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

National Report of the Commonwealth of Australia

10 October 2014

Contents

A. Introduction

This is the fifth Australian National Report, prepared for the Fifth Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the 'Joint Convention').[*] The 2011 National Report and Australia's presentation to the Fourth Review Meeting in 2012 highlighted the following major issues:

- The ongoing challenges associated with ensuring a coherent approach to regulations and waste management practice in view of the complex nature of national and regional legislation. The goal is for harmonisation of legislation between the nine jurisdictions within Australia's federal system as a way to enhance safety of radioactive waste management. Australia is continuing to address these challenges through the ongoing development and application of a *National Directory for Radiation Protection* (NDRP)†.
- Planning for a national radioactive waste management facility. The goal of this process is to site and establish a centralised, purpose built facility. The facility will be for the management of Australia's radioactive waste; that is waste held by the Commonwealth and any State or Territory jurisdiction.
- Australia's adoption of a new national scheme for classification of radioactive waste in 2010, based on the current International Atomic Energy Agency (IAEA) scheme.
- An IAEA Integrated Regulatory Review Service (IRRS) follow-up review of the Commonwealth regulator, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), was conducted in November 2011.
- The draft of a new ARPANSA regulatory guide "Applying for a Licence for Radioactive Waste Storage and Near-Surface Disposal Facilities" (working title).
- ARPANSA has developed a National Source Register which covers and tracks Category 1, 2 & 3 sources in all Australian jurisdictions.
- The MOATA Argonaut 100 kW reactor was successfully decommissioned in 2010, and the lessons learned from this project will be used in planning the future decommissioning of the shut-down HIFAR 10 MW DIDO-type research reactor.
- Current research reactor spent fuel management practices, including re-examination of the safety case for spent-fuel storage, in light of lessons learned from the Fukushima nuclear power plant accident, to assess the impact of a blackout event.
- The proposal to construct an interim waste store at the Australian Nuclear Science and Technology Organisation (ANSTO) for intermediate-level waste (ILW) including reprocessed vitrified ILW that will return from France by the end of 2015.

This fifth National Report by Australia provides an update on these and all other relevant issues under the terms of the Joint Convention. It also seeks to provide sufficient background where necessary to enable it to be read as a stand-alone document.

[*] The Joint Convention entered into force for Australia on 3 November 2003.

[†] The aim of the *National Directory for Radiation Protection* (NDRP) (ARPANSA, July 2011, updated 2014b) is to provide nationally uniform requirements for the protection of people and the environment against the exposure or potential exposure to ionising and non-ionising radiation and for the safety of radiation sources, including provision for the national adoption of codes and standards. The NDRP has been developed to assist radiation protection regulators and other sectors involved in implementing radiation controls such as mine operators and occupational health and safety regulators.

The main developments since the 2012 review meeting are:

- Passage of the *National Radioactive Waste Management Act* 2012. The Act provides the Commonwealth Government with the authority to site and establish a national radioactive waste management facility. An initial business case was developed in 2013-14. This was done in keeping with the concept of an evolving safety case. The business case reinforces the need for a centralised, purpose-built facility. The process for volunteering land as a potential site for the facility, as set out under the Act, is open.
- Regulatory pressures have highlighted the need to develop policy for the ultimate disposal of Australia's ILW. Strategies for this will be formally considered by the Commonwealth in a detailed business case.
- Regulatory guides have been published for licensing of radioactive waste storage and disposal facilities [*Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2* (OS-LA-SUP-240L, March 2013)] and siting of controlled facilities [*Regulatory Guide: Siting of Controlled Facilities v2* (REG-LA-SUP-240L, August 2014)], and five new or updated national standards have been published in the Radiation Protection Series (RPS) (see Section E).
- ARPANSA issued licences on 29 November 2013 to ANSTO to prepare a site for, and to construct a controlled facility (the ANSTO Interim Waste Store) for interim storage of ILW at the ANSTO Lucas Heights Science and Technology Centre, NSW. In issuing these licences, ARPANSA stated that the storage facility is considered to be an interim measure which should not delay the development of a proper long-term strategy for the storage of radioactive waste and the establishment of a national radioactive waste management facility.
- Follow-up actions resulting from the recommendations of the 2011 IRRS review of ARPANSA have been undertaken or are being planned, including amendments to the ARPANS Act and Regulations expected to take effect from 1 July 2015, and development of an ARPANSA communication strategy and plan to aid improved public consultation.

It was requested, in the Final Summary Report of the Fourth Review Meeting, for Contracting Parties to address, at the Fifth Review Meeting, the issue of the safety implications of very long storage periods and delayed disposal of spent fuel and radioactive waste. Australia is consciously addressing this issue through its policy, regulatory and operational bodies. Evidence in this report includes the spent fuel management strategies in place, and putting on the national agenda the need to develop policy for the ultimate disposal of Australia's ILW. Meanwhile, storage requirements are clearly identified nationally as interim measures.

Background: Australia's federal system

Australia is a federation of nine jurisdictions (Figure 1): the Commonwealth Government, six state governments (New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania), and two territory governments (Northern Territory and the Australian Capital Territory).

In 1998, the Commonwealth Government created a regulator for Commonwealth entities, the CEO of ARPANSA, to regulate the radiation protection and nuclear safety activities of Commonwealth entities, regardless of the jurisdiction in which the operations are undertaken. These entities include the Department of Defence, ANSTO and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). As well, one of the functions of the CEO of ARPANSA is to promote national uniformity in radiation protection across all jurisdictions.

Figure 1: Map of Australia showing states and territories.

Assessment of Australia's compliance with the Joint Convention

The governments of Australia and the states and territories reconfirm that each has in place the framework of appropriate law, and the legislative, regulatory and administrative measures, including a system of authorisation, monitoring and inspections, necessary for implementing all obligations under this Joint Convention.

It should be noted that while Australian states and territories supported ratification of the Joint Convention, compliance of the states and territories of Australia is not subject to separate Commonwealth Government legislation. The Commonwealth Government is committed to further development of a framework governing the long-term management of radioactive wastes arising from its activities, including, as appropriate and necessary, long-term storage and disposal.

Most Australian jurisdictions do not define radioactive waste in their legislation and many do not classify radioactive materials in long-term storage as waste as defined by the Joint Convention. However, each jurisdiction has storage arrangements for radioactive materials and radioactive waste. This report can only assess compliance with the Joint Convention in relation to those facilities containing radioactive materials that have been characterised as waste for the purposes of the Joint Convention.

B. Scope of Report

- The discussion of management of spent fuel in this report does not include reprocessing activities. Australia's policy is that spent fuel is sent overseas, under contractual arrangements that include reprocessing in some cases. No spent fuel reprocessing facilities exist in, or are proposed for, Australia. In addition:
    - the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prevents a Commonwealth body or a corporation from constructing or operating a reprocessing facility;
    - the *Australian Radiation Protection and Nuclear Safety Act 1998* (ARPANS Act) prohibits the Commonwealth regulator from licensing the construction or operation of reprocessing facilities; and
    - states also have prohibitions; in Queensland, the *Nuclear Facilities Prohibition Act 2007* prohibits reprocessing in the State of Queensland, and in Victoria the *Nuclear Activities (Prohibitions) Act 1983* prohibits nuclear fuel cycle activities including reprocessing of spent fuel.
- The management of wastes arising from operating uranium mines is discussed under the relevant articles. Wastes that contain only naturally occurring radioactive materials and that are not part of the nuclear fuel cycle have not been included in this report.
- Australia has no spent fuel within military or defence programs. Radioactive waste managed within military programs has not been declared as radioactive waste for the purposes of this Joint Convention.

C. Policies and Practices

Article 32 Reporting (1)

Spent fuel management policy

Australia's policy on spent fuel management is unchanged since the 2011 National Report. Spent fuel is transported overseas, to the United States (US) in the case of US-obligated fuel that qualifies under the Foreign Research Reactor Spent Nuclear Fuel Acceptance (FRR-SNFA) take-back 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 and in accordance with contractual obligations. It is noted that the FRR-SNFA take-back program is valid for all spent fuel irradiated up to 12 May 2016.

Spent fuel management practices

In Australia, the Commonwealth is the only jurisdiction in which spent fuel is managed. The current and planned spent fuel management practices for the spent fuel arising from the HIFAR and OPAL research reactors are described below.

Shut-Down Reactor (HIFAR)

The High Flux Australian Reactor (HIFAR), a 10 MW research reactor, was shut down in January 2007. All spent fuel from HIFAR has been shipped to the US, to the United Kingdom (UK) Nuclear Decommissioning Authority (NDA) facility at Dounreay, or to the AREVA facility at La Hague, France. The shipments of spent fuel were carried out in accordance with the requirements of the IAEA *Regulations for the Safe Transport of Radioactive Material* (2005), TS-R-1 or earlier iterations thereof, and the *International Maritime Dangerous Goods Code* (International Maritime Organisation).

