioactive waste management facility and of wastes from the mining and milling of radioactive ores are also supplied.

Nuclear facilities in the process of being decommissioned

The 100 kW MOATA research reactor was shut down in 1995, and fuel and cooling water were removed in 1996. Decommissioning will be undertaken in three stages: post-operational care with fuel removed (current status); partial dismantling with continuing care; and complete dismantling. Detailed planning for the remaining two stages is currently in progress, and it is anticipated that decommissioning will be completed by 2010.

HIFAR, a 10 MW research reactor, was shut down in January 2007.ANSTO has been granted a licence to possess and control the facility for a safe enclosure period (anticipated to be around 10 years), following which a licence to decommission the reactor will be sought.

Section E – Legislative and Regulatory System

Article 18 implementing measures

Each of Australia's jurisdictions has in force an Act of Parliament establishing a framework that includes regulation of the safety of radioactive waste management and, in the case of the Commonwealth government, the safety of spent fuel management.

Each Act establishes a licensing system for the management of radioactive material, a regulatory authority, inspection and enforcement provisions and authorises the making of safety standards in the jurisdiction that enacted the legislation. In the case of the Commonwealth government, the licensing system covers management of spent fuel.

Each jurisdiction has taken the necessary administrative steps to enable the regulatory body to achieve functions allocated to it under the enabling legislation.

Further details of the legislative and regulatory framework and regulatory body for each jurisdiction are contained below under Article 19. Annex B contains a list of the statutory instruments currently in force.

In terms of factual compliance, Australian jurisdictions are continuing to work together to further develop and implement a uniform national set of policies and practices for the safety of radioactive waste management. In accordance with the *Australian Radiation Protection and Nuclear Safety Act 1998*, the CEO of ARPANSA and the Radiation Health Committee are promoting national uniformity in radiation protection and nuclear safety, including radioactive waste management, through the development of the *National Directory for Radiation Protection*. Codes and standards relevant to radioactive waste management developed as part of the Directory have been adopted by Australian jurisdictions into existing regulatory frameworks.

The ARPANS Act contains provisions for the licensing of nuclear installations that include facilities for the management of spent fuel, and for the storage or disposal of wastes arising from the reprocessing of spent fuel.

Assessment of compliance

The current legislative framework in conjunction with the implementation of the relevant elements of the National Directory for Radiation Protection by each of the jurisdictions demonstrates that Australia complies with the Joint Convention. Further improvement can be achieved by the systematic implementation of the requirements of the relevant parts of the Directory by each Australian jurisdiction. A review recently completed on the effectiveness of the National Directory in achieving national uniformity has found that there is a high level of alignment but that the process is still incomplete.

Article 19 Legislative and regulatory framework

Legislation in each Australian jurisdiction has been developed or is being reviewed to be consistent with the general principles for regulatory frameworks set out in the *National Directory for Radiation Protection* (ARPANSA 2004).

The objective of Australian radiation protection legislation is to protect the health and safety of people and the environment from the harmful effects of ionizing and non-ionizing radiation.

The legislation passed in each jurisdiction:

- establishes a regulatory body accountable to a Minister and through that Minister to the Parliament;
- includes requirements to comply with nationally accepted national standards for occupational exposure limits, dose limits, disposal of radioactive waste, transport of radioactive material and air and waterborne discharge limits;
- requires reporting of incidents and exposures; and
- gives the regulatory body powers to monitor and enforce compliance with legislative requirements.

There is an additional national regulatory framework for protection of the environment established under the *Environment Protection and Biodiversity Conservation Act 1999*(Cth) [8].

National safety requirements and regulations for radiation safety

The regulatory frameworks in each Australian jurisdiction meet the objective identified above through the following principles and requirements:

1. Radiation protection principles including justification of practices to ensure that benefits outweigh the detriment, limitation of radiation doses to individuals from all practices, and optimisation of protection and safety so that individual doses, the number of people exposed and the likelihood of exposure are all kept as low as reasonably achievable, economic and social factors being taken into account.
2. Management requirements to provide for responsible persons to establish a safety culture, establish quality assurance programs, reduce the probability of human error leading to accidents, make appropriate training and information available to staff, allocate sufficient resources to enable safety and security of radiation sources over their lifetime (including disposal), and provide the qualified expertise necessary to observe the requirements.
3. Technical requirements such as shielding design and interlocks as necessary, to ensure that radiation sources remain within control, and that they are secure from theft or damage. Defence-in-depth measures in facility design and operation procedure, which are intended to prevent accidents, to mitigate the consequences of accidents and to restore safety should an accident occur. Also good engineering practice to be followed throughout the life (siting, design, construction, operation and decommissioning) of a facility.
4. Processes for verification of safety and security, which involve safety assessments to identify and determine the magnitudes of radiation exposures during normal operation and accidents, and to assess the provisions for protection, safety and security. Establishment of procedures and equipment required for monitoring operations and

[8] Further information on this framework is available at www.ea.gov.au/epbc/index.html

certifying compliance with safety requirements and standards. Maintenance of appropriate records and reports.

5. Risk management principles, which include a broader evaluation of risk assessment and take into account not only scientific data but also social and economic considerations.
6. Intervention actions for accidental or abnormal exposure situations requiring protective action to reduce or avert radiation exposures, or their likelihood.

Nationally accepted standards are imposed in each jurisdiction by way of Regulations made under the relevant Act that establishes the jurisdiction's regulatory framework. Standards may also be imposed as specific conditions of licence or registration. Below is a schedule identifying the standards relevant to radioactive waste management and spent fuel management by subject and the IAEA or ICRP equivalent where applicable.

Regulatory subject	***Australian code or standard***	***International equivalent***
Occupational exposure and dose limits	Recommendations for Limiting Exposure to Ionizing Radiation, National Standard for Limiting Occupational Exposure to Ionizing Radiation (Printed 1995 - Republished 2002)	ICRP 60 and BSS 115
Transport of radioactive material	Code of Practice for the Safe Transport of Radioactive Material (2008)	IAEA Regulations for the Safe Transport of Radioactive Material 2005 Edition
Mining and milling of radioactive ores	ARPANSA Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005).	IAEA Management of Radioactive Waste from the mining and milling of ores (2002), IAEA occupational Radiation Protection in the Mining and Processing of Raw Materials (2004) and IAEA Application of the Concepts of Exclusion, Exemption and Clearance (2004)
Disposal of radioactive waste	Code of Practice for the Disposal of Radioactive Waste by the User (1985), Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992)9	IAEA Near Surface Disposal of Radioactive Waste Requirements, Safety Standards Series No. WS-R-1.

The *Code of Practice for Disposal of Radioactive Wastes by the User* (NHMRC 1985) was promulgated by the National Health and Medical Research Council of Australia in 1985 and is used as guidance by all Australian jurisdictions for disposal by air, water, landfill and by incineration. The Code is being replaced with a new schedule for the National Directory for Radiation Protection, which will update levels by introducing uniform disposal limits for radionuclides that were not in use at the time of writing the 1985 Code, and brings other provisions up to date in terms of current exposure models. The proposed schedule also

[9] Copies of the Australian codes and standards are available at http://www.arpansa.gov.au/Publications/codes/index.cfm

includes discharge limits to air and water that was not part of the 1985 Code. Discharge limits currently included in legislation vary considerably across the country.

ARPANSA's *National Directory for Radiation Protection* (2004) provides the framework for the national adoption of ARPANSA's Codes and Standards.

Licensing system (including prohibition without a licence) for spent fuel and radioactive waste management activities

The legislative framework established by Australian States and Territories prohibits the use of non-exempt radioactive material (including radioactive waste) and ionizing/non-ionizing apparatus without a licence and requires the material/apparatus and premises to be registered or the subject of a licence condition requiring a detailed inventory to be maintained and amenable to regulatory inspection. Licensing is also required where premises are operated by the regulator such as the small stores of radioactive material in each jurisdiction. Radiation regulators in most jurisdictions also licence the transport of radioactive material.

The practices to which the relevant legislation in each of the nine Australian jurisdictions apply include:

- the manufacturing or possession of radiation sources;
- the use of radiation or radioactive materials for any practice which involves or could involve exposure to radiation or radioactive materials including medical, dental, industrial, veterinary and agricultural purposes, in consumer products, education, training, research, or the servicing and maintenance of radiation apparatus or sealed sources;
- nuclear installations and radiation facilities identified in the National Directory for Radiation Protection, the preparation of a site, possession or control, construction, operation, decommissioning or disposal of an installation of facility;
- practices involving exposure to natural sources specified by the regulator as requiring control;
- practices dealing with radioactive material arising from exploration, mining, mineral processing or petroleum industries;
- practices involving radioactive waste management and the disposal of radioactive material;
- sale or transfer of responsibility of ionizing radiation sources identified in the National Directory for Radiation Protection;
- transport of radioactive material; and
- any other radiation related practice specified by the regulator.

The administration of radiation control legislation in each jurisdiction is the responsibility of the regulator in each jurisdiction. The legislation in each jurisdiction provides the following powers and functions to the Regulator relevant to the management of radioactive waste management and spent fuel management:

- advise the Minister on radiation protection and nuclear safety matters;
- set standards for radiation protection and safety and security of radiation sources;
- assess applications for authorisations against criteria specified in the Act or regulations;

- grant, refuse, vary, revoke or suspend authorisations and impose conditions on these authorisations;
- grant exemptions from regulatory requirements and determine conditioned for exemptions;
- ensure a system of periodic inspections, documentation and reporting to verify compliance with regulatory requirements;
- enforce compliance with regulatory requirements;
- require safety assessments and environmental assessments where appropriate;
- accredit persons or classes of persons to assess compliance with the requirements of the legislation, and set the conditions to which they should be subject;
- maintain a register of radiation sources, including requirements for amendment of the register;
- plan for, and give directions in the case of, a nuclear or radiological emergency;
- require notification of radiation incidents to the Regulator;
- investigate radiation incidents and provide reports to ARPANSA for inclusion in the Australian Radiation Incidents Register;
- promote or conduct studies, investigations and research associated with radiation protection and nuclear safety, including public health and safety and environmental considerations; and
- prepare an annual report for tabling before the Parliament.

ANSTO waste and spent fuel

As previously reported, regulation of spent fuel is only undertaken by the Commonwealth government regulator, the CEO of ARPANSA. The Commonwealth government legislation prohibits dealing with controlled material or conduct relating to a controlled facility without a licence. Controlled facilities are licensed by activity stage; that is, site, construct, possess and control, operate and dispose, abandon and decommission. Spent fuel management is regulated under a facility licence authorising the operation of the relevant facilities.

For Commonwealth use of radiation, including spent fuel management, the CEO of ARPANSA must take into account the following significant matters in deciding whether or not to issue a licence:

(i) international best practice in relation to radiation protection and nuclear safety as it relates to the licence application;

(ii) whether the information establishes that the proposed conduct can be carried out without undue risk to the health and safety of people, and to the environment;

(iii) whether the applicant has shown that there is a net benefit from carrying out the conduct relating to the controlled facility;

(iv) whether the applicant has shown that the magnitude of individual doses, the number of people exposed, and the likelihood that exposure will happen, are as low as reasonably achievable, having regard to economic and social factors;

(v) whether the applicant has shown a capacity for complying with these regulations and the licence conditions; and

(vi) the content of any submissions made by members of the public about the application.

Radioactive ores

Radiation protection regulation of the mining and milling of radioactive ores is undertaken by radiation regulators in the States and Territories where such ores are mined – South Australian and the Northern Territory.

Radioactive ores are defined in the legislation of Australian jurisdictions where the material contains greater than 0.02% uranium or 0.05% thorium by mass. In South Australia, waste material would not be considered radioactive waste unless these limits were exceeded. It is proposed that, in the revision of the South Australian regulations, these limits will be replaced with the radionuclide exemption limits listed in the *National Directory for Radiation Protection* (ARPANSA 2004).

In the case of solid wastes originating within the supervised area of uranium mining or milling operations in South Australia, the material is designated as radioactive waste unless clearly demonstrated otherwise. That is, for the waste material to be released from the site. For example, for recycling, it must be shown to have a specific activity no greater than 35 kBq/kg. Alpha surface contamination levels must also be below an approved value. Any waste material not meeting these criteria, are disposed of on-site according to the approved Radioactive Waste Management Program.

Any disposal of radioactive waste in South Australia requires the approval of the South Australian Minister for Environment and Conservation, or the Minister's delegate within the South Australian Environment Protection Authority.

In the Northern Territory, it is an offence to dispose of radioactive waste without a licence to do so. Exemption levels for radioactive material are taken from the *National Directory for Radiation Protection* (ARPANSA, 2004). Only disposal according to Australian codes of practice is licensable.

Mt Walton East

Registration and licensing are the principal means by which the use of radiation is regulated in Western Australia. The Radiation Safety Act requires prescribed radioactive substances, x-ray equipment and electronic products, together with the associated premises, to be registered. Registrants may include individuals, companies, organisations or institutions. The Act further requires persons who manufacture, store, transport, sell, possess, install, service, maintain, repair, use, operate or otherwise deal with prescribed radioactive substances, x-ray equipment or electronic products to be licensed or, where permitted, work under the direction and supervision of a licensee.

Institutional control and regulatory inspection

All users of radioactive materials including radioactive waste are subject to the responsibilities detailed in the ARPANSA *Recommendations for limiting exposure to ionizing radiation (1995)*. The requirements to meet these responsibilities can be summarised as follows:

1. A plan for the management of radiation safety in planned situations for occupational and public exposures that must address the following:
   - Approvals and Authorisations
   - Radiation Management Plan
   - Control of Exposure
   - Monitoring Radiation Exposure
   - Incidents Accidents and Emergencies
   - Induction and Training
   - Record Keeping and Reporting
   - Assessment and Compliance
2. The management of radiation safety for medical exposures
3. Radiation safety in emergency situations
4. Radiation safety in existing situations

ANSTO waste and spent fuel management

Under the *Australian Radiation Protection and Nuclear Safety Act 1998 (Cth),* ANSTO must comply with the following statutory conditions set out in the Regulations to the Act in the management of waste facilities and spent fuel:

(i) The licence holder must investigate suspected breaches of licence conditions. If a breach is identified, the licence holder must rectify the breach and any of its consequences as soon as reasonably practicable. The licence holder must also inform the CEO about the breach as soon as reasonably practicable.

(ii) The licence holder must take all reasonably practicable steps to prevent accidents involving controlled material, controlled apparatus or controlled facilities described in the licence. If an accident happens, the licence holder must take all reasonably practicable steps to control the accident, minimise its consequences (including injury to any person and damage or harm to the environment), tell the CEO about the accident within 24 hours of it happening and submit a written report within 14 days.

In accordance with Regulation 63, ARPANSA has published guidelines[10] on how licence holders will report their compliance with the Act, the Regulations and licence conditions.

Part 7 of the ARPANS Act prescribes powers available to the agency to conduct inspections[11] to monitor and enforce compliance with the Act, its Regulations[12] and licence conditions.

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[10] These guidelines can be found on the web at http://www.arpansa.gov.au/Regulation/LicenceHolders/index.cfm

[11] A copy of ARPANSA's inspection policy is also available for viewing on the web at http://www.arpansa.gov.au/Regulation/LicenceHolders/index.cfm

[12] A copy of the Act and Regulations is available athttp://www.arpansa.gov.au/Regulation/Legislation/index.cfm

Pursuant to Regulation 50 of the Australian Radiation Protection and Nuclear Safety Regulations 1999, the holder of a licence must, at least once every 12 months, review and update any plans and arrangements for managing the controlled facility, controlled material or controlled apparatus to ensure the health and safety of people and protection of the environment. Section 36 of the *Australian Radiation Protection and Nuclear Safety Act 1998* allows the CEO of ARPANSA to impose additional or vary existing licence conditions.

Radioactive Ores

The mining or milling of radioactive ores in South Australia is subject to regulatory control via a licence issued under section 24 of the South Australian *Radiation Protection and Control Act 1982*. Conditions attached to the licence require uranium mining operators to comply with the requirements of the Code of Practice & Safety Guide on *Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005) and the *Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (ARPANSA 2002)*.

Companies in South Australia that hold licences to mine or mill radioactive ores are required, under conditions on the licences, to report annually on radioactive waste production and management. The operation of mines and management of radioactive wastes on site also involve approvals of facilities such as tailings dams and evaporation ponds, waste management plans, and releases of radionuclides to the environment. The South Australian radiation regulator is responsible for granting approvals under the *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005). In its assessment of applications for approval of waste management plans and waste disposal facilities, the South Australian radiation regulator consults with the South Australian mining regulator that issues a mining lease under *Mining Act 1971 (SA)*.

In the case of radioactive wastes remaining from mining or processing of radioactive ores which ceased prior to the introduction of the South Australian *Radiation Protection and Control Act* 1982, legislative control is achieved via registration of the sites as premises under the *Radiation Protection and Control Act 1982*.

Mt Walton East

The safety of the Mt Walton East Intractable Waste Disposal Facility is assessed regularly, as required by the conditions of registration, in particular the requirements for a technical auditor and the ongoing requirement for monitoring. The monitoring is undertaken by an approved licensed Radiation Safety Officer (RSO) who has qualifications and experience in health physics. The RSO reports in writing to the Radiological Council the results of monitoring and any other factors of radiological concern after any site changes, including the receipt of material for disposal and sealing of the storage chamber.

Enforcement of legislation and licence conditions

Legislation in each Australian jurisdiction provides for authorisations to regulate various dealings with radiation sources. The holding of the relevant authorisation is a mandatory condition of engaging in a particular dealing, unless exemptions apply. The authorisation can

be effected through a single authorisation covering various dealings or through separate authorisations covering particular dealings.

Legislation in each Australian jurisdiction enables the regulator to refuse to grant an authorisation if:

- the applicant is not a fit and proper person;
- it is necessary to do so in the interests of public health and safety; or
- the proposed use of radiation is inappropriate or unjustified.

Legislation in each Australian jurisdiction enables the regulator to suspend, vary or cancel an authorisation if there is evidence to suggest that:

- the authorisation was obtained improperly;
- the holder of an authorisation has contravened a condition of the authorisation;
- the holder of an authorisation has been convicted of an offence against the legislation under which the authorisation was granted, or other relevant legislation;
- unless the authorisation is suspended, varied or cancelled there would be a risk to the health and safety of people and the environment;
- unless the authorisation is suspended, varied or cancelled there would be a security risk from access to the radioactive source;
- the holder of an authorisation ceased to hold a qualification or meet other criteria which formed the basis on which the authorisation was granted;
- the holder of an authorisation has consistently made decisions that compromised radiation safety; or
- the holder of an accreditation has ceased working in a capacity for which accreditation is required.

Where an Australian regulator makes a decision to suspend, vary or cancel an authorisation, it advises all other relevant regulators within and outside of its jurisdiction of the decision.

Compliance is assessed by site inspections and routine and non-routine reporting by the licence holder. The frequency and extent of inspections depend on the risk posed by the facility, equipment or material concerned and past conduct of the licence holder. The regulatory body in each jurisdiction has legislative powers to undertake inspections, gather evidence and enforce conditions of licence.

ANSTO waste and spent fuel management

The Commonwealth government regulator ARPANSA considers the following in relation to enforcement action:

- judgement on the risk or hazard level
- multiple breaches or history of non-compliance
- failure to comply with requirements in the regulations
- incidents that are serious

- reckless disregard for safety.

Radioactive ores

Mining operations are periodically inspected by the South Australian radiation regulator and quarterly meetings are held to review safety of operations, including radioactive waste management.

Mt Walton East

For the Mt Walton East facility, a registration under the Radiation Safety Act is required to be held by the site operator. The conditions imposed on the registration cover aspects of packaging, transport, radiation monitoring, operational requirements and reporting. Direct reference is made to such documents as the Radiation Safety (General) Regulations, *Code of Practice for the Safe Transport of Radioactive Material* (ARPANSA, 2001), the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) and IAEA Technical Reports Series 376 *Quality Assurance for Radioactive Waste Packages* (1995). Additionally reference is made to documentation specifically developed for Mount Walton East.

Each disposal campaign needs to be individually approved by the Radiological Council and the Environmental Protection Authority of Western Australia.

Assignment of responsibilities

The principles for the regulatory frameworks require that a 'responsible person' be primarily responsible for radiation protection and safety, and that regulators establish and enforce standards through a system of regulation. Responsible persons are required to make notifications, or gain approvals and authorisations from regulators before conducting a practice. Authorisations include registrations, licences and accreditations.

In jurisdictions where mining of radioactive ores takes place, radiation regulation can be undertaken in conjunction with regulators of mining and transport.

For example, in South Australia companies that hold licences to mine or mill radioactive ores are required, under conditions on the licences, to report annually on radioactive waste production and management. The operation of mines and management of radioactive wastes on site also involve approvals of facilities such as tailings dams and evaporation ponds, waste management plans, and releases of radionuclides to the environment. The South Australian radiation regulator is responsible for granting approvals under the ARPANSA *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005). In its assessment of applications for approval of waste management plans and waste disposal facilities, the radiation regulator consults with the mining regulator that issues a mining lease under *Mining Act 1971(SA)*. Mining operations are periodically inspected by the radiation regulator and quarterly meetings are held to review safety of operations, including radioactive waste management.

In the case of radioactive wastes remaining from mining or processing of radioactive ores in South Australia which ceased prior to the introduction of the *Radiation Protection and*

Control Act (1982) (SA), legislative control is achieved via registration of the sites as premises under the *Radiation Protection and Control Act (SA)*.

In the Northern Territory, regulation of the mining of uranium ores is undertaken by the mining regulator in accordance with the *Mining Management Act 2001 (NT)* which targets protection of the environment. The Act requires operators to follow best practice and companies by default use the ARPANSA *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005). The Code is also used by the occupational health and safety regulator to control occupational exposures.

Assessment of compliance

Australia has an adequate legislative and regulatory framework to ensure the safe management of radioactive waste and spent fuel. The legislative and regulatory frameworks are consistent with the objectives of the Convention.

Article 20 Regulatory body

Regulatory authorities responsible for implementing the legislative framework

The regulatory authority established in each jurisdiction for the purpose of implementing Commonwealth government, State or Territory radiation safety regulations is also designated with implementation and maintenance of the requirements of this Convention.

The majority of licensees in State and Territory jurisdictions are medical users of radiation sources. The Commonwealth regulates medical use of radiation sources by the defence forces. These authorities have been adequately resourced for their roles. The staffing of radiation protection regulators in each jurisdiction varies from 1 up to about 20 staff depending on the population and scale of operations within that jurisdiction. The staff possess the experience, skills and knowledge needed to undertake their regulatory activities.

The nine radiation protection regulatory bodies within Australia, are as follows:

- Commonwealth government: the Australian Radiation Protection and Nuclear Safety Agency;
- New South Wales: the Department of Environment and Conservation, previously known as the Environment Protection Authority;
- Queensland: Department of Health;
- South Australia: Environment Protection Authority;
- Tasmania: Director of Public Health, Department of Health and Human Services;
- Victoria: Department of Human Services;
- Western Australia: Radiological Council;
- Australian Capital Territory: Australian Capital Territory Radiation Council; and
- Northern Territory: Northern Territory: Department of Health and Families

Jurisdiction	***Approximate number and type of licensees/licences***	***Regulator and radiation protection regulatory body***	***Number of staff in the regulatory body***	***Expertise of regulatory staff***
Commonwealth government	100 licences (~60 source and ~40 facility) including for Department of Defence and defence forces, radiopharmaceutical production facility, 3 research reactors – 1 operating, 2 shutdown	CEO of ARPANSA, Regulatory and Policy Branch	35	16 regulatory scientists and engineers, 14 policy, 5 administrative
South Australia	3 U mines (2 operating) and 4 866 licensees	Minister for the Environment, Environment Protection Authority, Radiation Protection Division	16	14 scientific and technical, 2 administrative and clerical staff
New South Wales	20 000 licensees (which includes 8 000 registered sources or premises)	Minister for Climate Change and the Environment, Department of Environment and Climate Change, Hazardous Materials and Radiation Section.	14	9 scientific and technical, including policy and 5 administration staff
Queensland	13 500 licensees, 4 045 sealed radioactive sources registered, 6069 radiation apparatus registered	Minister for Health, QLD Department of Health, Radiation Health Unit	16	10 scientific, 6 administrative
Tasmania	354 licences (consisting of 731 apparatus, 557 radioactive materials, 2 416 authorised persons)	Director of Public Health, Department of Health and Human Services, Health Physics Unit	4	3 scientific and 1 administrative
Victoria	6500 operator licences, 2500 management licences	Minister for Health, Department of Human Services, Radiation Safety section	14	7 technical and policy staff, 7 administrative staff
Western Australia	4864 licences, 1741 registered premises including 1 operating disposal facility	Western Australian Radiological Council, Radiation Health Branch	19	2 technical, 4 policy, 10 scientific, 3 administrative
Australian Capital Territory	458 registrations, 488 licensees	Australian Capital Territory Radiation Council, Radiation Safety Section	1	1 scientific

Jurisdiction	***Approximate number and type of licensees/licences***	***Regulator and radiation protection regulatory body***	***Number of staff in the regulatory body***	***Expertise of regulatory staff***
Northern Territory	315 licences, 347 registered x-ray units and 1 operating U mine	Chief Health Officer, Department of Health and Families, Radiation Protection section	2.5	2 scientific, 0.5 administrative

Effective independence of the regulatory function

Within all jurisdictions in Australia, there is currently an effective independence between the appropriate regulatory authorities for radiation safety and other areas within organisations dealing with spent fuel or radioactive waste management.

There is an effective independence between ARPANSA and all its licence holders; for example ARPANSA and ANSTO report to different ministers, and ARPANSA reports directly to parliament on a quarterly and annual basis.

In Queensland, it is the regulatory authority which operates Queensland's radioactive waste store on behalf of the State. However, the Store is operated under the scrutiny of the independent Radiation Advisory Council which is required to seek, obtain and consider a report from an external technical auditor at least every two years to review all actions of the regulatory authority in managing the facility. Additionally, there is a Management Advisory Committee, which represents the State and the Esk Shire Council (where the facility is located), which advises the Minister on the management of the facility based on the review of records, audit reports, and any other inspection of the facility by the Committee.

In all other jurisdictions, the regulatory body is effectively independent of its licence holders and owners of radioactive waste, with the exception that the regulatory bodies all have some sources and store a small quantity of radioactive waste.

Assessment of compliance

Australia has an effective independence of its regulatory functions within each of the nine Australian jurisdictions responsible for the regulation of radioactive waste management and spent fuel to assure its safe management. Australia has appropriate regulatory bodies to implement the established legislative and regulatory framework.

Section F – Other General Safety Provisions

Article 21 Responsibility of the licence holder

Responsibility of the licence holder

In accordance with the *National Directory for Radiation Protection*, Australian legislation requires that a 'responsible person' be primarily responsible for radiation protection and safety.

The responsible person is defined in relation to any radioactive source, ionizing or non-ionizing radiation apparatus, nuclear installation, prescribed radiation facility or premises on which unsealed radioactive sources are stored or used means the person:

- having overall management responsibility including responsibility for the security and maintenance of the sources, apparatus, installation or facility;
- having overall control over who may use the source or apparatus, installation or facility; and
- in whose name the source, apparatus, installation or facility would be registered if this is required.

Jurisdictional control

Australia's research reactors are owned by ANSTO; they are funded, and the liability for them is carried, by the Commonwealth government.

The uranium mines and milling facilities in South Australia and the Northern Territory are privately owned and any liability would be carried by the owner. The South Australian and Northern Territory regulatory bodies require a bank guarantee or cash deposit before operations can commence.

Dedicated facilities for storage of radioactive material in each of the jurisdictions are owned by the relevant State or Territory. The regulatory authority operates the facility on behalf of the State or Territory. Adequate resources and qualified staff are provided by the States and Territories to support the facilities.

Assessment of compliance

Australia's legal framework provides adequate assignment of responsibilities for the safety of spent fuel management and the safety of radioactive waste management to the operators or licensees. Regulators have adequate provisions for control of orphan sources in the absence of a licence holder or other responsible party.

Article 22 Human and financial resources

Staffing

All jurisdictions have reported that staff of the regulatory authorities possess the essential skills, knowledge and expertise to assess the safety in management of radioactive materials

and waste within their jurisdiction and to conduct the necessary inspections for regulatory compliance monitoring

ARPANSA staff members possess the essential skills, knowledge and expertise to assess the safety of the operation of the spent fuel management and radioactive waste management facilities at ANSTO and to conduct the inspection of these facilities for regulatory compliance monitoring.

Within ANSTO Waste Operations and Fuel Management, staff are appropriately trained and are qualified to carry out their tasks using defined procedures and instructions. The adequacy of human resources is reviewed on an ongoing basis to ensure that operations are safe. ANSTO operations are designed to respect the ALARA principle: workers' radiation doses are routinely monitored, as are environmental releases. Aggregated worker dose data and environmental release information are reported to ARPANSA and are publicly available in ANSTO reports.

In relation to operator capabilities, for Victoria and Western Australia, authorised practices that generate radioactive wastes are advised to access commercially available health physics support to assist with waste management.

In South Australia, radioactive waste includes both large quantities of uranium tailings and small quantities of radioactive waste in the form of sealed radioactive sources and unsealed radioactive wastes held by numerous owners including hospitals, universities, research organisations, industrial companies and government departments. Owners of radioactive waste are responsible for providing qualified staff and financial resources to enable appropriate controls and monitoring of radioactive wastes to effect compliance with the provisions of the *RPC Act* and its regulations.

Financial resources

The adequacy of ANSTO's financial resources is reviewed on an ongoing basis to ensure that operations are safe. ANSTO is a statutory body corporate of the Commonwealth government and so the ultimate liability lies with the Commonwealth government.

Financing of institutional controls and monitoring after closure

This article is currently only applicable to the Mt Walton East Intractable Waste Disposal Facility in Western Australia. There are no specific funds set aside however, the facility is owned by the Western Australian government and the financial responsibility for monitoring following closure would be bourne by the Western Australian government.

Assessment of compliance

Regulators have ensured that there are adequate resources currently to comply with this article, however in the future there is potential for shortages of adequately trained and experienced staff due to the ageing workforce for regulators and operators.