No waste from spent fuel elements shipped to the US under the FRR-SNFA program will be returned to Australia. Under contractual requirements with the UK Atomic Energy Authority (UKAEA) and AREVA, waste arising from reprocessing of spent fuel elements at their facilities will be returned to Australia as long-lived ILW. The uranium extracted during the reprocessing of spent fuel at La Hague has been sold to AREVA under a country to country agreement. The uranium from the reprocessing of spent fuel at Dounreay was used in the fabrication of fresh fuel elements for HIFAR.

Operational Reactor (OPAL)

The OPAL reactor commenced operation in 2006 and is Australia's only operating reactor. OPAL is a 20 MW thermal, open pool, light water reactor designed for low-enriched uranium (LEU) aluminium-clad fuel. The reactor currently operates on uranium silicide (U_3Si_2-Al) fuel.

The option to use a uranium molybdenum (U-Mo) fuel in the future is currently under review and is unlikely to occur before 2024 due to the time required to fully qualify this fuel. Spent U-Mo fuel will contain some silicon and as such will provide a challenge for future reprocessing options which are currently under assessment.

Spent uranium silicide fuel from the operation of OPAL that is irradiated and discharged from the reactor before May 2016 will be returned to the US under the FRR-SNFA program. Current planning is for two shipments of OPAL spent fuel to be returned to the US in 2016 and 2018. After that period, the spent fuel is

planned to be sent to AREVA, France, for reprocessing under a new contract currently being negotiated. As a further back-up option, INVAP (Investigaciones Aplicadas, the Argentine company that constructed the OPAL reactor) has guaranteed to provide an alternative solution consistent with Australia's requirements, using proven technologies. Argentina has already developed and demonstrated a novel technology for conditioning aluminium-clad 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 that is 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 reactor 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.

In addition to the above, the option to use existing spent fuel storage ponds (used to store the former HIFAR reactor spent fuel) in order to provide a buffer staging area for the loading of the OPAL reactor spent fuel for future overseas shipments to the US and France will be assessed. This option will undergo a thorough safety assessment by the relevant Australian regulatory bodies before any implementation.

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 from minimising the number of such shipment operations.

Assuming up to 30 spent fuel elements arising per year, it is anticipated that, on average, there will be one overseas shipment of spent fuel every five or six years. As indicated above, the first such shipment is planned for late 2016 and the second in late 2018 (both shipments going to the US as part of the FRR-SNFA take back program). Under contractual arrangements with the reprocessing companies, all waste generated by reprocessing must be capable of classification as less than high-level waste (HLW), as defined in Australia.[*] Long-lived ILW generated by reprocessing will be placed in interim storage at ANSTO pending the availability of an appropriate national radioactive waste management facility.

Radioactive waste management policy

As stated in previous National Reports, Australia's radioactive waste management policy requires that all radioactive waste generated within Australia be stored or disposed of in Australia at suitably sited facilities after being categorised in accordance with the national classification scheme, which is consistent with agreed international practice.

The Commonwealth Government commissioned an initial business case for the long-term management of Australia's radioactive waste in 2013-14. The business case was developed in keeping with approval

[*] From RPS No. 20 *Classification of Radioactive Waste* (2010), high-level waste (HLW) is defined as waste that contains such large concentrations of both short- and long-lived radionuclides that, compared to ILW, a greater degree of containment and isolation from the accessible environment is needed to ensure long term safety. HLW generates significant quantities of heat from radioactive decay, and normally continues to generate heat for several centuries.

requirements and the concept of an evolving safety case (Figure 2). Through the initial business case, the cost and benefits of a broad range of policy options were assessed. Overall, the assessment showed that a centralised, purpose-built radioactive waste management facility is needed. It also recommended further assessment in a detailed business case.

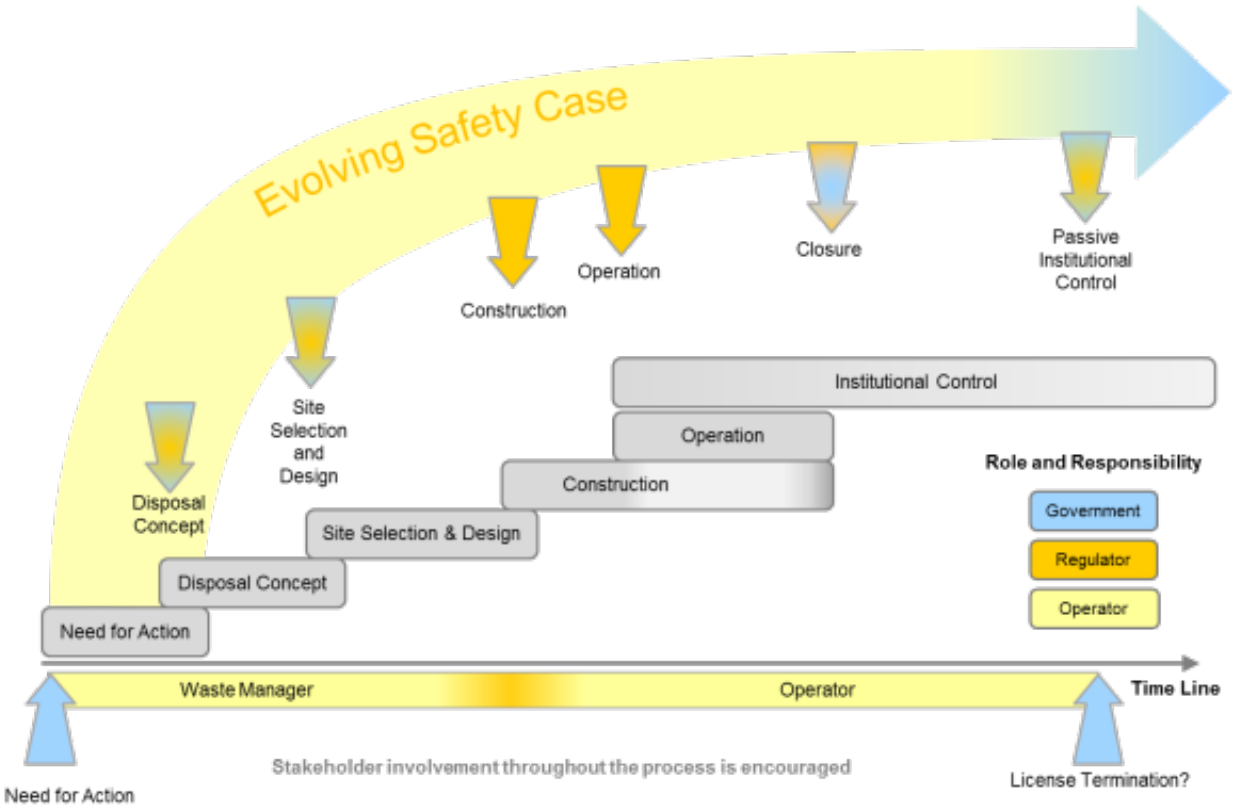

Figure 2: The evolving safety case for radioactive waste disposal facilities [Figure taken from IAEA PRISM: The International Project on Practical Illustration and Use of the Safety Case Concept in the Management of Near-Surface Disposal – Overview Report – Draft Working Material (2012)]

The Commonwealth Government approach is to bring several designs and site options forward in a detailed business case. The assessed designs will be for near-surface disposal of LLW and interim storage of ILW. National strategies for the ultimate disposal of ILW will also be considered. Only land that has been volunteered by its owners will be considered as a potential facility site.

This approach is supported by the *National Radioactive Waste Management Act 2012*. Two volunteer nomination processes are set out in the Act. The first allows Land Councils in the Northern Territory to volunteer Aboriginal land on behalf of its traditional owners. The second provides for a nationwide volunteer process.

Nominations for a volunteer site are currently only open to Land Councils in the Northern Territory (NT), under the first process. In June 2014, the Government agreed to a request by the Northern Land Council that the site at Muckaty Station in the NT no longer be considered for the facility. No other sites have been nominated under this process.

On 8 September 2014, a notice indicating the Government's intention to consider opening a nationwide volunteer process was released. If a nationwide process is opened, land owners in all states and territories will be able to volunteer a site for further consideration. Interested parties have until 10 November 2014 to comment on the proposal.

Radioactive waste management practices

Radioactive waste management practices are largely unchanged since the 2011 National Report. Low- and intermediate-level radioactive waste continues to be stored by Commonwealth, state and territory government regulators and licensees at over one hundred locations around Australia in both rural areas and urban centres.

ANSTO manages wastes arising from its research reactor operation, radioisotope production and research activities according to nationally and internationally accepted criteria. ANSTO currently conditions waste and minimises volumes by releasing decayed and decontaminated material that is below criteria for clearance from regulatory control. ANSTO's integrated radioactive waste management strategy for LLW and ILW is shown in Figure 3.