Article 23 Quality assurance

Establishment and implementation of quality assurance programs

Australian radiation regulators monitor compliance of licensees with a variety of quality assurance programs through regular site visits. These programs include certification to ISO 9001 for spent fuel operations and radioactive waste management facilities at ANSTO and *Quality Assurance for Radioactive Waste Packages*, IAEA Technical Report Series No.376 (1995).

Large scale operations regulated by the States and Territories operate under quality assurance systems as part of the management plan required by the regulator.

Assessment of compliance

Australian regulators have complied with this article by appropriately applying the requirement for quality assurance programmes.

Article 24 Operational radiation protection

Ensuring application of ALARA, adherence to dose limits and prevention of uncontrolled releases at spent fuel or radioactive waste management facilities.

Dose constraints are 0.1 mSv per annum for liquid discharges and 0.3 mSv per annum for airborne discharges are imposed on ANSTO. Those constraints cover all of ANSTO's activities, including the operation of spent fuel and radioactive waste management facilities. Further, an ALARA objective of 0.02 mSv to a member of the public from all authorised airborne discharges is applied.

State jurisdictions that operate radioactive waste management or disposal facilities are subject to national limits as stated in the ARPANSA *Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (1995).*

Ensuring application of ALARA, adherence to dose limits and corrective measures to mitigate effects of uncontrolled release at a regulated nuclear facility.

Dose limits to workers and the public are consistent across Australia's nine jurisdictions. These limits are specified in the ARPANSA *Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (1995)*. The *Recommendations* and *National Standard* is referenced in the *National Directory for Radiation Protection* (ARPANSA 2004) for national adoption. The *Recommendations* and Standard would apply to all facilities used for the storage of radioactive material in each of the jurisdictions. The *Recommendations* require a plan for control of exposure. Such a plan addresses optimisation by specifically ensuring the avoidance of exposure where practicable.

The *National Standard for Limiting Occupational Exposure to Ionising Radiation* (ARPANSA 1995) stipulates an effective dose limit of 20 mSv per year, averaged over a period of five consecutive calendar years with no more than 50 mSv in one year. For women who declare a pregnancy, the dose limit is 1 mSv to the foetus for the remainder of the pregnancy. In addition, conditions of licence can include requirements for disposal of radioactive waste and the use of personal radiation monitors.

In addition to the *National Standard* and *Recommendations*, some jurisdictions use management plans such as the waste management plan required in the *Code of Practice and Safety Guide on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005). Independent audits are generally used by Australian jurisdictions to verify compliance with management plans. Jurisdictions also apply the requirements of the *Code of Practice for the Disposal of Radioactive Waste by the User* (NHMRC 1985), which is in the process of being replaced by a schedule in the *National Directory for Radiation Protection* (ARPANSA 2004) to update the list of radionuclides and exposure scenarios. Records of discharges must be kept and in some jurisdictions approval must be given before discharges or disposal of very low level waste can be undertaken.

In relation to the spent fuel and radioactive waste management facilities at ANSTO, the ANSTO Health, Safety and Environment Policy contains principles that commit ANSTO to undertake its functions in a manner that protects human health and the environment and is consistent with national and international standards. ANSTO undertakes regular and continuous monitoring of staff and of all emissions from its functions. That monitoring shows that members of the public resident in areas surrounding the site receive less than 1% of the public dose limit of 1 mSv per year. Public health studies have confirmed that the operation of ANSTO's facilities has had no negative impact upon the health of nearby residents.

ANSTO has an internal ALARA trigger that requires assessment for annual worker doses greater than 2 mSv as part of the optimisation process. An investigation level of 1 mSv/month is also set for occupationally exposed workers, such that exposures above this level require a documented investigation and follow up action to reduce radiological exposure, if applicable. The system of radiation protection employed is considered adequate for protection of the foetus prior to declaration of pregnancy, so there are no special limits for women of child-bearing age. Workers who are potentially exposed to radiation are routinely monitored for external exposure (and internal exposure if required). Comprehensive records are maintained.

Assessment of compliance

Australia's compliance with this article is demonstrated through the mandatory use of radiation management plans and independent audits that ensure optimisation, adherence to national dose limits and limitation of uncontrolled releases to the environment.

Article 25 Emergency preparedness

Emergency plans

The *National Directory for Radiation Protection* (2004) provides guidance to Australian regulators for intervention in radiological emergencies and chronic exposure situations. Such guidance is applicable to spent fuel management and radioactive waste management facilities.

The guidance states that:

- In order to reduce or avert exposures in intervention situations, protective actions or remedial actions must be undertaken whenever they are justified.
- The form scale and duration of any such protection action or remedial action must be optimised so as to produce the maximum net benefit, understood in a broad sense under the prevailing social and economic circumstances.
- Responsible persons must be accountable for the development, maintenance and implementation of emergency plans. Emergency plans should be consistent with the principles and requirements in the IAEA's *Preparedness and Response for a Nuclear or Radiological Emergency*, Safety Standards Series No. GS-R-2, 2002.

In the case of spent fuel and waste management facilities at ANSTO, a *Response Plan for Accidents and Incidents at ANSTO/LHSTC,* developed in close consultation with the emergency services agencies, covers all possible events at the ANSTO site, including spent fuel and radioactive waste management facilities.

ANSTO measures to prevent nuclear emergency situations include:

- plant design;
- operating procedures, limits and conditions;
- site safety culture;
- compliance with ARPANSA regulations; and
- formal processes for approval of modifications or changes to procedures.

At the Mt Walton East Intractable Waste Disposal Facility in Western Australia, an emergency response/contingency plan is developed for each burial campaign and forms part of the documentation requiring approval prior to site mobilisation.

For storage facilities operated by State and Territory radiation regulators, a variety of measures are employed to ensure preparedness for an emergency including:

- where waste storage facilities are part of a hospital or another institution, emergency preparedness plans for the institution include waste facilities;
- where operational management plans are used for storage facilities, these include remediation procedures in the event of an incident, requirement for periodic incident response exercises and the review of results of such exercises;
- advising fire services and other emergency services of the locations of radioactive materials;
- use of a model reference incident for response planning purposes of a scale that can be directly applied to a radiological emergency; and
- provision of additional radiation monitoring equipment for emergency services and enhanced equipment and training for hospitals.

Nationally, Commonwealth (Commonwealth government) response plans are written in terms of a generic national response and are always scoped to support the States and Territories when requested. The Commonwealth Disaster Plan has specific arrangements for dealing with

national emergencies and contains specific details regarding a radiological incident. Each State and Territory has local Hazardous Materials Plans in place for responding to an incident involving hazardous materials. Plans at the national level are reviewed regularly and exercised as required. Commonwealth Disaster Plan arrangements in the event of a Radiological or Nuclear Incident are due for review.

National radiological emergency plan

It is not foreseen that Australia could be affected by a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

Assessment of compliance

Australia is compliant with Article 25 in that appropriate on- and off-site emergency plans are in place in all jurisdictions and are tested regularly.

Article 26 Decommissioning of a nuclear facility

Section 32 of the ARPANS Act includes the requirement that the CEO of ARPANSA, when making a licensing decision about decommissioning of a facility, takes into account international best practice in radiation protection and nuclear safety. Other information regarding decommissioning plan and the decommissioning schedule required by the Regulations must also be taken into account. Any radioactive waste arising from dismantling or decommissioning activities will be stored in existing storage facilities at ANSTO until a final disposal option is available.

In States and Territories, most simple storage facilities operated by the regulators would not require complex procedures to be undertaken to decommission the facility. Hence some do not have decommissioning plans in place but would require them prior to undertaking decommissioning activities. More complex facilities include a preliminary or conceptual decommissioning plan as part of the radiation management plan for the facility.

Staffing and financial resources

ANSTO is cognisant of the challenges posed by diminishing numbers of staff qualified in the nuclear industry and seeks to ensure that it has the appropriate resources in future years.

Each year, ANSTO allocates funds from its annual budget to decommissioning projects. ANSTO is also in the process of updating a decommissioning process plan for long-term planning and management of decommissioning projects.

In South Australia, for the decommissioning of uranium mining facilities, the mining or milling company is expected to provide appropriate technical expertise and resources. Provisions of the South Australia radiation protection legislation could be applied to require a company to provide appropriate resources and personnel for decommissioning. Under the *Mining Act 1971* a bond may be set by the relevant Minister to recover costs of rehabilitation of mining sites. At present, the Beverley uranium project is subject to a bond that is revised periodically. The bond is set at a level to cover the estimated cost for rehabilitation of the mine and milling site to current standards. In the case of the Olympic Dam project, the *Roxby Downs (Indenture Ratification) Act 1982* (SA) applies. While there is no provision for a bond

under the Indenture Act, the mining company is required to maintain an ongoing rehabilitation program at the site.

ARPANSA is developing skills and expertise in safety assessment of decommissioning practices.

Operational radiation protection

A preliminary decommissioning plan was submitted as part of the application for a licence to operate the OPAL reactor. This included the choice of materials to minimise activation, space for access and minimisation of the radioactive waste that will be produced during commissioning. In licensing OPAL for operation, ARPANSA was satisfied that ANSTO has plans and arrangements to satisfy decommissioning requirements.

Operational radiation protection will be a very important consideration during the decommissioning of MOATA and the preparation for safe enclosure of HIFAR. During the decommissioning of the HIFAR and MOATA reactors there will be in place operational protection through radioactive waste management to ensure that discharges are managed and uncontrolled releases avoided.

The application for a licence to possess or control HIFAR contained a radiation protection plan (http://www.arpansa.gov.au/pubs/hifar/partb3.pdf) which outlined the measures which will be taken to minimise exposures during the safe enclosure period. The application for approval to dismantle Moata, to be lodged in the near future, will also contain similar detail.

Emergency preparedness

The *Response Plan for Accidents and Incidents at ANSTO/LHSTC* encompasses all facilities at the site including shutdown reactors.

Record keeping

ANSTO keeps comprehensive records of all radioactive waste generated from ongoing production and specific decommissioning activities. The records are maintained through databases and tracking systems. Record keeping for spent radioactive sources is also managed through comprehensive database management.

Assessment of compliance

Currently regulatory requirements adequately address the provision of resources, operational limits, emergency plans and record keeping in regard to decommissioning and disposal facility closure as required by Article 26. For older facilities that did not have decommissioning plans that would be regarded as adequate by current standards, regulators are ensuring that conceptual plans are developed prior to decommissioning activities.

Section G – Safety of Spent Fuel Management

Article 4 General safety requirements

Compliance with this article remains as reported in the last Australian National Report.

Within Australia, only the Commonwealth government has responsibility for the management of spent fuel. Thus this Section only refers to the Commonwealth entity ANSTO that manages spent nuclear fuel and the Commonwealth government regulator (ARPANSA) that licences the spent fuel management facilities.

ANSTO possesses the only facilities in Australia for managing spent fuel, as all the spent fuel produced in Australia comes from research reactors once operated, or currently operated, by ANSTO. The relevant regulatory authority, ARPANSA, has issued facility licences to ANSTO which authorises ANSTO to operate its spent fuel management facilities. The facility licences are subject to licence conditions which specify how individuals, society and the environment are to be protected against radiological hazards.

At ANSTO spent fuel from HIFAR was stored in several wet-store facilities for various periods after discharge from the reactor. A large dry store was also used in the past for the interim storage of spent fuel prior to further handling, such as transport offshore for long-term storage or reprocessing, depending on its destination. See Section D for further detail.

The spent fuel management facilities for the OPAL reactor form part of the OPAL reactor facility. As such, ANSTO's compliance with the requirements of Chapter 2 of the Convention has been examined in detail as part of the consideration of its applications to the regulatory body ARPANSA for authorisations to prepare a site, construct, commission and operate the facility.

Measures to ensure criticality and removal of residual heat

This is relevant to wet storage of aged spent fuel before final shipment. ARPANSA requires that facilities for the storage of spent fuel at ANSTO adequately address criticality and heat generation issues as part of the licence authorisation and licence conditions. The wet storage facilities currently in use, or formerly used for spent fuel, adequately address criticality as well as the removal of any decay heat generated during the storage period. All operations involving fissile material are covered by criticality certification. The subcritical mass of fissile nuclide is also stipulated by operational limits and conditions for spent fuel storage.

Measures to ensure minimum practical generation of radioactive waste

ANSTO gives priority to minimising its generation of radioactive waste including by selection of appropriate materials. The generation of radioactive waste from spent fuel storage is kept to a minimum and consists largely of water filters and ion-exchange resins.

Measures to take into account interdependencies

The spent fuel handling equipment takes into account the interdependencies among the different steps in spent fuel management.

Protection of individuals, the public and the environment

ARPANSA's Commonwealth nuclear safety legislation, the *Australian Radiation Protection and Nuclear Safety Act 1998*, accompanying regulations and subsidiary regulatory guidance, such as ARPANSA's Regulatory Assessment Principles, provide for effective protection of individuals, society and the environment. These are based on internationally endorsed criteria and standards.

Assessment of biological, chemical and other hazards

Whilst Australia does not reprocess spent fuel, ANSTO has safely managed its spent fuel since commencement of reactor operations, and has stored that spent fuel in both dry and wet facilities. Currently, only wet storage of spent fuel is in practice at ANSTO. Management of the wet facilities entails monitoring and controlling pond chemistry, and radiation safety is maintained by standard practices as applied to all radioactive materials whether in dry or wet storage.

Avoiding greater and undue burdens on future generations

'Burden on future generations' is taken into account in the decision on whether or not to give the applicant a licence to operate or use the facility, equipment or material. For example, the CEO of ARPANSA must consider international best practice in radiation protection and nuclear safety when assessing each licence application and in addition:

- whether the information establishes that the proposed conduct can be carried out without undue risk to the health and safety of people, and to the environment; and
- whether the applicant has shown that there is a net benefit from carrying out the conduct relating to the controlled facility; and
- whether the applicant has shown that the magnitude of individual doses, the number of people exposed, and the likelihood that exposure will happen, are as low as reasonably achievable, having regard to economic and social factors.

These factors are considered taking into account both current and future impacts of the facilities.

Assessment of compliance

Australia has effective regulatory and operations controls in place to ensure that it has effective compliance with the general safety measures for the management of spent fuel.

Article 5 Existing facilities

Review of safety assessment of spent fuel management facility

As previously reported, Commonwealth government legislation and ARPANSA's licensing system require that appropriate steps be taken to review the safety of any existing spent fuel management facility and to ensure that all reasonably practical improvements are made to upgrade facility safety. As part of its regulatory activities, ARPANSA routinely inspects the Fuel Management facilities at ANSTO. In addition, the safety of these facilities is reviewed

through ANSTO's internal review processes including inspections, evaluation of performance and criticality certification systems. The safety of the spent fuel facilities is assessed at a regular interval and the safety analysis reports for these facilities are updated accordingly.

Assessment of compliance

The Australian operator and regulator have demonstrated compliance with this article by ensuring through both legislative and internal means that the safety of spent fuel management facilities is assessed on a regular basis.

Article 6 Siting of proposed facilities

The Commonwealth government is the only jurisdiction with facilities related to the management of spent fuel.

Evaluation of site related factors

Commonwealth government environment legislation (*Environment Protection and Biodiversity Conservation Act 1999 (Cth))* requires that any proposed facility that is characterised as a nuclear action be referred to the Minister for the Environment who determines whether an approval is needed and on the form of assessment. ARPANS legislation requires that the assessment of the environmental impact be taken into account by the CEO of ARPANSA in deciding whether to issue a facility licence authorising the preparation of a site.

Evaluation of safety on individuals, the public and the environment

Under Commonwealth government legislation, establishment of a new spent fuel management facility for the storage of spent fuel, is not regarded as a 'nuclear action', and therefore would not trigger the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*. Under the ARPANS Act, the storage of spent fuel would require a facility licence and the application for a licence must include an assessment of the impact of the facility on the safety of people and the environment.

Provision of information to the public

In accordance with Regulation 40, under the Australian Radiation Protection and Nuclear Safety Regulations 1999, the Commonwealth government regulatory body, the Australian Radiation Protection and Nuclear Safety Agency, is required to invite public submissions on any application involving a nuclear installation. Paragraph 41(3)(g) of the Regulations requires the CEO of ARPANSA to take into account the content of any public submissions in deciding whether or not to issue a facility licence that authorises conduct in relation to a nuclear installation.

In the past, public submissions have been invited as part of assessing the application for a licence to prepare a site for, to construct and a licence to operate the Australian Nuclear

Science and Technology Organisation's OPAL research reactor[13], including its spent fuel management facilities.

Consultation with other jurisdictions

State and Territory jurisdictions within which a spent fuel management facility would be located are consulted as part of the public consultation process undertaken as part of the environmental approval process and the regulatory licensing process.

Avoiding unacceptable effects on other jurisdictions

It is not foreseen that Australian spent fuel management facilities would have impacts on other Contracting Parties.

Assessment of compliance

Australia has appropriate legislative and regulatory measures in place to ensure proper evaluation of sites for spent fuel management facilities and the meaningful engagement of the public in the decision making in relation to siting.

Article 7 Design and construction of facilities

Arrangements for limiting radiological impacts

Commonwealth government legislation and ARPANSA's licensing system require that the design and construction of a spent fuel management facility incorporate suitable measures to limit radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases.

Plans and provisions for decommissioning

At the design stage, plans and other provisions for decommissioning of a facility are only in the preliminary stages of development and are revised and updated as the facility moves through the licensing stages.

Validation of technologies used

The technologies incorporated in the design and construction of a spent fuel management facility must be supported by proven design, experience, testing and analysis.

Assessment of compliance

Australia has appropriate legislative and regulatory measures in place to ensure proper assessment of the construction of spent fuel management facilities.

[13] Information about the submission process and a copy of the public consultation reports for the construction and operating stages of the licensing process can be found at www.arpansa.gov.au/Regulation/opal/index.cfm.

Article 8 Assessment of safety of facilities

Safety and environmental assessment requirements

Commonwealth government legislation and ARPANSA's licensing system require that, before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility, and covering its operating lifetime, must be carried out.

Status of safety and environmental assessments

Before operation of a spent fuel management facility, updated and detailed versions of the safety and environmental assessments must be prepared. As noted above, the safety and environmental impact of OPAL's spent fuel management facilities was subject to examination during the licence processes[14].

Assessment of compliance

Australia has appropriate legislative and regulatory measures in place to ensure proper assessment of the construction of spent fuel management facilities.

Article 9 Operation of facilities

Basis of licensing decision

Commonwealth government legislation and ARPANSA's licensing system require that the grant of a licence to operate be based on appropriate assessments and be conditional on the completion of a commissioning program demonstrating that the facility, as constructed, can be operated safely.

Definition and revision of operational limits and conditions

Operational limits and conditions derived from tests, operating experience and assessments, must be defined and revised as necessary. The operational limits and conditions are derived from the safety analysis conducted for the facilities.

Procedures for operation, maintenance, monitoring, inspection and testing

Operation, maintenance, monitoring and inspection must be conducted in accordance with established procedures.

Availability of engineering and technical support

Engineering and technical support in all safety-related fields must be available throughout the operating life of the spent fuel management facility.

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[14] For information on the licensing action undertaken under the *Australian Radiation Protection and Nuclear Safety Act 1998* please visit www.arpansa.gov.au/Regulation/opal/index.cfm.

Reporting of incidents significant to safety

Incidents significant to safety must be reported to the regulatory authority in a timely manner by the licence holder.

Collection and analysis of operating experience

Under the ANSTO Business Management System and the Occupational Health, Safety and Environment system, ANSTO collects and analyses data on operating experience, and acts upon that data where appropriate.

Preparation and update of decommissioning plans

Decommissioning plans for spent fuel management facilities are in place and will be reviewed by ANSTO, in conjunction with ARPANSA, prior to implementation.

Assessment of compliance

Australia has in place the appropriate regulatory and operational framework to ensure the safe operation of its spent fuel management facilities.

Article 10 Disposal of spent fuel

No Australian spent fuel is designated for direct disposal in Australia. However, Commonwealth government legislation and ARPANSA's licensing system require that where spent fuel is designated for disposal, it will be handled as radioactive waste from the point in the nuclear fuel cycle where it is no longer regarded as spent fuel.

Currently it is anticipated that all spent fuel managed in Australia by ANSTO will be transported overseas for either reprocessing or long-term storage and/or disposal, and thus will be regarded as spent fuel until it enters the off-shore jurisdiction.

Assessment of compliance

Australia has in place arrangements to ensure the safe disposal of spent fuel.

Section H – Safety of Radioactive Waste Management

Article 11 General safety requirements

Measures to ensure criticality and removal of residual heat

Criticality is considered in guidance provided by the *Safety Guide for the Predisposal Management of Radioactive Waste* published by ARPANSA in September 2008. The guidance advises that if fissile material is present in laboratory or medical waste, the potential for criticality should be evaluated and eliminated by means of design features and administrative controls.

In practice, radioactive materials currently in storage with the States and Territories are mostly low level and hence not subject to consideration of criticality and removal of residual heat. At present, Australia does not have radioactive wastes that contain sufficient quantities of fissile material for criticality to be a consideration.

Heat removal and criticality is catered for in the design and operation of relevant facilities. For example, all steps in waste management are subject to ANSTO's internal safety management processes. Those safety management processes consider all factors relevant to safety, including criticality and heat generation. In addition to the safety management processes, residual heat and criticality are also catered for in facility design.

ARPANSA licenses and routinely inspects the waste management operations at ANSTO. In addition, the safety of these facilities is optimised by the operator through ANSTO's internal review processes, including inspections, evaluation of performance and criticality certification systems.

Measures to ensure minimum practical generation of radioactive waste

Regulatory guidance on management of radioactive waste, in particular the *Recommendations for Limiting Exposure to Ionizing Radiation (ARPANSA 1995),* is used by waste producers to achieve compliance with mandatory Australian requirements.

The *Safety Guide for the Predisposal Management of Radioactive Waste* published by ARPANSA in September 2008, advises that all processes that generate waste should be assessed before commencement and that regular reviews should be undertaken to determine if the amount of radioactive waste can be reduced by changes in process design or operational procedures.

In facility design, the guidance advises that the following aspects for waste minimisation should be considered:

- selection of materials, processes and structure, systems and components for the facility;
- selection of design options that favour waste minimisation during operations and when the facility is eventually decommissioned;
- use of effective and reliable techniques and equipment; and
- clear demarcation of zones and equipment potentially containing radioactivity to prevent spread of contamination.

During operations, the guidance advises that the following aspects be considered:

- segregating the different types of radioactive waste (e.g. long-lived alpha emitting waste, short-lived beta/gamma waste, waste with very low concentrations of radioactivity, concentrated liquids, low concentration liquids) if this segregation optimises subsequent treatment and conditioning steps;
- minimising the amount of non-radioactive material used in controlled areas to prevent contamination and generation of additional waste;
- keeping non-radioactive wastes well separated from radioactive waste in a controlled area. Non-radioactive waste should be checked before being removed from a controlled area to confirm it is non-radioactive;
- planning activities and the use of equipment for handling waste to limit generation of secondary radioactive waste;
- decontaminating equipment and materials to minimise the volume of waste that is radioactive, together with control of secondary waste arising from decontamination; and
- recycling and reusing materials and structures, systems and components that are potentially contaminated.

Waste contaminated with radionuclides of short half-life can be collected and stored until the radioactivity decays sufficiently to meet exemption levels adopted by all jurisdictions in their legislation, as detailed in the *National Directory for Radiation Protection.*

In most jurisdictions, licensees are required to prepare plans for the management of waste. These plans also address the processes by which the generation of radioactive waste is minimised.

At ANSTO, waste minimisation practices include segregation of wastes at the source (radioactive from non-radioactive) to reduce the potential for cross-contamination; waste exemption process to allow for free-release of exempt level waste and the separation of short-lived from long-lived wastes to allow for delay and decay.

Measures to take into account interdependencies

Interdependencies have been carefully considered in the development of the *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA 2008). The guidance includes consultation with responsible personnel and organisations. The interdependencies have also been considered in the development of annexes in the Safety Guide for the six typical categories of waste generated in Australia: devices containing low levels of long-lived alpha emitters; devices containing higher levels of long-lived alpha emitters; disused sealed sources of low activity (<100 MBq) and gaseous tritium light sources; disused sealed sources of higher radioactivity (>100 MBq); laboratory and medical waste; and residues from industrial processing and waste from remediation of contaminated sites.

ANSTO has in place procedures for clearances and certification between each step in radioactive waste management.

Internationally consistent radiation protection legislation

The legislative systems in place in Australia, described in *Section E: Legislative and Regulatory System*, underpin the process of minimizing the risk of harm to individuals, society and the environment from exposures to ionizing radiation that result from the management of radioactive waste. These systems are based on the documents *Recommendations for Limiting Exposure to Ionizing Radiation* and the *National Standard for Limiting Occupational Exposure to Ionizing Radiation (ARPANSA, 1995 - republished 2002)* which are in turn consistent with the *Basic Safety Standards* (1996) and ICRP 60 (1990).

Other subordinate legislative measures used to control exposures include conditions of licence based on national guidance. These conditions often refer to codes of practice in relation to the near surface disposal of radioactive waste (*Code of Practice for the Near Surface Disposal of Radioactive Waste (NHMRC 1992)*) and the disposal of very low level radioactive waste by the user (*Code of Practice for the Disposal of Radioactive Wastes by the User (NHMRC 1985)*).

The Near Surface Disposal Code defines three categories of waste that can be disposed of by near surface disposal:

- Lightly contaminated items such as protective clothing, laboratory equipment, plastic etc.;
- Shielded sources and small items of contaminated equipment; and
- Bulk materials such as contaminated soils or large individual items of contaminated plant.

Waste that is unsuitable for near surface disposal must be stored pending disposal at depth or disposal following a suitable period of decay.

Discharge of very low level radioactive waste to the air or sewer usually takes place as part of an on-line operation such as in the preparation and dispensing of radionuclides. Incineration is not commonly used in Australia and is usually reserved for biological waste, such as animal carcases contaminated to low levels with radionuclides of low radio-toxicity. Little radioactive residue is usually left in the ash, which is monitored and disposed of according to licence conditions[15].

Currently, the regulatory requirements for discharge of very low level radioactive materials vary between jurisdictions. In some jurisdictions, discharge limits for airborne and waterborne radionuclides are given in schedules in regulations; in other jurisdictions specific conditions of licence are used to regulate these emissions. The schedules are usually based on the criteria that the dose to any member of the public at the point of discharge should not exceed the dose limit for members of the public. Some of the regulations, however, predate the ICRP 60 recommendations, which were adopted in Australia in 1995, and the ICRP Lung Model described in ICRP 66, and as such are not current with respect to current dose conversion factors and public dose limits.

Australian regulators are in the process of replacing the Code with a new schedule in the *National Directory for Radiation Protection (ARPANSA 2004)* which will update levels by

[15] A copy of the Code of Practice for the Disposal of Wastes by the User is available at www.arpansa.gov.au/pubs/rhs/rhs13.pdf

introducing disposal and discharge limits for radionuclides that were not in use at the time of writing the 1985 Code and will bring other provisions up to date in terms of current exposure models. Once the schedule has been agreed to by all the governments of Australia, it will be adopted into existing regulatory frameworks in each jurisdiction.

Assessment of biological, chemical and other hazards

As mentioned above, regulatory guidance on management of radioactive waste is used by waste producers to achieve compliance with mandatory Australian requirements.

The *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA, 2008), published by ARPANSA in September 2008, advises that the radioactive waste management plan, safety assessment and management system include consideration of the physical, chemical and/or biological characterisation of waste.

The Safety Guide also advises that the design and operation of facilities for the predisposal management of radioactive waste should take into account any potential hazards due to other non-radioactive physical, chemical or biological characteristics of the waste. Protection from non-radiological hazards should be provided in accordance with the relevant standards on health and safety and environmental protection.

In the case of a near-surface disposal facility, the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that an assessment of the likely behaviour of the waste in the geochemical environment of a disposal facility be undertaken. The Code requires the following:

- treatment of waste containing inorganic acids, alkalis and corrosive salts to neutralise the chemical effect; radioactive waste must not contain corrosive materials;
- separation and packaging of flammable or combustible materials from non-flammable solids;
- avoidance of waste containing or capable of generating gaseous materials in quantities which might lead to the release of harmful vapours or fumes or compromise the integrity of the facility;
- exclusion of waste containing material that readily detonates upon impact, decomposes explosively, reacts violently with water or undergoes vigorous exothermic reaction;
- treatment, conditioning or packaging of waste containing pyrophoric material;
- solidification of liquid waste to ensure compliance with the stability requirements for the category of waste;
- avoidance of including biological materials in the waste;
- treatment or conditioning of waste contaminated with toxic, pathogenic or infectious material to minimise both the potential hazard for occupationally exposures and long-term public exposures; and
- treatment or conditioning of wastes containing chelating agents to reduce effects of leaching by water.

Avoiding greater and undue burdens on future generations

As part of the application of the optimisation principle, the *Recommendations for Limiting Exposure to Ionizing Radiation* (ARPANSA, 1995) states that the risks to individuals in the case of potential exposures should be managed so as to limit the inequity likely to result from the inherent economic and social judgements. This requirement extends not just to the current generation but also to future generations.

'Burden on future generations' is taken into account in the decision on whether or not to give the applicant a licence to operate or use the facility, equipment or material. Some jurisdictions require that responsible persons must have adequate measures in place before they can acquire a radioactive source. These measures include an appropriate facility to store the source, measures in place to relocate or dispose of the radioactive source, return of sealed sources to supplier as a condition of licence, or demonstration of the optimisation principle for the proposed application. Other jurisdictions have a strategy for the sustainable management of radioactive waste within their jurisdiction.

In the case of Western Australia, a disposal facility has been established for waste generated within the jurisdiction. This minimises the potential risk for future generations arising from orphan sources.

Assessment of compliance

Australia's compliance in terms of requiring producers to minimise waste production is largely dependant on national regulatory guidance and any specific licence conditions. Inconsistencies across jurisdictions in the provision of disposal facilities is a weakness in terms of meeting the requirement to reduce the burden on future generations. There is also a weakness in our regulatory framework in failing to specifically address the need to reduce the undue burden on future generations by requiring the minimisation of the waste produced.