The majority of medical waste from hospitals is short-lived and managed via delay and decay facilities at the point of generation until it can be legally disposed of or discharged as being below regulatory concern. It is then managed with other non-radioactive medical wastes. Some of the major hospitals utilise delay tanks for control of liquid effluent.

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 until such time as an appropriate avenue for disposal becomes available.

In Queensland, certain sources may be stored in the State's dedicated radioactive waste store and while there is no direct storage cost imposed on the owner of the source, the owner is required to ensure that standards in relation to predisposal management of radioactive waste and transport of radioactive materials and the waste acceptance criteria for the waste store are met.

In Western Australia, a near-surface and bore-hole waste disposal facility at Mt Walton East is available for holders of radioactive materials regulated by the Western Australian regulator. The Environmental Protection Authority's 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.

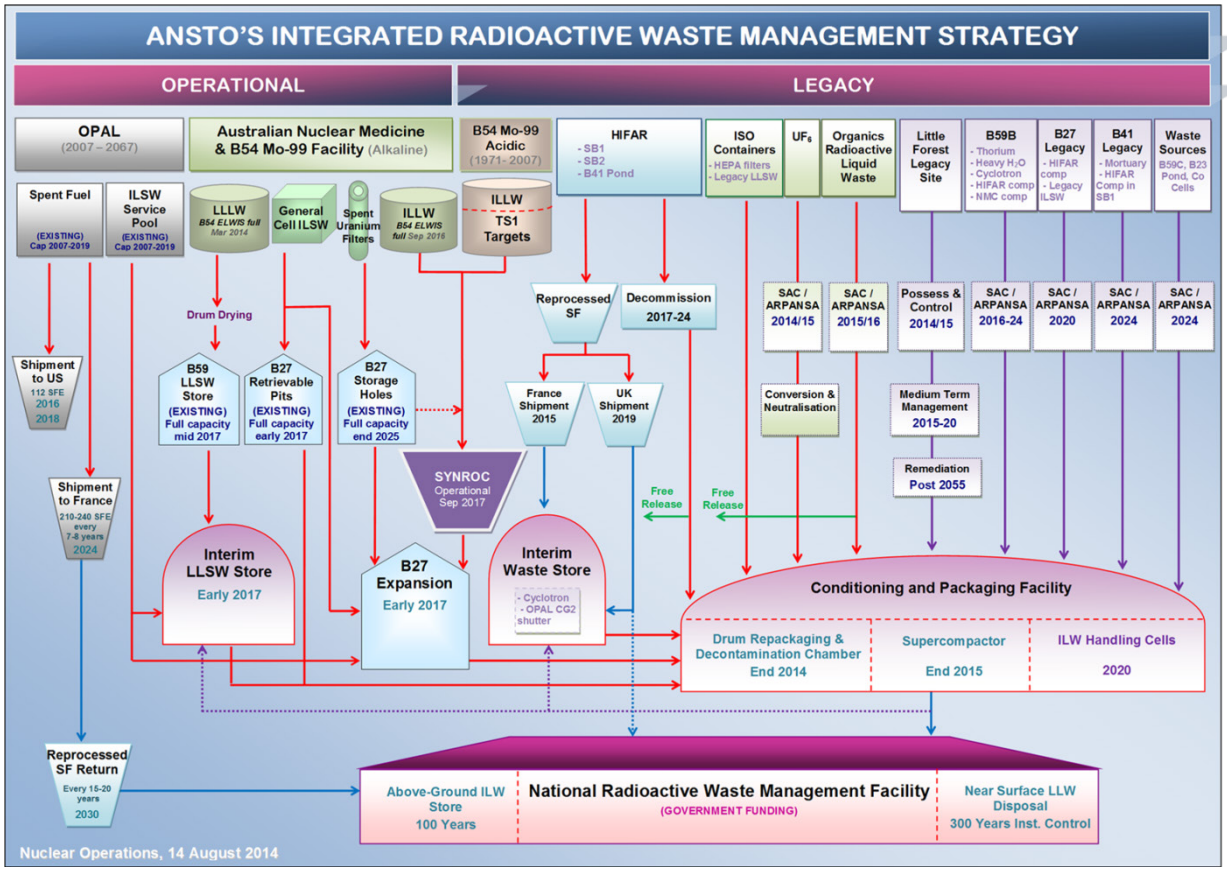

Figure 3: ANSTO's integrated radioactive waste management strategy for LLW and ILW.

Criteria used to define and categorise radioactive waste

RPS publication No. 20, *Safety Guide: Classification of Radioactive Waste (2010)* (ARPANSA, 2010) is based on the IAEA *General Safety Guide: Classification of Radioactive Waste* (GSG-1) (IAEA, 2009), adapted for the Australian situation. This Safety Guide provides a national classification system for radioactive waste. While the guidance is advisory, all jurisdictions have indicated their intention to adopt the scheme.

A categorisation of radioactive waste for operational purposes, based on Australian holdings, has also been developed as part of the predisposal management safety guide RPS No. 16 *Safety Guide: Predisposal Management of Radioactive Waste* (ARPANSA, 2008b). 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 user disposal code for very low-level waste, *Code of Practice for the Disposal of Radioactive Wastes by the User (1985)* (NHMRC, 1986) or if not, then under a special licence.

While there is no national protocol for clearance in Australia, uniform provisions for exemption, based on international guidance from the IAEA (BSS 115), have been adopted by all jurisdictions as part of the NDRP (ARPANSA, 2014b). However, the provisions in the NDRP do not explicitly deal with bulk quantities of raw material such as might be encountered in the mining industries. An amendment to ensure application of exemptions to bulk quantities of raw material has been drafted for adoption into the NDRP. Exposures that are not amenable to control are excluded.

D. Inventories and Lists

Article 32 Reporting (2)

List of spent fuel management facilities

The ANSTO site at Lucas Heights is the only site in Australia with spent fuel management facilities. These spent fuel management facilities are described in Section C of this report.

Spent fuel inventory

Inventory of OPAL spent fuel elements:

Material description	*Number**	*Mass of Uranium (total) kg*
OPAL spent fuel elements	185	393.6

***** As at 27/05/2014

Inventory of HIFAR spent fuel elements that have been sent abroad for re-processing and for which there is a contractual requirement for the return of waste to Australia (as at 27/05/2014):

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 from HIFAR were sent to the UKAEA in 1963 and 729 spent fuel elements (715 from HIFAR and 14 from the previously decommissioned MOATA reactor) have been sent to the USA under the FRR-SNFA program for which there is no requirement for the return of waste to Australia.

Radioactive waste management facilities

Commonwealth Radioactive Waste Management Facilities

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 for interim storage awaiting final disposal in a national radioactive waste management facility. 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’s radioactive waste management facilities comprise:

- a low-level solid waste store;
- a decontamination centre;
- a low-level solid waste compaction facility;
- a low-level liquid waste treatment facility;
- a delay and decay facility for decay of short-lived waste;

- an intermediate-level liquid waste storage and treatment facility;
- a 'hot cells' facility;
- an intermediate-level solid waste store facility;
- a waste treatment and packaging facility;
- spent fuel ponds; and
- a dedicated redundant source store and storage hot cells.

ANSTO also has responsibility for the Little Forest Legacy Site, 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.

CSIRO has a number of small stores for waste at its laboratories around Australia (Black Mountain, Belmont, Clayton, North Ryde, University of Queensland - Gatton, Armidale, Rockhampton, Parkville, Aspendale, Pullenvale, Lucas Heights and Woodville).

A store for Commonwealth radioactive waste is located at Evatt's Field on the Woomera Prohibited Area, South Australia. It contains large quantities of lightly contaminated soil. ARPANSA also has a small waste store located at its Yallambie, Victoria, premises.

State and Territory Radioactive Waste Management Facilities

Radioactive waste interim storage facilities managed by the State and Territory Governments comprise:

- a closed store for radioactive materials collected from the community, hospitals, industry and educational institutions in New South Wales;
- an interim store in Victoria that contains a variety of radioactive material surrendered to the regulator by the owner of the material or seized by the regulator for safe keeping over the past approximately 25 years. The materials in the facility can be considered as waste in that it is unlikely that there will be any further use for the materials;
- an interim store in Tasmania for some legacy radioactive waste from industry and medicine;
- a small, closed facility for radioactive waste which was generated in the Northern Territory, in a secure interim storage room at Royal Darwin Hospital;
- a radioactive waste store located on the grounds of the Health Protection Service at Holder in the Australian Capital Territory. The store contains a variety of radioactive material surrendered to the regulator by the owner of the material for safe keeping over the past decades. The materials in the facility can be considered as waste in that it is unlikely that there will be any further use for the materials in the future. The waste store has been at capacity for a number of years and no new materials are being accepted by the regulator. The store is located in open space at the rear of the premises and consists of a locked steel box that is mounted on a concrete slab and enclosed within a secure compound with swipe card access and an alarmed, 24 hour security system;
- a store situated on the Queen Elizabeth II (QEII) Medical Centre Site at Sir Charles Gairdner Hospital in Perth. 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 store is located within a fenced, locked compound and is linked to the 24-hour security of the QEII Medical Centre; and
- a purpose-built radioactive waste facility owned by the Queensland State Government located in South East Queensland at Esk in the Somerset Region (Figure 4). 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.