Article 12 Existing facilities and past practices

Review of safety

Existing radioactive waste management facilities are licensed under the regulatory system of the jurisdiction in which they are located. Existing legislation allows for inspections of facilities to be performed in accordance with specified criteria. Should this review of safety reveal that a facility requires upgrading, then licence conditions may be amended to instigate facility improvements.

The disposal of radioactive wastes at the Mt Walton East facility in Western Australia has been regulated by the radiation regulator since 1992. The site was chosen based on criteria in the IAEA publication, *Site Investigation for Repositories for Solid Radioactive Waste in Shallow Ground, Technical Report Series No. 216 (1982)*. All aspects of the design, operational requirements, duties and responsibilities must comply with the Western Australian legislation and the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (NHMRC 1992)*. Radiation monitoring at the disposal facility is carried out in accordance with documented commitments given to the regulator. Monitoring includes absorbed dose rates in the air above the disposal sites, radon monitoring, water monitoring

and pre- and post-disposal monitoring. Personnel monitoring is carried out during a disposal campaign.

In South Australia, the Radium Hill Low-Level Radioactive Waste Repository was operated by the State Government from 1981 to 1998. The material disposed at this repository was naturally occurring radioactive materials from mining and mineral processing operations conducted in South Australia. The site was registered as a repository in 2003 under the South Australian *Radiation Protection and Control Act (1982)* and conditions were attached to the registration to permit development of an appropriate long-term management plan for the site. A preliminary risk assessment on the site was performed in 2004. The assessment showed dose levels well below the public dose limit of 1 mSv/year[16].

Also in South Australia, the Port Pirie Treatment Plant, which is a legacy site, is regulated as a radioactive waste management facility by the South Australian radiation regulator.

The site known formerly as the British Atomic Weapons Test Site at Maralinga in South Australia was rehabilitated through the 1990s and licensed to possess and control radioactive material by ARPANSA in 30 October 2000. The site is subject to periodic review of environmental and public safety.

In the Northern Territory, the tailings dams for the storage of waste at the Ranger uranium mine forms part of the authorisation to operate. The mine has been in operation and regulated since the 1980's. The *Mining Management Act 2001(NT)*, requires operators to use best practice as a consequence companies have used the ARPANSA *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005) to demonstrate to the mining regulator best practice in protecting the environment. For ensuring safety of the occupational exposed persons at the site, the Code is used as a regulatory tool by the occupational health and safety regulator. Offsite impacts of the operation including public exposures, are monitored by the statutory officer of the national department for the environment – the Supervising Scientist.

The tailings dams at the Olympic Dam Uranium mine site have been discussed earlier in this report.

Review of past practices

In this report, the term 'past practices' is taken to refer to radioactive waste management facilities that were not under regulatory control at the time the Joint Convention entered into force for Australia on 3 November 2003.

From 1960 to 1968, ANSTO operated a near-surface disposal site for radioactive waste (Little Forest Burial Ground) near the boundary of the site. Since closure in 1968, this site has been continuously under care and maintenance, inspection and monitoring. Monitoring results continue to demonstrate the adequacy of the facility; however, its eventual decommissioning is being considered as part of the overall decommissioning strategy for the ANSTO facilities and operations. Monitoring results are provided to ARPANSA and published annually in the ANSTO Environmental Report.

[16] www.pir.sa.gov.au/__data/assets/pdf_file/0016/10825/rb2004_009_radium_hill.pdf

There were a number of uranium mines in the Northern Territory and Queensland abandoned in the past. These sites have been rehabilitated and continue to be monitored. More detailed information in relation to the history if these sites can be found in Annex D.

Assessment of compliance

Subsequent to the entry into force of the Joint Convention in Australia, a number of the sites subject to this Article have undergone remediation works and been brought within the regulatory licensing system.

Article 13 Siting of proposed facilities

Since Australia's last national report, there have not been any new facilities, legislative requirements or mandatory standards for the siting of radioactive waste management facilities.

Evaluation of relevant site-related factors

There is a separate national regulatory framework[17] for environment protection established under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), which is binding on all jurisdictions. The actions taken that might affect the environment include 'nuclear actions' (defined in the Act). If a person refers a proposed 'nuclear action' to the Commonwealth government Minister for the Environment, and the Minister decides that the proposed action requires approval, a process for assessment such as an environmental impact assessment must be carried out.

Proposed radioactive waste management facilities require approval for siting according to the legislative and regulatory systems of the jurisdiction applicable to the site of the facility. That is, if the site is to be operated by or on behalf of the Commonwealth, then ARPANSA will be the regulator regardless of the location.

Legislative requirements in the selection of a site for a proposed facility are based on the national *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992). This code of practice details the general characteristics of a site suitable for the establishment of a radioactive waste management facility, the criteria for site-selection and the need for a public consultation process. The code sets out selection criteria for site characteristics that will facilitate the long-term stability and provide adequate isolation of the waste. The criteria include socioeconomic, ecological and land use factors as well as natural physical characteristics.

As mentioned under Article 12, the site of the Mt Walton East disposal facility in Western Australia was established in 1992 based on criteria in the IAEA publication, *Site Investigation for Repositories for Solid Radioactive Waste in Shallow Ground, Technical Report Series No. 216 (1982).*

ANSTO has a large radioactive waste management facility. Although that facility has been in operation for many years, new components are subject to separate environmental impact and

[17] Further information on this framework is available at www.ea.gov.au/epbc/index.html.

regulatory processes. For example, the waste treatment and packaging facility was subject to environmental impact assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and to safety assessment processes under the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth).

Impact on safety of people and the environment

The purpose of an environmental assessment is to bring together all the information on the impacts that a proposed action would have on matters protected by the EPBC Act, to ensure that the Minister makes an informed decision on whether or not to approve the action. The regulatory framework established under the Act is distinct from that established under the *Australian Radiation Protection and Nuclear Safety Act 1998,* in that the former is limited to assessing and authorising the impact of an action on the environment (the latter covers people **and** the environment).

Under the ARPANS legislation, separate authorisation is required for closure of a waste management facility.

In the case of a near-surface disposal facility, the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) includes radiation protection considerations in accordance with the objective to establish a waste facility that isolates the radioactive waste to ensure there is no unacceptable health risk to humans, and no long-term unacceptable detriment to other biota and the environment from the operation of the facility or following its closure. The radiation protection considerations are based on the justification, optimisation and limitation radiation protection principles. Dose limits are applicable to personnel employed at the disposal facility and any member of the public inadvertently exposed during operations or during the institutional control period.

Availability of information to the public

Public consultation would be undertaken as part of the environmental approval process and the regulatory licensing process. Consultations with the relevant jurisdictions would take place as part of public consultation.

Referrals under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) and any subsequent environmental impact assessments/statements are released for public comment as part of public consultation by the Minister for the Environment.

Licence applications to ARPANSA for the siting of a radioactive waste management facility may also be subject to public consultation. This entails release of the application for public comment and the requirement for the CEO of ARPANSA to take into account the content of public submissions in deciding whether to issue a licence.

Consultation with other Contracting Parties

It is not foreseen that Australian waste management facilities would have impacts on other Contracting Parties that would require consultation.

Avoiding unacceptable effects on other Contracting Parties

As stated, it is not foreseen that Australian waste management facilities would have impacts on other Contracting Parties.

Assessment of compliance

As there have been no new facilities or legislative requirements, Australia remains compliant with Article 13.

Article 14 Design and construction of facilities

Since Australia's last national report, there have not been any new facilities, legislative requirements or mandatory standards for the design and construction of radioactive waste management facilities.

Limiting possible radiological impacts

In each Australian jurisdiction, the radiological impact of the design and construction of a radioactive waste management facility are examined as part of the licensing process for the jurisdiction in which the facility is to be located. For a proposed facility, all design and construction-related, legislated, technical and safety requirements need to be met. Under the legislative system, conditions can be imposed to require, for instance, the use of 'best practicable technology' and the preparation of technical provisions for the closure of the facility.

Facilities that are designated 'nuclear actions[18]' would also be subject to the Commonwealth legislation, the *Environment Protection and Biodiversity Conservation Act 1999,* and require the approval of the Commonwealth Minister for the Environment.

In the case of a near-surface disposal facility, the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) sets out mandatory requirements for the facility design which include packaging of waste, structural parameters, engineered barriers, cover specifications, backfill, surveying, water management, drainage, waste parameters, buffer zone and restricted occupancy zone.

Each jurisdiction has discharge limits set out in legislation, as conditions of licence, or as part of mandatory management plans. As mentioned previously, Australian regulators are in the process of harmonising discharge limits for very low level radioactive wastes.

Provision for decommissioning allowed in design

At the design stage of a waste management facility, plans and other provisions for decommissioning of the facility are only in the preliminary stages of development and are revised and updated as the facility moves through the licensing stages.

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[18] *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999* Subdivision E – Protection of the environment from nuclear actions.

Technical provisions for closure of disposal facility

In the case of a near-surface disposal facility, the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that prior to commencement of operations, the operator prepare draft or conceptual plans for decommissioning of the facility and rehabilitation of the site and that these plans be submitted for approval. The plans are required to be reviewed and resubmitted every five years for approval.

The Code also stipulates that approval for ceasing operations must be applied for at least three years prior to the proposed closure date. Detailed plans for the decommissioning of the facility and for rehabilitation must also be submitted at this time.

Validation of technologies for design and construction

The technologies incorporated in the design and construction of a radioactive waste management facility must be supported by proven design, experience, testing and analysis.

In the case of a near-surface disposal facility, the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that the structure be constructed in accordance with best engineering practice.

In the case of uranium mining operations, the *Code of Practice & Safety Guide on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005), requires the use of 'best practicable technology' as part of the approved Radioactive Waste Management Plan, to ensure the release of radioactive material is minimised and to provide for the protection of people and the environment from the possible harmful effects of the associated mining and milling operations.

Assessment of compliance

As there have been no new facilities or legislative requirements, Australia remains compliant with Article 14.

Article 15 Assessment of safety of facilities

Safety and environmental assessment requirements

As part of legislative and regulatory requirements, an assessment of safety and environmental impact of a proposed radioactive waste management facility is required for approval before construction of the facility can commence. If deemed necessary by the relevant regulatory authority, the assessment of safety and environmental impact may be reviewed and updated prior to the operation of the facility. Regulators would also consider security in addition to safety.

As indicated earlier, ANSTO's waste management facilities are subject to licensing processes under the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth) and to internal safety review in accordance with the requirements of the ANSTO safety system.

In the case of a near-surface disposal facility, the national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires the proponent to submit to the regulatory authority a detailed analysis of the design and operation of the facility and an assessment of the projected long-term integrity of the site after closure. A safety analysis subject to independent technical audit is also required of the proponent. The safety assessment must:

- identify pathways through which radionuclides could be released during the operation of the facility or after its closure;
- include a quantitative treatment of scenarios for inadvertent intrusion after institutional control;
- demonstrate that protection of humans is optimised;
- demonstrate that potential radiation exposure is below prescribed limits in the Code;
- estimate the probability of the occurrence of the exposure scenarios; and
- provide justification of any probability less than one for the identified scenarios.

Post-closure safety and environmental assessment requirements

In the case of a near-surface disposal facility, the national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that site rehabilitation plans must include the proper provision of site markers and that exclusion barriers are to remain for the duration of the institutional control period. Following the institutional control period, the Code also requires removal of all superfluous surface structures which may encourage occupation of the site. The operator is required to remain responsible for the site and all necessary site rehabilitation work until the work has been approved by the regulator.

The Code requires the regulator to ensure that a program of surveillance involving site inspections and environmental monitoring be carried out during the institutional control period and that the historical records of the waste disposed are maintained. This includes the location and purpose of the disposal site being marked on land titles as caveats or mentions for the institutional control period. The perimeter fence and site markers must also be maintained during the institutional control period.

Review of safety and environmental assessments prior to operation

In the case of a near-surface disposal facility, the national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires the establishment an environmental management plan prior to commencement of construction and operation of a near-surface disposal facility, and a radiation management plan prior to commencement of disposal operations. Both plans must be reviewed approximately every three years during the period of operation and the review must be reported publicly.

The radiation management plan includes personnel training, personnel monitoring, maintaining records, monitoring within the operational area of the facility, designation of areas of potential radiation exposure, emergency preparedness, contamination control and protective clothing and apparatus.

Assessment of compliance

Ongoing regulatory reviews and independent audits against national and licence requirements verify Australia's ongoing compliance with Article 15.

Article 16 Operation of facilities

Basis of licensing decision

A licence to operate a radioactive waste management facility is required prior to operation of such a facility. The regulatory authority would not grant the licence until, amongst other requirements, it had been demonstrated that the proposed facility meets the requirements for design and construction, and an assessment of safety and environmental impact had been undertaken. Additional licence conditions can be imposed as required. For instance, conditions could be imposed to cover the reporting of significant safety incidents to the regulatory authority. As indicated earlier, ANSTO facilities are subject to ongoing licensing processes under the *Australian Radiation Protection and Nuclear Safety Act 1998* and to internal safety review in accordance with the requirements of the ANSTO safety system.

Definition and revision of operational limits and conditions

In the case of a near-surface disposal facility, the national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) provides generic activity concentration limits for a range of radionuclides at concentrations categorised as low level waste and short-lived intermediate level waste. These limits are applicable to a remote arid site and based on institutional control periods of 100 and 200 years. In practice, values will be derived for a specific disposal site using data for environmental parameters and exposure scenarios particular to that site.

The *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) also specifies requirements for treatment, packaging and conditioning of waste, transport, disposal operations, environmental and radiation management and emergency response plans, and records and inventory keeping.

The *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA, 2008) includes generic waste acceptance criteria for the disposal of radioactive waste in near-surface and deep borehole facilities. The Safety Guide advises that if a disposal facility is not established and the waste acceptance criteria are not known, an assessment should be undertaken to determine the type of disposal appropriate to the particular waste stream and an estimate made of the range of likely waste acceptance criteria for that type of disposal.

Procedures for operation, maintenance, monitoring, inspection and testing

The regulatory authority in each jurisdiction conducts a risk-based routine program of radiation safety monitoring to assess a person's compliance with the legislation and their level of radiation safety. These monitoring activities may lead directly to investigations and inspections and consequent enforcement activities when breaches of the relevant legislation have been identified.

Inspections and investigations are formal regulatory functions which may only be conducted by an appointed inspector. Inspectors also have a number of prescribed powers for example, issue of prohibition notices and improvement notices; seizure of radiation sources; and the ability to take emergency actions.

The legislation in each jurisdiction contains reporting requirements on matters such as abnormal or unplanned exposure to radiation, radiation sources not in control, damage or malfunction of a source of radiation, loss or theft of a source of radiation, contamination by a radioactive substance, unintentional or accidental release of a radioactive substance, and corrective actions taken.

In Western Australia, appropriate safety measures must be outlined in the radiation management plan. The safety of the Mt Walton East Intractable Waste Disposal Facility is assessed regularly, as required by the conditions of registration, in particular the requirements for a technical auditor and the ongoing requirement for monitoring.

Availability of engineering and technical support

The issuing of a licence to operate a radioactive waste management facility takes into account the availability of engineering and technical support during the operating lifetime of the facility.

ARPANSA has prepared regulatory guidance[19] for applicants of licences for near-surface disposal facilities and storage facilities. The guidance advises that applicants should describe in detail the knowledge, skills and experience of the operator of the proposed facility for the initial campaign and the requirements that will be placed on operators for subsequent campaigns.

Waste characterisation and segregation procedures

The *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA, 2008) advises on approaches to the characterisation and segregation of waste and suggests segregation on the basis of half-life into three categories consistent with the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992):

- short-lived material with half-life less than six years;
- medium-lived material with half-life more than six years but less than 40 years; and
- long-lived material with half-life more than 40 years.

The Safety Guide also advises that waste can be segregated on the basis of the level of radioactivity and the radiotoxicity of the radionuclides present based on the exemption levels used in the *National Directory for Radiation Protection* (ARPANSA, 2004). Alpha emitting waste can also be segregated from low or non-alpha emitting waste. Non-radiological considerations for segregation are also discussed.

[19] ARPANSA Regulatory Guidance for Radioactive Waste Management Facilities: Near-surface Disposal Facilities; and Storage Facilities 2006

The *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA, 2008) also provides specific advice on the management of wastes typical to Australia's current waste inventory.

Reporting of incidents significant to safety

The *National Directory for Radiation Protection* (ARPANSA, 2004) specifies the types of incidents that must be reported to ARPANSA for compilation in the Australian Radiation Incident Register. The types of radiation incidents relevant to waste management facilities to be reported to the register include:

- incidents that cause or may lead to radiation injuries or radiation doses exceeding the annual dose limits to workers or members of the public;
- unintentional or unauthorised discharges of radioactive materials into the environment;
- nuclear incidents such as criticality incidents; and
- other incidents that the regulator considers warrant reporting.

Australian regulators all require licensees to report incidents significant to safety. For example, a licence holder subject to the *Australian Radiation Protection and Nuclear Safety Act 1998* must comply with the following statutory conditions set out in the Regulations to the Act:

(i) The licence holder must investigate suspected breaches of licence conditions. If a breach is identified, the licence holder must rectify the breach and any of its consequences as soon as reasonably practicable. The licence holder must also inform the CEO of ARPANSA about the breach as soon as reasonably practicable.

(ii) The licence holder must take all reasonably practicable steps to prevent accidents involving controlled material, controlled apparatus or controlled facilities described in the licence. If an accident happens, the licence holder must take all reasonably practicable steps to control the accident, minimise its consequences (including injury to any person and damage or harm to the environment), tell the CEO about the accident within 24 hours of it happening and submit a written report within 14 days.

In accordance with the Act and Regulations, incidents are reported[20] to the Parliament in ARPANSA's quarterly reports.

Collection and analysis of operating experience

In accordance with Regulation 63, ARPANSA has published guidelines on how licence holders should report their compliance with the Act, the Regulations and licence conditions.

In South Australia mining and mineral processing operations that are registered or licensed under the *Radiation Protection and Control Act 1982* (SA), are required to provide the regulator periodic assessment and review of operational experience. Both quarterly and annual reports are provided by the mining operations. These reports provide detailed

[20] These reports are available on the web at http://www.arpansa.gov.au/AboutUs/Corporate/quarterlyreports.cfm.

information about the waste management activities including the qualities of wastes (both solid and liquid) in storage or disposed during the relevant reporting period.

Preparation and update of decommissioning plans

The *Safety Guide for the Predisposal Management of Radioactive Waste* (ARPANSA, 2008) recommends that decommissioning be considered in the design of facilities to be used for the predisposal management of radioactive waste. The complexity of this consideration should be commensurate with the facility's size and operations. The Guide advises that design options and operating practices that will facilitate decommissioning should be chosen and a decommissioning plan that can be updated during the life of the facility should be prepared.

Uranium mines and production facilities are required under the ARPANSA *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)* to submit a mine management plan or equivalent addressing all facets of mine management including decommissioning and site rehabilitation.

There are former uranium mining facilities at Rum Jungle and Nabarlek (Northern Territory), Radium Hill (South Australia), and Mary Kathleen (Queensland). Each have been decommissioned and the sites rehabilitated to the extent possible at the time – Nabarlek has been fully rehabilitated.

In New South Wales, a storage facility for radioactive materials has been decommissioned by the NSW radiation regulator since Australia's last 2005 report in 2005. Records relating to the facility have been preserved. Monitoring controls have not been required as all radioactive materials were removed and the site decommissioned. Radioactive materials within the store were repackaged and relocated to a purpose built multi-function facility. No unplanned releases occurred during decommissioning.

Preparation and update of closure plans for disposal facility

The national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that prior to the commencement of operations, the operator must prepare draft or conceptual plans for decommissioning the facility and rehabilitating the site, and submit the plans to the regulator for approval. The plans must be reviewed and resubmitted every five years for approval.

The Code also requires that at the end of the institutional control period, the status of the site must be reviewed to determine whether any further management or control should be instituted.

Assessment of compliance

Australia meets Article 16 in terms of formal compliance with the relevant legislative and subordinate regulatory measures such as guidance. However, due to the limited number of relevant facilities to which this framework is applicable, its effectiveness has not been tested.

Article 17 Institutional measures after closure of disposal facility

Maintaining records

The national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires that detailed records be kept by the operator and the regulator of all waste consigned and received at the facility. For each shipment, the waste generator, the type of waste, its volume and weight, and the nature and concentration of the radionuclides in the waste must be recorded. All data from environmental and area monitoring at and around the facility must also be retained.

The Code also stipulates that site records must be kept at least until the end of the institutional control period in two widely separated locations, one of which must be the government archives of the relevant jurisdiction and must include:

- location of any disposal structures;
- location of the waste packages or containers within the structures and the date of their emplacement;
- details of the contents of waste packages or containers; and
- details of the backfilling and cover materials.

Records of the location, design and inventory of radioactive wastes at the former Radium Hill uranium mine ('Radium Hill Uranium Mine and Low-Level Radioactive Waste Repository') and Port Pirie Treatment Plant sites will be preserved by the South Australian radiation regulator and the owner of the sites, the South Australian Government Department of Primary Industries and Resources. The South Australian regulator will ensure that the records relating any other such facilities in the State are preserved.

Conduct of institutional controls

As mentioned under Article 15, the national standard *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992) requires the regulator to ensure that a program of surveillance involving site inspections and environmental monitoring be carried out during the institutional control period and that the historical records of the waste disposed are maintained. This includes the location and purpose of the disposal site being marked on land titles as caveats or mentions for the institutional control period. The perimeter fence and site markers must also be maintained during the institutional control period.

The institutional control period must be at least 100 years and can only end with the approval of the relevant regulatory authority. In addition, licence conditions may be imposed in certain instances. For example, licence conditions requiring post-closure environmental monitoring were imposed in the licence to authorise rehabilitation of the Maralinga atomic weapons test site.

As mentioned under Article 12, ANSTO has one closed facility (Little Forest Burial Ground) that was used for disposal of radioactive material between 1960 and 1968. This facility is secure and is routinely monitored for ground water and airborne and surface contamination. The results are publicly available in the annual ANSTO Environmental and Effluent Monitoring report.

Intervention measures

Any unplanned releases of radioactive materials into the environment that are detected during the institutional control period would trigger regulatory assessment of any impacts followed by intervention measures and changes to the control procedures as required.

Regulatory controls over the Radium Hill and Port Pirie sites, and any other facilities in South Australia after closure, will require appropriate monitoring and access restrictions to be maintained, and intervention measures to be undertaken if unplanned releases of material to the environment are detected.

Assessment of compliance

A program of on-going monitoring, assessments and audits of closed disposal sites has verified Australia's continuing compliance with Article 17.

Section I – Transboundary Movement

Article 27

Requirements as a state of destination

Australia prohibits the import of radioactive substance including radioactive waste unless permission in writing to import the substance has been granted by the Commonwealth government (Commonwealth) Minister for Health or an authorised officer within ARPANSA. The Regulation defines 'radioactive substance' as any radioactive material or substance, including radium, any radioactive isotope or any article containing any radioactive material or substance.

Requirements as a state of origin

Australia only permits the export of a few specific types of radioactive material. This export of radioactive materials requires authorisation from the relevant Commonwealth government (Commonwealth) Minister in the following circumstances: for the export of radioactive waste to Pacific Island states; for the export of high activity sources; and for the export of fertile and fissile materials.

Prohibited destinations

Since the 2005 National Report, Australia has amended the Customs Regulations to also prohibit the export of source material, most special fissionable material and other fissionable materials (in accordance with the Code of Conduct) without the prior written permission of the Commonwealth government Minister for Resources and Energy.

The export of all fissile and fertile material such as uranium ores also requires authorisation.

The prohibited export of radioactive waste to the Pacific Island Developing Countries is specified in Regulation 13G of the Customs (Prohibited Exports) Regulations 1958 unless permission in writing to export the radioactive waste has been granted by the Minister for Resources and Energy. The Regulation defines 'radioactive waste' as waste consisting of material that emits ionising radiation as a result of the spontaneous transformation of the nucleus of the atom but does not include material that has an activity concentration below 1 Becquerel per gram or an activity below 1000 Becquerel.

Return to manufacturer

The Commonwealth government, state and territory jurisdictions allow the transboundary movement of disused sealed sources for return to the manufacturer. These movements must comply with all relevant legislative and regulatory requirements, and are covered by the ARPANSA *Code of Practice for the Safe Transport of Radioactive Material* (ARPANSA, 2008) which follows the IAEA Transport Requirements.

Assessment of compliance

Australia has adequate controls for import of radioactive materials including radioactive waste, but only controls the export of radioactive waste if it:

- contains nuclear material;
- consists of one or more high activity radioactive sources as defined in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources; or
- is destined for Pacific Island states.

Section J – Disused Sealed Sources

Article 28

Legislative requirements for dealing with disused sealed sources

The focus of Australia's regulatory control over disused sealed sources is through a requirement on the owner of the source to have a confirmed arrangement with the supplier for the return of the source at the end of its useful life.

Australia operates a radioactive material import control scheme under the Customs (Prohibited Imports) Regulations 1958 (Cth)[21]. The scheme is administered by ARPANSA in conjunction with the Australian Customs Service and State and Territory radiation protection regulators. The Regulations allow ARPANSA to attach conditions to a permission given to import a radioactive material. In addition to other conditions that might be placed on the permission, the person importing the material must inform the radiation protection regulator in the State or Territory that the imported material will reside, of the possession or intent to possess the material; and undertake not to resell or lease or hire or otherwise part with the possession or custody of the material without prior notification of the appropriate statutory authorities.[22]

ARPANSA has delegated powers from the Minister for Health to issue export permissions for the export of high activity radioactive sources from Australia, including sources which are designated as radioactive waste. These permissions are issued under Regulation 9AD of the Customs (Prohibited Exports) Regulations 1958 (Cth). In order to export a high activity radioactive source, the exporting party is required to present to the Australian Customs Service a valid ARPANSA Export Permit signed by an authorised ARPANSA officer. The export control has been introduced to satisfy Australia's commitment to the International Atomic Energy Agency's Code of Conduct on the Safety and Security of Radioactive Sources.

The Australian Customs Service operates radiation monitors at various entry points into Australia. Monitors are also maintained at the Lucas Heights Science and Technology Centre (which houses ANSTO, one of the major holders of sources in Australia), and scrap metal merchants.

Re-entry of disused sources

Sealed radioactive sources are manufactured by ANSTO and sources are re-furbished in a number of jurisdictions and exported to other states and overseas. In each jurisdiction, possession of sealed sources (used or disused) requires a licence. Each jurisdiction allows the re-entry of disused sealed sources or devices containing sealed sources, under legislative and regulatory control and with the manufacturer's approval and Customs approval, provided that

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[21] A copy of the Regulations may be downloaded at http://www.comlaw.gov.au/comlaw/management.nsf/lookupindexpagesbyid/IP200400519?OpenDocument

[22] Further information on the import control schemes can be found at http://www.arpansa.gov.au/Regulation/Permits/index.cfm.

the source and/or device was manufactured within the jurisdiction and that the sealed source is ultimately to be returned to the manufacturer for recycling or disposal. Each jurisdiction requires that such manufacturers be licensed and have approved procedures in place for the management of sealed sources that are returned to them.

Assessment of compliance

Australia has adequate controls for re-entry of disused sealed sources.

Section K – Planned Activities to Improve Safety

A national audit was performed of radium legacy wastes in 2007. Most of the radium was from medical applications and from the luminising industry. Ultimately the intention is to condition and centrally store all this waste until a suitable disposal facility becomes available.

Also nationally, a revised schedule for the *National Directory for Radiation Protection* that will update limits for disposal and discharge of radionuclides is being adopted by Australian jurisdictions that will update limits for disposal and discharge limits for radionuclides.

As mentioned earlier in the report, the new Commonwealth Government is reviewing all aspects of Australia's long-term radioactive waste management policy.

As reported in the 2005 national report, the South Australian radiation regulator completed a comprehensive audit of the storage and management of radioactive material in South Australia. The report on the audit contained recommendations for improvements in the storage and management of radioactive waste. Many of the recommendations related to the safe storage and containment of radioactive material and were addressed in the normal course of regulatory operations.

In response to the recommendations concerning the future management of the South Australia's radioactive waste, the South Australia Government endorsed a study of the feasibility of establishing a state-owned radioactive waste store and repository, which included a limited assessment of Radium Hill and Olympic Dam as options for the store and repository. The study found that sites exist at both Olympic Dam and Radium Hill that appear suitable for the store and repository and recommended implementing the store and repository at either site. The Olympic Dam region had a number of advantages over Radium Hill. The main advantages were better security and infrastructure, and availability of skilled staff.

In December 2005, the South Australian Government announced its intention that an interim store and repository would be located in the Olympic Dam region. The facilities would be outside the Olympic Dam uranium mine lease area.

The South Australian regulator is working with other government agencies regarding the requirements and options for implementation of the interim store and repository.

In Tasmania, the *Radiation Protection Act 2005 (Tas)* permits disposal in accordance with the *Code of Practice for the Disposal of Radioactive Waste by the User (1985)* and/or a licence. An audit of all radioactive waste will be conducted in due course. The storage location for radioactive materials under Tasmanian government control has been further upgraded and complies with relevant requirements.

The Queensland government is concerned about an issue relating to the storage of radioactive substances during transit. Queensland is requiring certain transport organisations, particularly those who tend to accumulate sources prior to shipment overseas, to minimize inventories of radioactive substances stored during transit and be licensed so that an appropriate record of their inventory may be kept.

The Northern Territory government will commence the *Radiation Protection Act 2004 (NT)*, which has the objective 'the radiation protection of people and the environment'. There is a written plan for the commencement of this Act.

At the Mount Walton East Intractable Waste Disposal Facility in Western Australia, the category of waste that can be disposed of and the activity limits are as outlined in the *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia* (NHMRC, 1992). Following a review of international documents in 2007, additional restrictions were placed on the acceptance of some sources for burial in the 2008 disposal campaign, with the Radiological Council committing to a further review prior to the next campaign.