Figure 4: Queensland Radioactive Waste Store

The Mt Walton East Intractable Waste Disposal Facility is used for the disposal of intractable (chemical and radiological) waste generated within Western Australia. This facility lies about 75 km northeast of Koolyanobbing and approximately 53 km north of Jaurdi Station homestead. Access to the site is by a 100 km dedicated unsurfaced road that extends northward from the Boorabbin siding on the Great Eastern Highway. It is located on land within the Shire of Coolgardie. 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.

Wastes facilities at current mining operations and from past practices

Mining operation	Waste structures
Ranger Mine (NT) - operational	Tailings dam, evaporation ponds, and solid waste disposal stockpiles.
Beverley Uranium Project (SA) - operational	Evaporation ponds, liquid waste re-injection wells and low-level radioactive waste disposal facilities
Honeymoon Uranium Project (SA) - operational	Evaporation ponds, liquid waste re-injection wells and low-level radioactive waste disposal facilities.
Olympic Dam Uranium Project (SA) – operational	Tailings dams, associated evaporation ponds and a solid waste disposal pit.
Port Pirie Plant (SA) – past practice	Uranium and thorium tailings dams
Radium Hill Mine (SA) – past practice	Tailings and a low-level waste repository

In relation to abandoned tailings in the South Alligator region of the Northern Territory, the licence holder (Parks Australia North) has completed a new near-surface containment facility at El Sherana for uranium mining and milling tailings (UMMT) and contaminated materials.

Radioactive waste management inventory

Australia has approximately 4044 m^3 of radioactive waste (suitable for near-surface disposal) within civilian programs awaiting disposal. This total consists of the following approximations:

- 2100 m^3 of lightly contaminated soil from ore-processing research;
- 1936 m^3 of operational waste stored at the ANSTO site; and
- 8 m^3 of miscellaneous waste including contaminated items, medical equipment and luminous signs.

It should be noted that these figures are estimates of waste volumes for disposal. Waste that has already been disposed is not included in the above volume estimates. This includes waste disposed at:

- the Mt Walton East Facility in Western Australia (near-surface disposal facility);
- El Sherana in the Northern Territory (UMMT);
- Radium Hill Low-Level Radioactive Waste Repository in South Australia (near-surface disposal facility);
- Maralinga in South Australia (remediated nuclear weapons test site); and
- the Little Forest Legacy Site managed by ANSTO, New South Wales (legacy waste).

The current estimated inventory of radioactive waste in Australia that is not suitable for near-surface disposal consists of a waste volume of approximately 465.5 m^3. Of this:

- 275 m^3 is from irradiation cans, ion exchange resins (HIFAR and OPAL), irradiated aluminium cut from HIFAR spent fuel assemblies, HIFAR coarse control arms and general waste from radiopharmaceutical production;
- 165 m^3 is uranium and thorium residues stored at ANSTO;
- 11 m^3 is liquid waste from production at ANSTO of Mo-99 for radiopharmaceuticals; and
- 14.5 m^3 is miscellaneous waste held at various storage sites in Australia.

Annex A presents tables of the inventories of radioactive waste stored in facilities in Australia and waste that has been disposed of in the Little Forest Legacy Site, El Sherana, Maralinga and Mt Walton East facilities. These data have been supplied by the relevant regulatory authority with responsibility for maintaining the inventories of radioactive waste in their jurisdictions. It should be noted that these tables have not incorporated volumes of sealed sources, sources of unknown activity and sources of unknown radionuclides. Where the activities of waste with mixed radionuclides could be apportioned to individual nuclides, this was done. Inventories of sealed sources requiring disposal, 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.

There have been no burials at the Mt Walton East Intractable Waste Disposal Facility in Western Australia since 2011; hence the inventory is unchanged. Current plans are for a forthcoming burial campaign which is likely to be in 2015 or 2016.

Nuclear facilities in the process of being decommissioned

HIFAR, a 10 MW research reactor, was shut down in January 2007. In September 2008, ARPANSA granted ANSTO a licence to 'possess or control' the facility for a safe enclosure period (anticipated to be around 10 years and possibly longer); after that it is anticipated that a licence application to decommission the reactor will be lodged. Timing of the final dismantling of the HIFAR reactor will be dependent on the availability of the National Radioactive Waste Management Facility.

E. Legislative and Regulatory System

Developments since the Fourth Review Meeting:

Since the 2011 National Report, Australia has continued to develop national guidance relating to radioactive waste management as part of the national uniformity process, in which standards are developed, referenced in the NDRP (ARPANSA, 2014b) and adopted by Australian regulators. The goal is for radioactive wastes to be subject to uniform legislative and regulatory requirements across the nation.

In this period, five new or updated national standards have been published by ARPANSA in the Radiation Protection Series. These standards are:

- A new 'Fundamentals' document RPS F-1 *Protection Against Ionising Radiation* (ARPANSA, 2014a) which, together with a new RPS C-1 *Code for Radiation Protection in Planned Exposure Situations as Applied to Workers, the Public and the Environment* (expected to be published in 2014), will supersede RPS 1 (ARPANSA, 2002). RPS F-1 takes into account the most recent ICRP recommendations (Publication 103) and the new *International Basic Safety Standards* (IAEA, GSR Part 3, 2014).
- An update to the NDRP (ARPANSA, 2014b).
- An updated transport code RPS C-2 *Code for the Safe Transport of Radioactive Material* (ARPANSA, 2014c).
- An updated safety guide RPS 18 *Use of Radiation in Schools* (ARPANSA, 2012a), which includes guidance on storage, disposal and transport of radioactive sources.
- A new safety guide RPS 2.2 *Approval Processes for the Safe Transport of Radioactive Materials* (ARPANSA, 2012b), to assist in applying for approvals to transport radioactive material.

The near-surface disposal code, *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* (NHMRC, 1992) is currently under revision, to take into account recent international developments, particularly with respect to the new Australian waste classification system and the use of the safety case.

ARPANSA has taken steps to have all occurrences of 'nuclear waste' in the ARPANS Act and the *Australian Radiation Protection and Nuclear Safety Regulations 1999* (ARPANS Regulations) corrected to 'radioactive waste'. These and other amendments to the ARPANS Act and Regulations resulting from the IRRS review of ARPANSA are expected to take effect from 1 July 2015.

ARPANSA has published regulatory guides for licensing of radioactive waste storage and disposal facilities (March 2013) and siting of controlled facilities (August 2014).

Article 18 Implementing Measures

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

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 ARPANS Act, 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 codes and standards and the NDRP (ARPANSA, 2014b). The NDRP is a dynamic

document that will evolve as nationally agreed positions are reached by jurisdictions, and made effective by adoption into respective jurisdictional laws or by inclusion as conditions of respective jurisdictional licenses.

Article 19 Legislative and Regulatory Framework

Establishing and maintaining a legislative and regulatory framework

The objective of Australian radiation protection legislation includes protection of the health and safety of people and the environment from the harmful effects of ionising and non-ionising radiation.

The legislation current in each jurisdiction:

- establishes a regulatory body accountable to a Minister of the Crown and through that Minister to the Parliament;
- includes requirements to comply with 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 EPBC Act*.

The *National Directory for Radiation Protection* (ARPANSA, 2014b) contains the agreed *de minimus* regulatory requirements implemented in all Australian jurisdictions. The NDRP is the principal means for addressing the inconsistencies in radiation protection regulation across the various Australian jurisdictions. The NDRP provides an overall agreed framework for radiation safety, including both ionising and non-ionising radiation, together with clear regulatory statements to be adopted by the Commonwealth Government and the States and Territories. The NDRP is developed by all regulators though the processes of the Radiation Health Committee. This Committee, established under the ARPANS Act, includes radiation regulators from each jurisdiction. Additions to the NDRP require final approval from health ministers on behalf of respective governments from each of the jurisdictions before being adopted.

Recently ARPANSA has initiated an on-going transition of the RPS national standards documents to a structure comprising Fundamentals, Codes and Guides.

Safety requirements and regulations for radiation safety in Australia

The legislative and regulatory frameworks in each jurisdiction include the following principles and requirements:

- Radiation protection principles including justification of practices to ensure that benefits outweigh the detriment, radiation dose limitation and optimisation of protection and safety.
- 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 and provide the qualified expertise necessary to observe the requirements.

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

- Technical requirements such as shielding design and interlocks as necessary, to ensure that radiation sources remain within control and are secure from theft or damage.
- Defence-in-depth measures in facility design and operating procedures, which are intended to prevent accidents, to mitigate the consequences of accidents and to restore safety should an accident occur.
- 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 certifying compliance with safety requirements and standards.
- Maintenance of appropriate records and reports.
- Risk management principles, which include a broader evaluation of risk assessment that take scientific data and social and economic considerations into account.
- 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 established 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 and public exposure and dose limits	RPS No. 1 *Recommendations for Limiting Exposure to Ionising Radiation, National Standard for Limiting Occupational Exposure to Ionising Radiation* (Printed 1995 - Republished 2002); RPS No. F-1	ICRP Publications 60 and 103, and IAEA safety standards SF-1 (2006) and GSR Part 3 (2014)
Transport of radioactive material	RPS No. C-2, *Code for the Safe Transport of Radioactive Material (2014)*	IAEA *Regulations for the Safe Transport of Radioactive Material 2012 Edition* (SSR-6, 2012)
Mining and milling of radioactive ores	RPS No. 9, *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	*Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2* (2013), RHS 13 *Code of Practice for the Disposal of Radioactive Wastes by the User (1985),*RHS 35 *Code of practice for the near-surface disposal of radioactive waste in Australia* (1992)[†]	IAEA Safety Requirements *Near Surface Disposal of Radioactive Waste*, Safety Standards Series No. WS-R-1, 1999; superseded by IAEA Specific Safety Requirements *Disposal of Radioactive Waste*. (SSR-5, 2011)

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

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

Spent fuel

As previously reported, regulation of spent fuel is only undertaken within the Commonwealth jurisdiction by the Commonwealth Government regulator, the CEO of ARPANSA. Spent fuel management is regulated under a facility licence authorising the operation of the relevant facilities. Commonwealth Government legislation prohibits dealing with controlled material or conduct relating to a controlled facility without a licence.

Radioactive waste management activities

The legislative framework established by all Australian jurisdictions prohibits the use of non-exempt radioactive material (including radioactive waste) and ionising/non-ionising apparatus without an authorisation or 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. In most jurisdictions, licensing is also required where premises are operated by the regulator, such as stores for radioactive waste. For example, The *Radiation Safety Act 1975* (WA) requires prescribed radioactive substances, X-ray equipment and electronic products, together with the associated premises, to be registered. 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, to work under the direction and supervision of a licensee. Radiation regulators in most jurisdictions also licence the transport of radioactive material.

Naturally occurring radioactive material (NORM)

Guidance for deciding whether natural sources should be controlled is provided in the RPS No. 15 *Safety Guide: Management of Naturally Occurring Radioactive Material (NORM)* (ARPANSA, 2008a), which is consistent with the IAEA Safety Reports Series No. 49 *Assessing the Need for Radiation Protection Measures in Work Involving Minerals and Raw Materials* (2006). This does not apply to undisturbed ore-bodies or areas of high natural background. The application of the exemption and exclusion limits in the NDRP (ARPANSA, 2014b) also contributes to decisions on the control of natural sources, provided that the exemption and exclusion limits have been implemented via respective jurisdictional legislation.

Radioactive ores

Radiation protection regulation of the mining and milling of uranium ores is undertaken by radiation regulators in the States and Territories where such ores are mined – South Australia and the Northern Territory and, prospectively, Western Australia and Queensland. In South Australian legislation, radioactive ores are regulated if they contain more than 35 kBq/kg of a radioactive element or compound, which in the case of uranium ore is approximately 0.02% uranium by mass. Waste from ore processing is not considered radioactive waste unless these limits are exceeded. However, all solid wastes originating within a supervised area of uranium mining or milling operations in South Australia are designated as radioactive unless clearly demonstrated otherwise. For example, for recycling material 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 not meeting these criteria is disposed of on-site according to the approved Radioactive Waste Management Program.

Institutional control, regulatory inspection, documentation and reporting

Through implementation into respective jurisdictional laws, users of radioactive materials, including radioactive waste, are subject to the responsibilities detailed in RPS1. 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; and
    - assessment and compliance.
2. The management of radiation safety for medical exposures.
3. Radiation safety in emergency situations.
4. Radiation safety in existing situations.

In accordance with Regulation 63 of the ARPANS Regulations, ARPANSA has published guidelines[‡] on how Commonwealth licence holders should 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[§] to monitor and enforce compliance with the Act, its Regulations[**] and licence conditions.

The ARPANS Regulations require licence holders to review and update any plans and arrangements for managing a controlled facility, controlled material or controlled apparatus at least every 12 months, to ensure the health and safety of people and protection of the environment. Section 36 of the ARPANS Act allows the CEO of ARPANSA to impose additional, or vary existing, licence conditions.

ANSTO radioactive waste and spent fuel

Under the ARPANS Act, ANSTO must comply with the following statutory conditions set out in the subordinate Regulations in the management of waste facilities and spent fuel:

- 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.
- 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,

[‡] These guidelines can be found at www.arpansa.gov.au/pubs/regulatory/guides/OS-COM-SUP-270B.pdf
[§] A copy of ARPANSA's inspection policy is also available for viewing at: www.arpansa.gov.au/pubs/regulatory/licenceholders/OS-MAN-280_InspectionPolicy.doc
[**] A copy of the ARPANS Act and Regulations is available at www.arpansa.gov.au/Regulation/Legislation/index.cfm

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.

Radioactive ores

The mining or milling of radioactive ores in South Australia is subject to regulatory control via a licence to conduct mining or mineral processing issued under section 24 of the *Radiation Protection and Control Act 1982* (SA). Conditions attached to the licence require uranium mining operators to comply with the requirements of the mining code [*Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)* (ARPANSA, 1992)] and RPS1.

Companies in South Australia that hold licences to conduct mining or mineral processing of 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 mining code. In the 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 the *Mining Act 1971* (SA).

In the case of radioactive wastes remaining from mining or processing of radioactive ores that ceased prior to the introduction of the South Australian *Radiation Protection and Control Act 1982*, legislative control is achieved via a facilities licence under section 29A of the *Radiation Protection Control Act 1982*.

Uranium 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.

In the Northern Territory, qualified staff and financial resources are provided by the Territory Government for a program of inspections of uranium mining activities under its jurisdiction.

Mt Walton East Intractable Waste Disposal Facility

The safety of the Mt Walton East Intractable Waste Disposal Facility in Western Australia is assessed regularly, as required by the conditions of registration, in particular the requirement 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 trenches.

The site operator must hold a registration under the *Radiation Safety Act 1975* (WA). 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 1983*, *Code for the Safe Transport of Radioactive Material (2008)*, the near-surface disposal code (NHMRC, 1992) and IAEA Technical Reports Series 376 *Quality Assurance for Radioactive Waste Packages* (1995). Additionally reference is made to documentation specifically developed for Mt Walton East.

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

Enforcement of regulations 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 also enables the regulator to suspend, vary or cancel an authorisation in specific situations.

Where an Australian regulator makes a decision to suspend, vary or cancel an authorisation, best practice is that all other relevant regulators within and outside of its jurisdiction should be advised 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.

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 conduct mining or mineral processing of 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.

As noted previously in this document, the South Australian radiation regulator is responsible for granting approvals under the mining code. 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 Northern Territory, regulation of the mining of uranium ores is undertaken by the mining regulator in accordance with the *Mining Management Act* (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).

Article 20 Regulatory Body

Regulatory authorities responsible for implementing the legislative framework

The regulatory authority established in each jurisdiction for the purpose of implementing their radiation safety regulations is also designated with implementation and maintenance of the requirements of this Joint 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 Australian Defence Force. The staffing of radiation protection regulators in each jurisdiction varies from 2 up to about 20 staff depending on the population and scale of operations within that jurisdiction. Staff members possess the experience, skills and knowledge needed to undertake their regulatory activities.