Section L – Annexes

Annex A – Inventory of radioactive wastes

Inventory of radioactive waste held in Australian storage facilities (excluding ANSTO and mining and milling wastes)

Radionuclide(s)	***Total Activity [MBq]***
Ag-110m	74
Am-241	2069541
Am-241/Be	736223
Am-241/Be, Cs-137	1188
Ba-133	152
C-14	23951
C-14, Cs-137, Eu-152, Ni-63, Pb-210, Ra-226	100
Cd-109	10
Cf-252	77
Cl-36	1
Cm-244	4476
Co-57	9134
Co-60	1366624
Co-60, Cs-137	415
Co-60, Cs-137, Gd-153, Pu-238	37000
Co-60, Ra-226	20000
Cs-137	14732408
Cs-137, Ra-226	10000
Cs-137, Ra-226, Sr-90	10000
Eu-152	119
Fe-55	8569
H-3	2751532

Radionuclide(s)	***Total Activity [MBq]***
Hg-203	1
I-125	14
Ir-192	377887
Kr-85	46944
Na-22	1
Ni-63	1153
Np-237	1
Pa-231	2
Pb-210	1009
Pm-147	60118
Po-210	8
Pu-238	128327
Pu-239	100
Ra-226	312607
Ra-226, Th-232	200
Ra-226, U-238	20000
Ra-226/Be	7522
Sb-124	1200
Sn-113/In-113m	2
Sr-90	475578
Tc-99	74
Th-230	2000
Th-232	837
Th nat	30
Thorium Nitrate	1
Tl-204	185
U-234	800

Radionuclide(s)	***Total Activity [MBq]***
U-238	5718
U nat	216
Uranium tailings	7
U & Ra (liquids)	4
Y-88	15
Zr-93	73999

Inventory of wastes from the mining and milling of radioactive ores in SA

Site	***Estimated Mass (Tonnes)***	***Type of Waste***
Olympic Dam U Project	100,000,000	U Tailings
In-situ leach U projects (Beverley and Honeymoon)	~ 4900	Contaminated soil and solids from U processing
Port Pirie (Former U Treatment Plant)	~200,000	U Tailings
Radium Hill (Former U mine) Repository on Site	300,000 400	U Tailings & waste rock Contaminated soil and solids from U processing

(Current estimates as of 2008)

Inventory of wastes from mining and milling of ores in the Northern Territory

Tailings produced from 1 September 2005 to 30 September 2008, 6.4 Mt
Overall total tailings deposited at Ranger, 38.8Mt
Solid waste produced (mineralised and non-mineralised) from commencement of operations to 30 September 2008, 114.6 Mt
Solid waste produced (mineralised and non-mineralised) from 31 August 2005 to 30 September 2008, 33.8 Mt
Average grade of ore as reported in the ERA Annual Report, 0.24% U3O8

Radioactive waste in storage at ANSTO's radioactive waste management facility

Type of Waste	*Volume*	*Generation Rate*
Low-level Solid Waste	1560 m^3	30 m^3 per year
Intermediate-level Solid Waste	235 m^3	2 m^3 per year
Thorium and Uranium Residues (ILW)	165 m^3	nil
Intermediate-level Liquid Waste (to be solidified)	5.5 m^3	1.1 m^3 per year

Total activities per radionuclide in waste disposed of in Western Australia's Mt Walton East facility.

The following updated data is provided for "disposed" waste following a disposal operation at Mount Walton East in 2008:

Radionuclide(s)	*Total Activity (MBq) **
Am-241	126260
Cd-109	17
Cf-252	1.3
Co-60	255
Cs-137	28956
H-3	145085644
Ra-226	2281

*Estimated activity to 9 September 2008, allowing for radionuclide decay.

Annex B – References to national laws, regulations, requirements, guides, etc.[23]

Commonwealth government

- ***Australian Nuclear Science and Technology Organisation Act 1987***
- ***Australian Radiation Protection and Nuclear Safety Act 1998***
- **Australian Radiation Protection and Nuclear Safety Regulations 1999**
- Australian Radiation Protection and Nuclear Safety Agency, *Recommendations for Limiting Exposure to Ionizing Radiation* and the *National Standard for Limiting Occupational Exposure to Ionizing Radiation*, Radiation Protection Series No. 1, (1995 - republished 2002).
- Australian Radiation Protection and Nuclear Safety Agency, *Code of Practice for the Safe Transport of Radioactive Material,* Radiation Protection Series No. 2, 2008.
- Australian Radiation Protection and Nuclear Safety Agency, *National Directory for Radiation Protection,* Radiation Protection Series No. 6, 2004.
- Australian Radiation Protection and Nuclear Safety Agency, Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, Radiation Protection Series No. 9, 2005.
- Australian Radiation Protection and Nuclear Safety Agency, *Safety Guide for the Predisposal Management of Radioactive Waste*, Radiation Protection Series No.16, 2008.
- Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Guidance for Radioactive Waste Management Facilities: Near-Surface Disposal Facilities; and Storage Facilities*, 2006. http://www.arpansa.gov.au/Regulation/waste/index.cfm.
- *Environment Protection and Biodiversity Conservation Act 1999*
- Environment Protection and Biodiversity Conservation Regulations 2000
- National Health and Medical Research Council, *Code of Practice for the Disposal of Radioactive Waste by the User*, Radiation Health Series No. 13, 1985.
- National Health and Medical Research Council, *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia*, Radiation Health Series No. 35, 1992.
- National Road Transport Commission and Federal Office of Road Safety, *Australian Dangerous Goods Code*, 6th ed., 1998.

Australian Capital Territory

- ***Radiation Act 1983***
- **Radiation Regulation 2002**

New legislation is in the process of drafting, and is expected to be enacted around the fourth quarter of 2006

[23] Principal instruments appear in bold type.

New South Wales

- ***Contaminated Land Management Act 1997***
- ***Dangerous Goods Act 1975***
- **Environmental Planning and Assessment Regulation 2000**
- **National Parks and Wildlife (Land Management) Regulation 1995**
- ***Occupational Health and Safety Act 2000***
- ***Occupational Health and Safety Regulation 2001***
- ***Protection of the Environment Operations Act 1997***
- **Protection of the Environment Operations (Waste) Regulation 1997**
- ***Radiation Control Act 1990***
- ***Road and Rail Transport (Dangerous Goods) Act 1997***
- **Road and Rail Transport (Dangerous Goods) (Rail) Regulation 1999**
- ***Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986***
- ***Waste Avoidance and Resource Recovery Act 2001***
- **Radiation Control Regulation 2003**

Northern Territory

- ***Dangerous Goods Act 1996***
- ***Mining Management Act 2001***
- ***Radiation (Safety Control) Act 1978***
- ***Radiation Protection Act 2004*** (this Act is yet to come into effect and is intended to replace the *Radiation (Safety Control) Act 1978*)
- **Radiation (Safety Control) Regulations 1997**
- ***Radioactive Ores and Concentrates (Packaging and Transport) Act 2002***
- **Radioactive Ores and Concentrates (Packaging and Transport) Regulations 1980**
- ***Workplace Health and Safety Act 2007***

Queensland

- ***Radiation Safety Act 1999***
- Radiation Safety (Radiation Safety Standards) Notice 1999
- **Radiation Safety Regulation 1999**
- Queensland Department of Health, *Queensland's Radioactive Waste Store - Operational Management Plan.*
- Queensland Department of Health, *Queensland's Radioactive Waste Store - Operational Procedures Manual.*

- Queensland Government, *Agreement for the establishment and operation of a Secure Radioactive Waste Storage Facility at Esk between State of Queensland and Council of the Shire of Esk.*

South Australia

- ***Radiation Protection and Control Act 1982***
- **Radiation Protection & Control (Ionizing Radiation) Regulations 2000**
- ***Nuclear Waste Storage Facility (Prohibition) Act 2000***
- **Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003**

Tasmania

- ***Radiation Protection Act 2005***
- **Radiation Protection Regulations 2006**
- *Environmental Management and Pollution Control Act 1994*

Victoria

- *Radiation Act 2005 (came into force 1 September 2007)*
- **Radiation Regulations 2007**
- ***Nuclear Activities (Prohibitions) Act 1983***

Western Australia

- ***Nuclear Waste Storage and Transportation (Prohibition) Act 1999***
- ***Radiation Safety Act 1975***
- **Radiation Safety (General) Regulations 1983**
- **Radiation Safety (Qualifications) Regulations 1980**
- **Radiation Safety (Transport of Radioactive Substances) Regulations 2002**
- ***Mines Safety and Inspection Act 1994***
- **Mines Safety and Inspection Regulations 1995**

Annex C – References to reports on international review missions performed at the request of a Contracting Party

At the request of the Commonwealth of Australia, an international team of eleven experts in radiation and nuclear safety visited the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) from 25 June to 6 July 2007 to conduct a full scope Integrated Regulatory Review Service (IRRS) mission to review ARPANSA's regulatory framework and its effectiveness.

The scope of the mission included sources, facilities and activities regulated by ARPANSA: research reactors, industrial and research activities, safety and security of radioactive sources, radioactive waste management, decommissioning, and remediation. Both regulatory technical and policy issues were addressed. Among the policy issues discussed, particular attention was paid to the issue of progress in achieving national uniformity of radiation protection in the Commonwealth and the six States and Territories within Australia.

Particular strengths of ARPANSA, its policy, its regulatory framework and its regulatory activities identified by the IRRS team included the development and implementation of a National Directory for Radiation Protection as a means to progress the goal of national uniformity in radiation protection.

The team also reported recommendations or suggestions where improvements are necessary or desirable to further enhance the legal and governmental infrastructure for radiation and nuclear safety. Consideration of promotion of a national system for the classification of radioactive waste was one of the areas the team identified that would contribute significantly to the enhancement of the overall performance of the regulatory system.

The full report of the mission can be found at www.arpansa.gov.au/Regulation/irrs/index.cfm.

Annex D – Rehabilitation of uranium mine waste sites in Australia

The following report was included in the 2005 National Report for Australia.

Background

Australia has a number of contaminated sites resulting from past and present uranium mining activities. The extent and nature of the contamination varies from site to site. There are also a number of known deposits where no mining has taken place, but where there is some contamination resulting from exploration and from test programs in ore extraction and processing.

The wide range of climatic conditions, from tropical monsoon conditions in the far north to dry, arid conditions over much of the centre means that it is difficult to apply a uniform set of standards or waste management and rehabilitation requirements, across the whole country.

Significant uranium mining activity has occurred in Australia since the late 1940's and, as a consequence, wastes from these activities have been accumulating. This report presents the status of waste from previous activities, and the management and rehabilitation proposed for wastes from current activities. Only the Northern Territory, South Australia and Queensland are discussed, as no significant commercial uranium mining has occurred elsewhere in Australia.

Locations of past and present uranium mines and other deposits are shown on the accompanying figure[24].

Rehabilitation Standards

Australia is a federation, with jurisdiction resting with both the States and the Commonwealth of Australia. There are also two self-governing territories. Generally mining, waste management and radiation protection are matters regulated by the States, but the Commonwealth government has some powers in these areas.

The Commonwealth government developed two Codes of Practice for uranium mining: the Radiation Protection (Mining and Milling) Code 1987, and the Management of Radioactive Waste (Mining and Milling) Code 1982. These Codes were originally developed under legislation giving the Commonwealth government power to set standards for environmental protection in circumstances where Commonwealth government action was required (for instance in the granting of export licences for uranium). The Codes are administered and enforced by the States. An updated and combined *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* was promulgated in August 2005[25].

[24] Further details of former and current uranium mines in Australia are available from the Uranium Information Centre web sites: www.uic.com.au/fmine.htm and www.uic.com.au/emine.htm.

[25] The Code is available at http://www.arpansa.gov.au/Publications/codes/rps9.cfm.

The main provisions of the new Code are requirements for developing plans for radiation protection of both workers and members of the public, and for radioactive waste management. These plans must be consistent with the ALARA principle and, for waste management including decommissioning, use 'best practicable technology'. The plans must be submitted to the regulatory authority for approval, and then operations must be conducted in accordance with those plans. The Code requires compliance with the recommended ICRP dose limits.

Under the new Code, a Radioactive Waste Management Plan (RWMP) must be developed to provide for the proper management of radioactive waste arising from the operations. The RWMP must include a plan for decommissioning the operation and the associated waste management facilities and rehabilitating the site.

The following guidance on cessation of operations is provided in the new Code and Safety Guide:

The waste management plan should contain proposals for rehabilitation of the project as a whole and for individual components (for example tailings dams reaching their capacity). On decommissioning, these plans will need to be updated and engineering detail finalised.

Inappropriate attempts at rehabilitation may prejudice the ability to attain an acceptable final state. For this reason, rehabilitation operations should not be attempted without authorisation.

An application for authorisation to rehabilitate should include the following information:

- the condition of the site to be rehabilitated, including the facilities and waste to be rehabilitated, levels of contamination, and quantities of waste;
- details of rehabilitation measures to be undertaken;
- management of waste generated during rehabilitation;
- the anticipated final state of the site after rehabilitation, including estimates of the levels of residual contamination;
- details on ongoing monitoring and surveillance that will be required after rehabilitation; and
- contingency plans, and plans for remediation of any defects in the rehabilitation that may become apparent.

At the conclusion of the rehabilitation, the operator may wish to relinquish responsibility for the site. Generally the requirements and conditions for this step will be set in legislation. However, in respect of matters covered by the Code, requirements and responsibilities for continuing monitoring and surveillance of the site, and of any remedial work that may become necessary, will need to be determined. Any land use restrictions that may be necessary, and the administrative mechanisms that will implement them, will also need to be determined.

Northern Territory

In the Northern Territory, one of the main uranium-mining areas in Australia, various Territory Acts govern the management and safety of current uranium-mining practices.

Management of mining sites, and protection and safety of the environment, are administered under the Mining Management Act (2002) by the Territory Mines Division.

South Australia

Uranium mining in South Australia (SA) is controlled by a number of State legislative requirements. The most specific for uranium mining is the Radiation Protection and Control Act. This Act requires that uranium mining operations must hold a "licence to mine or mill", and the Code of Practice referred to above is routinely applied as a condition on such a licence. This is the main mechanism by which the Code is administered and enforced.

Historical Mining and Milling Operations

Northern Territory

From 1956 to 1964 the upper **South Alligator Valley**, an area about 200 km south-east of Darwin in the Northern Territory, was the location for 13 operating uranium mines and a number of prospects. These "boutique" mines contained mostly high-grade ore, and were worked mainly to extract uranium for the British nuclear weapons programme. The mining operations were a combination of open cut and underground operations. Processing of ore was initially carried out at other locations, notably Rum Jungle.

Later, small-scale processing was undertaken within the valley including a battery and gravity separation plant, gold separation and a small mill and solvent extraction plant. When operations ceased in 1964 the proponents walked away from their sites with little attempt to remediate the environmental impacts they had caused. It must be emphasised that there were no rehabilitation requirements under the regulations in force at that time. The area lay within a pastoral lease and remained in private hands until the mid 1980's when it was determined that the valley would form part of the Kakadu National Park.

In 1986 a survey of abandoned mines was undertaken by the Commonwealth government to establish the size and scope of a possible rehabilitation project. As the South Alligator Valley area lay within the proposed boundaries of Kakadu National Park, and visitor numbers were steadily increasing, it was decided that some form of works would be required to ensure the safety of visitors. In 1988, after discussions between the various agencies involved, it was agreed that a hazard-reduction program would be undertaken. This was to include reductions in physical as well as radiological hazards for visitors to the area.