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

Jurisdiction	*Radiation protection regulatory body (and relevant section)*	*Approximate number and type of licensees/licences*	*Number of staff in the regulatory body*	*Expertise of regulatory staff*
Commonwealth	Australian Radiation Protection and Nuclear Safety Agency (Regulatory Services)	90 licences (~60 source and ~30 facility) including for defence forces, a radiopharmaceutical production facility, 2 research reactors (1 operating, 1 shutdown)	25	20 regulatory scientists and engineers, 1 policy, 4 administrative
South Australia	Environment Protection Authority	6 mines licensed to conduct mining or mineral processing of radioactive ores (4 uranium mines and 2 mineral sands mines). 1 company licensed to conduct developmental testing of a process involving radioactive ores. 3 sites licensed as facilities where radioactive material from past practices are stored or disposed. 1 facility licensed to produce radioactive material. Approximately 160 registered premises where unsealed radioactive substances are handled or kept. Approximately 780 registered sealed radioactive sources. Approximately 1000 individuals licensed to use or handle radioactive substances.	14	12 scientific and technical, 2 administrative and clerical staff
New South Wales	Environment Protection Authority (Hazardous Materials, Chemicals and Radiation Section)	2778 radiation management licences to sell/possess radioactive substances or radiation apparatus, under which are held 1052 sealed source devices and 265 premises where radioactive substances are kept or used.	13	8 scientific and technical, including policy, and 5 administration staff

Jurisdiction	*Radiation protection regulatory body (and relevant section)*	*Approximate number and type of licensees/licences*	*Number of staff in the regulatory body*	*Expertise of regulatory staff*
		13471 radiation users licences (either radiation apparatus or radioactive substances)		
Queensland	Queensland Health (Radiation Health)	2170 possession licensees, 14576 use and transport licensees 5167 sealed radioactive sources registered 8967 radiation apparatus registered	16	10 scientific, 1 administrative In the Radiation Health unit, others in associated (licensing) team
Tasmania	Department of Health and Human Services (Radiation Protection Unit)	354 licences (consisting of 780 apparatus, 530 radioactive materials, 2000 authorised persons)	4	3 scientific and 1 administrative
Victoria	Department of Health (Radiation Safety section)	11014 operator licences, 3501 management licences	14	7 technical and policy staff, 7 administrative staff
Western Australia	Western Australian Radiological Council (Radiation Health Branch)	5759 licences, 1839 registered premises including 1 operating disposal facility 5125 sealed sources registered 4430 radiation apparatus registered	17	1 technical, 13 scientific and policy, 3 administrative
Australian Capital Territory	Australian Capital Territory Radiation Council (Radiation Safety Section of the Health Protection Service)	590 registrations, 1100 licensees	2	2 scientific
Northern Territory	Department of Health (Radiation Protection Section of Environmental Health)	998 licensees 467 registered apparatus 295 registered sealed sources	2.5	2 scientific, 0.5 administrative

Effective independence of the regulatory function

Within all jurisdictions in Australia, there is an effective independence between the appropriate regulatory authorities for radiation safety and other areas within organisations dealing with spent fuel or radioactive waste management, with the exception that the regulatory bodies all have some sources and store a small quantity of radioactive waste. Some jurisdictions have a form of executive management, independent of the regulatory body that can make decisions upon the safe management of facilities belonging to the regulatory body.

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, the regulatory authority 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 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 Somerset Regional 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 Western Australia, the registration of the radioactive waste store at the Queen Elizabeth II Medical Centre Site at Sir Charles Gairdner Hospital in Perth is held by the Radiation Health Branch of the WA Department of Health. The WA Radiological Council does not own/operate the store. The Radiological Council requires a registration of premises and sources and imposes conditions on the registration.

F. Other General Safety Provisions

Article 21 Responsibility of the Licence Holder

In accordance with the NDRP (ARPANSA, 2014b), Commonwealth legislation requires that a 'responsible person' be primarily responsible for radiation protection and safety. The responsible person is defined as the person who has overall management responsibility for the security and maintenance of the sources, apparatus, installation or facility and in whose name the source, apparatus, installation and facility would be registered if required.

The uranium mine facilities in South Australia and in the Northern Territory are privately owned and any liability will be carried by the owner. To protect against the contingency of a private company ceasing to exist, the South Australian and Northern Territory regulatory bodies require a bank guarantee or cash deposit before operations can commence. However, the bond for the existing Ranger uranium mine in the Northern Territory is held by the Commonwealth because of its authorisation arrangements.

Dedicated facilities for storage of radioactive material in each of the jurisdictions are owned and operated by the relevant State or Territory.

Enforcement actions

For Commonwealth regulated entities, penalties incurred for non-compliance with the ARPANS Act are based on the provisions of the Commonwealth Criminal Code. The imposition of penalties is the most severe enforcement action that could be taken against a licence holder and would only be resorted to if lower order enforcement action was either inappropriate, given the seriousness of the circumstances of the breach, or had not had a desired effect on the behaviour of a licence holder.

Queensland reports that a range of regulatory actions are available ranging from imposition of improvement notices, prohibition notices, seizure of radiation sources as well as revocation of licences and court action. The last prosecution in Queensland occurred in the early 1990s. The potential for seizure of radiation sources is seen as the most effective means of achieving compliance. Similar provisions exist in all Australian jurisdictions.

Article 22 Human and Financial Resources

Regulatory agencies

All jurisdictions have reported that regulatory authority staff possess the essential skills, knowledge and expertise to assess the safe 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 spent fuel management and radioactive waste management facilities at ANSTO and to inspect these facilities for regulatory compliance.

Recruiting qualified staff is an issue, as there is a relatively small pool of qualified radiation protection and nuclear safety experts within Australia. Measures have been put in place to maintain training and professional development opportunities for younger or less experienced staff and to allow staff to attend courses, seminars and conferences as needed. A number of staff are supported by ARPANSA to complete graduate studies at Australian universities.

ANSTO

Within ANSTO, staff that are responsible for the management of radioactive waste and spent fuel are appropriately trained and competent 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's 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.

ANSTO has an established ongoing 'Talent Review' process for succession planning. During this process, successors are identified for all linchpin (critical) roles in the organisation. If critical gaps are identified for these linchpin roles, ANSTO directs resources and develops a strategy to minimise this risk. The strategy may be one of intensive development for successors, a recruitment drive for this role or a combination of these methods.

One of the key activities to build the strength of ANSTO's 'long-term talent pipeline' started in 2008, when ANSTO employed 12 graduates who commenced a two year development program. Further intakes commenced in 2010 (24 Graduates), 2012 (8 Graduates) and ANSTO has just recruited for 2014 (14 Graduates). ANSTO also has development pathways available for post-doctoral graduates (1 year program), 'Year in Industry' students (1 year program) and vacation students (3 month program), as well as for apprentices and trainees. Each year these students are recruited for project roles and evaluated for potential future positions in the talent pipeline.

In addition, ANSTO has a 'development needs analysis' process, which is part of the Annual Performance Effectiveness Appraisal scheme and is also linked to the development needs of the ANSTO 'talent pipeline'. ANSTO's dedicated Safety and Radiation Protection staff deliver a range of training courses to other staff. ANSTO has a core pool of internal professionals as well as 'preferred supplier' relationships with providers who consistently deliver value-added programs for those areas where ANSTO does not have internal expertise or requires additional resources.

In 2012, ANSTO's training budget was centralised to allow a more focussed use of funds to support core development needs across the organisation that are of both a mandatory and non-mandatory nature. The training is aligned to support the development needs of ANSTO's 'talent pipelines'. The adequacy of ANSTO's financial resources is reviewed on an ongoing basis. ANSTO is a statutory body of the Commonwealth, so the ultimate liability lies with the Commonwealth Government. Funding of the proposed National Radioactive Waste Management Facility is a matter for the Commonwealth Government.

Operators and licence holders

Under the *Mining Management Act* (NT) and the *Work Health and Safety (National Uniform Legislation) Act 2011* (NT) the operator of a mine must ensure all workers are trained and competent to perform the work they are employed for. In the case of Ranger Mine and the Ranger Authorisation, the operator must implement a system to control radiological exposure of people. There is radiation reporting and monitoring requirements and the need for a Radiation Safety Officer as defined in the mining code (ARPANSA, 2005). With respect to operator capabilities, in Victoria, and in Western Australia if the support required is of a significant level, authorised practices that generate radioactive wastes are advised to access commercially available health physics support to assist with waste management.

In South Australia 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 *Radiation Protection and Control Act 1982* (SA) and its Regulations.

In the case of other jurisdictions, a number of different approaches are used commensurate with the types of sources and expertise of the licence holder. Tasmania requires that all licence holders have radiation management plans that specify a radiation safety officer, their duties and the roles and responsibilities of all persons expected to be dealing with radiation sources. Changes to the plan or personnel specified must be approved in advance. Other jurisdictions specify in conditions of licence that adequate staffing is required or that a list of all holders of authority be provided. In remaining jurisdictions, inspection of premises to ensure necessary safety requirements are being met and an emphasis on the responsibility of licensee to comply with requirements are used.

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. The facility is owned by the Western Australian Government and the financial responsibility for post-closure monitoring would be borne by the Western Australian Government. There are no specific funds set aside for monitoring after closure.

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. Within the Commonwealth, these programs include certification to ISO 9001 and ISO 14001 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. For example, periodical audits and inspections by the Northern Territory Government are conducted by Radiation Protection (NT Department of Health). Under NT legislation, this extends to inspections based on a sound knowledge of radiation risk and quality assurance of procedures that are controlled by the licence holder. Periodical inspections and audits form part of the regime for mining operations.

Article 24 Operational Radiation Protection

States and Territories that operate radioactive waste management or disposal facilities are subject to national dose limits that are consistent across Australia's nine jurisdictions. RPS1 stipulates an effective dose limit of 20 mSv per year for workers, 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, licence conditions can include a requirement for disposal of radioactive waste and the use of personal radiation monitors. Dose constraints are set by the relevant jurisdiction where applicable.

In addition to the dose limits discussed previously, some jurisdictions use management plans such as those required in the mining code (ARPANSA, 2005). Independent audits are generally used by Australian jurisdictions to verify compliance with management plans. Jurisdictions also apply the requirements of the user disposal code (NHMRC, 1986) which is in the process of being replaced by a schedule in the NDRP (ARPANSA, 2014b) 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. Some of the State and Territory stores only contain sources of very low activity, or are no longer active. An example is the Northern Territory Government's Interim Storage Room (no new waste has been received there since 1996). Due to its inactive status, operational radiation protection is

limited to periodical audits and to maintaining security of the store. Wall thickness and location prevent any emission of radiation in the environment while the contents provide a negligible exposure to people outside the store. Discharge of radioactive material into the environment is impossible.

In relation to the spent fuel and radioactive waste management facilities at ANSTO, the ANSTO Occupational 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. The monitoring results show that, by use of conservative assumptions, members of the public resident in areas surrounding the site receive less than 1% of the public dose limit of 1 mSv per year as a result of discharges from the ANSTO facilities. Public health studies have confirmed that the operation of ANSTO's facilities has had no negative impact upon the health of nearby residents.

Public dose constraints of 0.1 mSv per annum for liquid effluent discharges to sewer and 0.3 mSv per annum for airborne discharges are imposed on the ANSTO (Lucas Heights) site, where all nuclear installations are operating, 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. In addition, ARPANSA has issued ANSTO with facility licences specifying the annual notification levels for airborne discharges of radioactive material to the environment.

ANSTO has an internal ALARA trigger that requires investigations for annual worker doses greater than 2 mSv as part of the optimisation process. An investigation level of 1 mSv per month for effective dose is also set for occupationally exposed workers. Exposures above this level require a documented investigation and follow up action to reduce radiological exposure, if applicable. The system of radiation protection employed and the results of occupational monitoring are 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.

Article 25 Emergency Preparedness

Emergency plans

There is no overarching national nuclear emergency plan in Australia. The responsibility for the immediate radiation emergency response resides with the states and territories and there are plans covering both nuclear and radiological emergencies. The ARPANSA publication RPS No. 7 *Recommendations: Intervention in Emergency Situations Involving Radiation Exposure* (ARPANSA, 2004) provides guidance to Australian regulators for the implementation of protective measures in radiological and nuclear emergencies. RPS No. 7 is included as part of the NDRP (ARPANSA, 2014b).

At the national level, there is a rotating exercise schedule covering security, consequence management and other disasters relating to emergency response. The schedule rotates on a two year cycle through the states and territories. During the cycle, both field and table top exercises are conducted in order to test management and field responses at all levels.

A lesson learned from the Fukushima Daiichi accident is the importance of being prepared, before any accident should occur, for post-accident recovery ('remediation preparedness'). In ARPANSA's regulatory guide for licensing of radioactive waste storage and disposal facilities [*Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2* (OS-LA-SUP-240L, March 2013)], an application for any licence covered by the Regulatory Guide must, as part of the licence application, provide information on remediation preparedness. Demonstration of adequate preparedness to remediate the effects of any

environmental contamination arising from a radiation accident, including in the transport of radioactive materials, should include information on the following:

- division of roles and responsibilities in accident recovery, including the role of stakeholders;
- approaches to defining targets and end states;
- methods and technology available for environmental remediation; and
- description of a generic waste management program, including the use of the concepts of exemption and clearance, predisposal management and conditioning, storage and ultimate disposal of the potentially large amounts of waste arisings from environmental remediation.

Acknowledging that it is too late to begin planning for accident recovery after an accident has occurred, the purpose of such remediation preparedness includes, importantly, helping to build trust and provide assurance for relevant stakeholders.

Commonwealth support

Emergency Management Australia, which is part of the Commonwealth Attorney General's Department, is the Commonwealth agency responsible for coordination of Commonwealth Government consequence management activities in support of state and territory governments, in accordance with existing emergency management arrangements.

Commonwealth Government response plans are written in terms of a generic national response, with provision to support the States and Territories when requested. Commonwealth Disaster Plan arrangements in the event of a radiological or nuclear incident are reviewed regularly and exercises conducted as appropriate.

ARPANSA maintains specialised teams to support State and Territory arrangements to respond to radiation emergencies. These teams undertake ongoing training to ensure that the personnel in the teams have the required skills and resources to carry out the task expected of them in an emergency situation. The requirements and capabilities of these teams are intended to be consistent with the IAEA Radiation Assistance Network teams. ARPANSA provides its own in-house radiation emergency training for the staff forming the ARPANSA teams, including lectures, field deployment and exercises at local, national and international level.

Storage and disposal facilities

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

- emergency preparedness plans for the institution (such as a hospital) in which the waste facility is located;
- remediation procedures in the event of an incident, requirement for periodic incident response exercises and the review of results of exercises;
- advice to 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 staff.

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.

ANSTO

On-site arrangements for emergencies at the OPAL Research Reactor and associated spent fuel management facilities at Lucas Heights are the responsibility of the reactor operator ANSTO. It is a requirement of its ARPANSA Licence that ANSTO complies with the content of these arrangements, including the annual review and exercising of the emergency arrangements. The off-site arrangements for emergencies at the Lucas Heights facility are covered in a NSW State Sub-Plan and these are reviewed and exercised regularly, in line with other State Plans.

In the case of spent fuel and radioactive waste management facilities at ANSTO, the *ANSTO Lucas Heights Scientific and Technical Centre (LHSTC) Emergency Management Plan,* developed in close consultation with the emergency services agencies, covers response to accidents and incidents at the ANSTO facility.

Radiological emergencies in the vicinity of Australian territory

Given Australia's geographical position, it is unlikely that Australia could be affected by a radiological emergency at a spent fuel or radioactive waste management facility in a neighbouring country. However, emergency plans in all jurisdictions could be applied in responding to regional emergencies if necessary.

Article 26 Decommissioning

Section 32 of the ARPANS Act includes the requirement that the CEO of ARPANSA must take international best practice in radiation protection and nuclear safety into account when making a licensing decision about decommissioning of a facility. For Commonwealth regulated entities, ARPANSA has the power to ensure that the licence holder has appropriate numbers of qualified staff to perform the required safety related duties as ARPANS Regulations require an applicant for a licence to demonstrate through its plans and arrangements that it can manage safety and has capacity to comply with the regulations and licence conditions.

State and territory radioactive waste storage facilities

In the States and Territories, most simple storage facilities operated by the regulators would not require complex procedures to be undertaken in order to decommission the facility. Hence some do not have decommissioning plans in place but would require development of plans prior to undertaking specific decommissioning activities. More complex facilities require a preliminary or conceptual decommissioning plan as part of the overall radiation management plan for the facility. Current regulatory requirements adequately address the provision of resources, operational limits, emergency plans and record keeping in regard to decommissioning and closure of disposal facilities 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.

Emergency plans in all jurisdictions can be applied to the operation of facilities as well as decommissioning. Jurisdictions in which uranium mining has occurred also require maintenance of relevant records.

Exploration and mining sites

In South Australia, uranium and mineral sands mining companies are expected to provide appropriate technical expertise and resources for the decommissioning of their mining facilities. Provisions of the South Australia radiation protection legislation can be applied to require a company to provide appropriate resources and personnel for decommissioning.

Under the *Mining Act 1971* (SA) a bond may be set by the relevant Minister to recover costs of rehabilitation of mining sites. The bond is set at a level to cover the estimated cost for rehabilitation of the mine and milling site to current standards. The value of these bonds is revised periodically. In the case of the Olympic Dam project the *Roxby Downs (Indenture Ratification) Act 1982* (SA) (Indenture Act) 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.

In the Northern Territory securities for all exploration sites and mines are calculated by the Northern Territory Government, based on the disturbance and estimated rehabilitation cost. Mines must submit a Mine Management Plan annually. The appropriate security is reviewed and upgraded where necessary, based on this plan and planned future operations. The security is lodged with the relevant government department and is held against the operator to ensure satisfactory closure and rehabilitation of the site. On successful completion and rehabilitation of the site, the security held by the department is refunded to the operator. Securities are held against all authorised exploration and mining sites. The exception is the Ranger uranium mine, the only operating uranium mine in the Northern Territory. Regulation of this mine is carried out under a joint working agreement between the Commonwealth and Northern Territory Governments, and the security is held in trust by the Commonwealth Government.