As the main concern was to make the area as safe as possible for casual park visitors, the emphasis was on the reduction of physical hazards by fencing of open cuts, redirection of roads away from the edges of open cuts, collapsing of adits and shafts, and removal and burial of waste metal etc. At least two bat colonies were established in old workings, and consequently these adits and shafts were barred using heavy-duty grilles in such a way that the bats could still move in and out of the shafts whilst public access was barred.

The site of the abandoned South Alligator Uranium Mill had been subjected to an earlier radiological assessment. Apart from the residues in old reaction vessels and pipes, the main concern was tailings which had been deposited on flat ground on the banks of the South Alligator River. During monsoonal floods the tailings were often washed away by the runoff waters. In 1986 the bulk of the tailings were trucked elsewhere and reprocessed to extract

gold. However, there were small pockets of tailings left behind which represented a potential hazard to Park visitors. Although the mill was considered by some to be an important part of the region's mining heritage, it was determined that dismantling and burial was the only safe course to take and this was done as part of the hazard-reduction program.

The minimum depth of cover was 1.5 m. The area was left over-filled to allow for subsidence and in a suitable state for seeding in the following wet season. Before the hazard-reduction program was completed, a detailed radiological survey of other associated sites was undertaken to ensure that all potentially troublesome radioactive materials were identified and a program agreed with the contractor to ensure that such wastes were dealt with in a satisfactory manner.

Following the rehabilitation works, a monitoring program has been set up to ensure that the hazard reduction continues to be effective. Regular inspections for erosion and revegetation are supplemented with periodic radiation surveys.

Some further relatively small-scale remedial works are in preparation. An upper estimate of 15,000 m^3 of radiologically active material has been made for the Gunlom Residue site, historic containment sites in the South Alligator Valley, the top of El Sherana Pit and minor works elsewhere. Materials which may require containment include uranium tailings residues, uraniferous ores exposed by mining/exploration activities, and material from areas impacted by handling or containment of uraniferous ores.

In summary, the environmental impact of historical uranium mining activities in the South Alligator Valley of the NT was relatively low. However, the sites were not rehabilitated at the end of operations and a variety of safety hazards resulted which became of concern when the area was opened up as part of the Kakadu National Park. Physical hazards were managed by a combination of fencing, barring tracks, filling of shafts and burial of waste and scrap. Radioactive hazards were managed by burial of identified wastes at specific locations in conjunction with gamma-radiation surveys and some radon measurements. On-going monitoring programs indicate that the aims of the program are still being met many years after the program began. Minor erosion at containment sites has been repaired and revegetation is proceeding in a generally satisfactory manner.

The **Rum Jungle** uranium deposit was discovered in 1949 and the site, some 64 km south of Darwin, became the major Northern Territory uranium mine in the 1950's. It opened in 1953, and continued producing uranium until 1963, although copper production continued for several more years. Main production was from three open pits, all in close proximity to the East Finniss River. Overall production was about 3500 t of uranium from 860,000 t of ore (that is, an average ore grade of about 0.4%).

Tailings management appears to have been minimal in the early years of operation, but later tailings were discharged into an abandoned open pit. Minimal rehabilitation was carried out on closure; on completion of mining in 1971 it was decided by the Commonwealth government that funds should not be made available for any rehabilitation, so the area was simply abandoned.

Within a few years the Rum Jungle mine had become one of Australia's most notorious pollution problems, due to oxidation of sulphides by bacteria and the consequent release of

acid and metals into the East Finniss River. Areas of the site were regularly flooded during the monsoonal wet season, with annual rainfall of 1500 mm.

In 1983 a program to reduce the environmental impacts was commenced, with principal aims of neutralising the tailings and reducing the associated heavy metal pollution. Most of the tailings and other waste areas were capped, and erosion control measures introduced. Further rehabilitation work was performed in 1990-91.

Nabarlek was a small high-grade uranium deposit some 350 km east of Darwin. The ore body (600,000 tonnes with average grade of 2%) was mined in four months in 1979, and the stockpiled ore was treated in subsequent years, production finishing in 1988. All tailings were returned to the pit. Following completion of processing, the tailings were allowed to drain, and then covered with below ore-grade material and allowed to consolidate. Plant and equipment that could not be decontaminated and salvaged were also buried in the pit.

Final capping was carried out in 1995 and the area subsequently revegetated with a mixture of grasses and native species. Vegetation is now well established and there has been little erosion. Monitoring and research will continue, as Nabarlek represents the first rehabilitation of a uranium mine according to current principles and practice.

South Australia

The main historical operation in SA was at **Radium Hill** in a remote, arid area in the east of the State. It operated from 1954 to 1961 (that is, long before the Codes discussed above were developed) and approximately one million tonnes of ore averaging 0.13% U_3O_8 were mined. A physical (heavy media) concentration process was conducted at Radium Hill, and the resulting concentrate railed to Port Pirie on the coast for conventional chemical extraction of the uranium.

The wastes that remain at Radium Hill are estimated to be some 225,000 t of heavy media tailings and in addition around 75,000 t of waste rock. In contrast to the chemical extraction of uranium, the physical concentration process removed a large proportion of the elements of the uranium decay chain, and so the concentrations of radium-226, thorium-230 and other radionuclides are low. The heavy media tailings were contained in two above-ground tailings storage dams, with little containment, and were subject to both wind and water erosion.

In 1981-2, the tailings dams were rehabilitated by cover with local clay soil: the cover thickness was approximately 3 m on the sides and 1m on the top. No rock armouring to control water erosion was incorporated. At a later stage, some drummed residues from test work on uranium ores were buried in the top of the cover. The site is inspected regularly, and repairs made as required.

Approximately 200,000 t of conventional uranium mill tailings remain in clay-lined basins on the edge of the city of **Port Pirie**, where extraction of uranium occurred. The site is far from ideal, being on tidal mudflats, and was subject to flooding at extreme high tides. No significant rehabilitation work was carried out until the 1980's, when the tailings were covered by about 1.5 m thickness of granulated smelter slag from an adjacent lead smelter, some topsoil (up to 1 m), and revegetated. Subsequently a large quantity of slag was placed on the seaward side of the tailings dams, effectively eliminating the risk of flooding (under

current conditions). Additional slag was used to cover contaminated areas of the processing plant, contaminated tanks and other equipment debris.

Queensland

The **Mary Kathleen** uranium deposit in far north-west Queensland was discovered in 1954. Mining commenced at the end of 1956 and the treatment plant was commissioned in June 1958. Tailings were emplaced in a 12 hectare tailings dam in a small valley west of the plant. This overflowed into an evaporation pond of some 60 hectares.

At the end of 1982 the mine was depleted and finally closed down after 8880 tonnes of uranium oxide concentrate had been produced. During 12 years of operations (in two phases) about 9 million tonnes of ore was mined.

Notwithstanding the minimal conditions imposed on the original (1954) leases, the company took the view that it should conform to relevant current environmental and occupational health standards. Consequently, before the recommissioning for the second phase of operations in 1976, a full environmental impact study was undertaken and this incorporated a rehabilitation plan for the 64 hectares of waste dumps, 29 hectares of tailings dam and 60 hectares of evaporation ponds. Mary Kathleen then became the site of Australia's first major rehabilitation project of a uranium mine, which was completed at the end of 1985 at a cost of some A$19 million. In 1986 this work won an award from the Institution of Engineers Australia for environmental excellence[26].

Current Uranium Mining Operations

Ranger (Northern Territory)

Ranger is a large open-pit mine, situated in the catchment area of the East Alligator River approximately 250 km east of Darwin. The mine is on a 7860 hectare lease which is surrounded by the World Heritage listed Kakadu National Park of 1.98 million hectares. The mine is in a monsoonal part of Australia, with pronounced wet season from December to April (an average 1540 mm of rain falls in the wet season). Operation commenced in 1980 at a rate of about 3300 tonnes per year of uranium oxide concentrate. Processing is carried out on site. The ore is crushed, ground, and leached with sulphuric acid to dissolve the uranium. The liquid is then separated from the solid tailings and passed through a solvent extraction plant where the uranium is removed, in a standard uranium-extraction process.

There is a large tailings dam on the site. As this is a high-rainfall area, there is considerable public concern about contamination of surface and ground water. The Commonwealth government, through the Office of the Supervising Scientist (OSS), conducts a number of monitoring and research programs to monitor and assess the impact of the Ranger mine on the surrounding environment.

Until 1996 tailings from the treatment plant were emplaced in the engineered dam on the lease, but they are now being deposited into the worked-out #1 pit. No process or other contaminated water is released from the site, under normal operations.

[26] Further information on the rehabilitation can be found at www.uic.com.au/mku.htm.

The vegetation at Ranger is tropical open eucalypt forest, similar to much of the Kakadu National Park, and the Company operating the mine has a substantial environmental division. Current environmental projects include maintenance of biodiversity, fire management including control burning, terrestrial and aquatic weed control, feral animal control and rehabilitation of disturbed areas (including rock waste dumps, etc). Issues being studied include artificial wetland filters, soil formation from waste rock, and hydrology.

The project area is leased from the Aboriginal traditional owners, and among Ranger's long-term research priorities are projects which are relevant to eventual use of the land by its Aboriginal owners. As a guarantee of successful rehabilitation of the Ranger site, even if the operation were to close prematurely, the Company has lodged some A$31 million in a trust fund administered by the Commonwealth government; an amount which covers all existing liabilities.

Olympic Dam (South Australia)

The Olympic Dam project is a large copper/uranium mine, with associated processing plant and smelter, in an arid area of central South Australia. It has operated since 1988, and currently about 10 million tonnes are mined per annum, producing 230,000 t of copper and 4200 t of uranium. The uranium ore grade is low (approximately 650 ppm), but it is the world's largest known uranium deposit (and sixth largest copper deposit).

The tailings are stored in two large "sub aerial" tailings retention structures. These have a total area of 360 hectares, and a design height of 30 m and currently hold over 74 Mt of tailings. The ore reserves will support mining at the current rate for at least another 70 years, and so a considerable extension of the tailings area is to be expected.

Final rehabilitation plans for the tailings dams have not been completed. Research is to be undertaken to determine optimum wall slopes, cover thicknesses, armouring options, and revegetation techniques. Using this information, a rehabilitation plan will be developed, which must be approved by the regulatory authorities.

Approaches to decommissioning and rehabilitation being considered include the implementation of long-term closure measures, necessitating sufficient expenditure to relinquish the lease and leave the community no on-going liability (a "sustainable" solution that does not bequeath a problem to future generations), or to allow for indefinite on-going maintenance. The difficulty with the latter is how to ensure that any future maintenance organisation, and its funding, could endure for as long as maintenance is reasonably required.

Beverley (South Australia)

Beverley is an *in-situ* uranium mine, which has been operating since 2001, and currently producing approximately 1000 t of uranium per annum. Reserves are approximately 21 000 tonnes, with ore grade of 0.18%U. As an *in-situ* mine, there are no conventional 'tailings', waste rock or similar wastes. Small quantities (approximately 100 t per annum) of solid wastes accumulate in lined below-grade evaporation ponds. Other wastes, of the order of 100 cubic metres per annum, include contaminated filter media and similar material.

Upon decommissioning a wellfield, wells are sealed and capped, pipes are removed and the surface revegetated progressively. Again final disposal and rehabilitation plans have not been

finalised, but it is expected that the wastes will remain in the retention pond, which will then be backfilled to grade, armoured and revegetated. These plans must be approved before they can be implemented. At the end of the mine's life, process facilities will be removed and after discussion with the stakeholders the land can revert to its previous uses. The operating Company has provided financial guarantees to the SA government in respect to ongoing mine site rehabilitation up to the final completion of mining.

Honeymoon (South Australia)

Honeymoon is a small uranium deposit in the east of the state, with reserves of approximately 4200 t. It is currently in care and maintenance following a pilot scale operation, but options for bringing the project into commercial operation are being actively pursued.

Again, final waste management and rehabilitation plans have not been developed, but are expected to be similar to those in the case of Beverley, and will also require regulatory approval.

Conclusions

In common with many other parts of the world, uranium mining, and in particular the management of wastes, was not well controlled in the middle of last century. In many cases management of tailings and other wastes was minimal or non-existent, or wastes were sited in inappropriate areas, and generally no rehabilitation was carried out on closure. In some cases, notably Rum Jungle, there were serious detrimental effects on the environment, both from radiological and non-radiological contaminants.

As the consequences and potential consequences of this attitude were recognised, attempts were made to manage the wastes and rehabilitate the abandoned sites. These have generally been successful, but in a number of cases continuing remedial actions will be required for the foreseeable future.

It is now recognised that waste management is an integral part of any uranium mining operation, and regulatory requirements are currently in place for all Australian uranium mining operations to ensure that wastes are managed in accordance with current best practice, and that long term rehabilitation measures will be taken as currently operating facilities are closed. Final rehabilitation plans consistent with these regulatory requirements are being developed for wastes generated by current operations. Nabarlek in the Northern Territory was the first Australian uranium mine for which this regime was in place, and the successful rehabilitation that has been achieved there indicates the effectiveness of this approach.

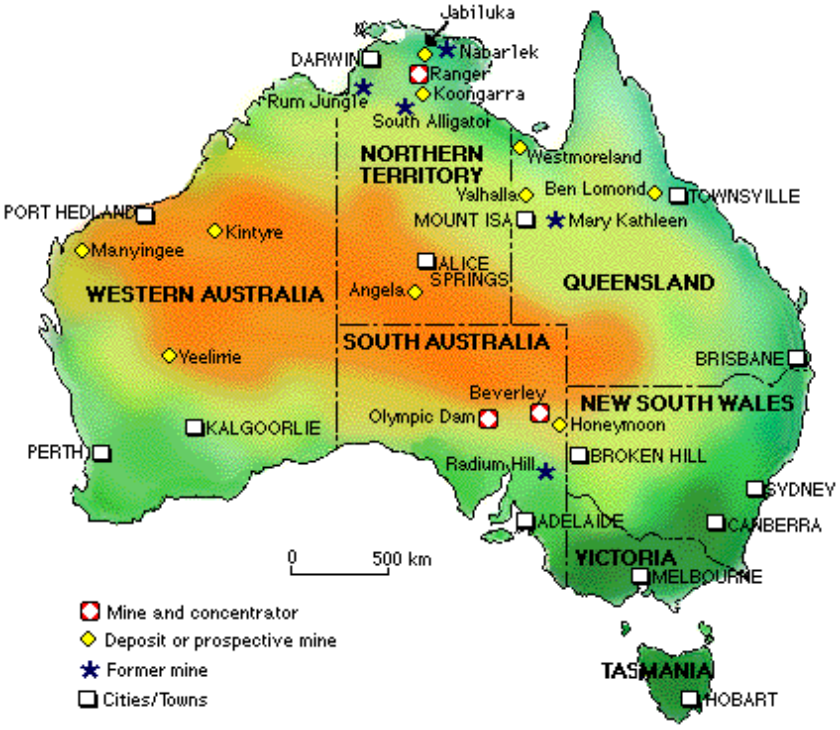

Figure showing locations of past, present and future uranium mines and deposits in Australia.