In the case of the Ranger uranium mine the operator is required to submit an annual rehabilitation plan based on a scenario that the mine will cease operations on 31 March of that year and is unable to recommence operations. The operator must outline plans and costings to close and rehabilitate the mine site. Both the Commonwealth and Northern Territory Governments and the Northern Land Council review the plan. Following agreement with the operator on the appropriateness of the plan, the Commonwealth engages an independent assessor to review the costs before they are approved. The security is updated to the new agreed amount for that year and is held by the Commonwealth Government.

ANSTO

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, provision of 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.

A detailed characterisation program is being developed for the HIFAR research reactor. An objective of the program is to determine the waste types and volumes leading to a decommissioning licence application and detailed plans for the eventual dismantlement. This program is expected to be completed by 2018, leading to the commencement of decommissioning activities pending a licence being issued by ARPANSA and the availability of the National Radioactive Waste Management Facility to accommodate waste arisings.

Each year ANSTO allocates funds to decommissioning projects. ANSTO is also updating a decommissioning process plan for long-term planning and management of decommissioning projects. ANSTO is cognisant of the challenges posed by diminishing numbers of staff qualified in the nuclear industry and is actively seeking to ensure appropriate resources in future years. Measures are in place to maintain the training and professional development of younger, less experienced staff; where necessary, staff are recruited

internationally, and new staff are being attracted through a focussed graduate recruitment program. Refer to the discussion on this issue in relation to Article 22 for more details.

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.

The ANSTO LHSTC Emergency Management Plan encompasses all facilities at the site, including the shut-down HIFAR reactor.

G. Safety of Spent Fuel Management

Within Australia, only Commonwealth Government agencies manage spent fuel. Thus this Section only refers to ANSTO, which manages spent nuclear fuel, and ARPANSA, which as the regulator licences the spent fuel management facilities. 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 Joint Convention was examined in detail as part of the consideration of its applications to the regulatory body ARPANSA for authorisations to prepare a site, construct and operate the facility.

Article 4 General Safety Requirements

Measures to prevent criticality and ensure removal of residual heat

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 each fissile nuclide is also stipulated by operational limits and conditions for spent fuel storage.

Measures to ensure minimum practical generation of radioactive waste

Under its Radioactive Waste Management Policy, ANSTO minimises its generation of radioactive waste by a number of different mechanisms, including selection of appropriate materials and strict segregation of active and non-active wastes. 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 processes address the interdependencies among the different steps in spent fuel management. These include adequate time required for the spent fuel to cool in a shielded wet storage facility, criticality control measures, cooling water chemistry control to ensure the integrity of the spent fuel stored under water, trained and competent staff, appropriately licenced spent fuel facility, inventory and safeguards management, and all related transport logistics.

Protection of individuals, the public and the environment

Commonwealth nuclear safety legislation, the ARPANS Act, together with 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

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 (Figure's 5 & 6), although dry storage had been used for HIFAR spent fuel in the past (Figure 7) and the facility is available for use as required. Management of the wet facilities entails monitoring and controlling the pond

chemistry, and radiation safety is maintained by standard practices as applied to all radioactive materials whether in dry or wet storage. The secure former spent fuel dry storage cells are currently used for storage of spent uranium filter (SUF) cups resulting from the fission molybdenum-99 production process.

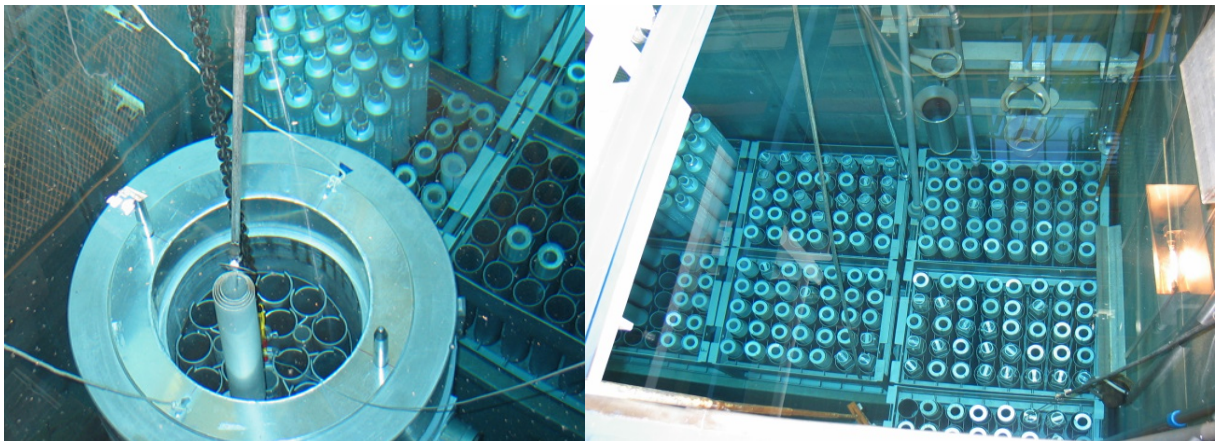

Figure 5: Wet storage facilities used for former HIFAR reactor spent fuel

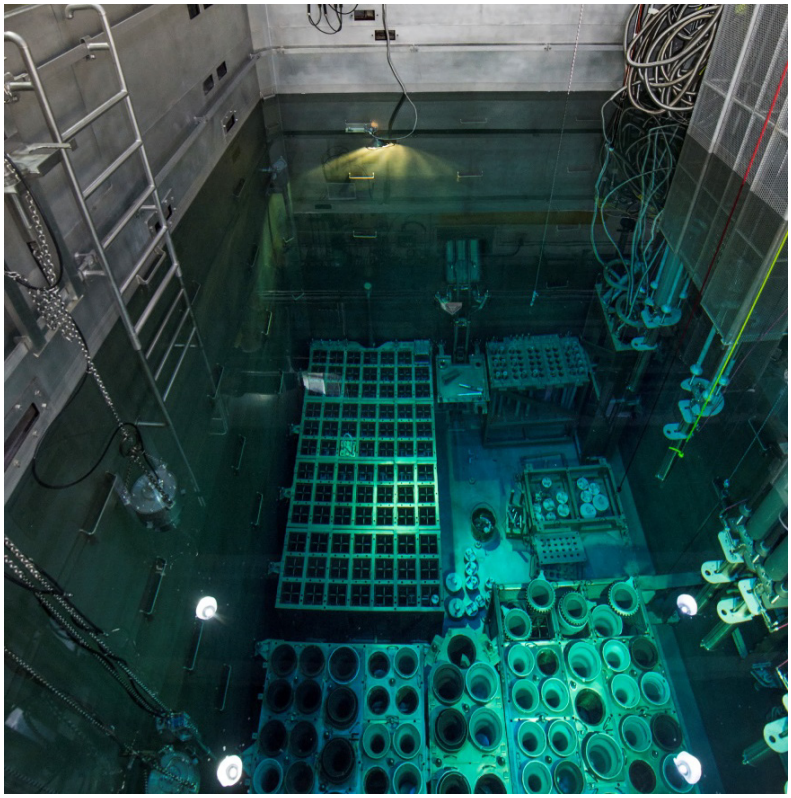

Figure 6: OPAL Reactor Service Pool including spent fuel rack storage

Figure 7: ANSTO's dry-storage facility

Avoiding greater and undue burdens on future generations

'Burden on future generations' is considered when assessing an application to operate or use a nuclear facility, equipment or material. The CEO of ARPANSA must consider international best practice in radiation protection and nuclear safety when assessing each licence application, and in addition must consider:

- 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;
- 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.

Article 5 Existing Facilities

There are no spent fuel management facilities currently in use which were existing at the time the Convention entered into force for Australia in 2003. The only spent fuel management facility currently in operation is the OPAL Reactor Service Pool. Other spent fuel management facilities are available and will be brought back into service in the near future as preparations for spent fuel shipments eventuate.

Article 6 Siting of Proposed Facilities

Commonwealth Government environment legislation (EPBC Act) requires that an application for a proposed facility that is characterised as a nuclear action* must be referred to the Minister for the Environment, who determines whether an approval is needed and, if so, the required level of assessment.

The ARPANS Act 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. This assessment must include an evaluation of:

- site-related factors likely to affect the safety of the facility during its operating lifetime;
- public protection;
- international best practice; and
- protection of the environment.

In 2014 ARPANSA published a regulatory guide on the siting of controlled facilities [*Regulatory Guide: Siting of Controlled Facilities v2* (REG-LA-SUP-240L, August 2014)] to assist applicants in meeting these criteria.

In accordance with Regulation 40 of the ARPANS Regulations 1999, ARPANSA must invite public submissions on any application involving a nuclear installation. The CEO of ARPANSA is required 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 licences to prepare a site for, to construct and to operate ANSTO's OPAL research reactor, including its spent fuel management facilities. The EPBC Act also has statutory public engagement requirements. The Minister for the Environment is required to invite comments on any referral prior to a decision whether it is a controlled action and if it is a controlled action, comments are to be invited as part of the assessment.

Consultation with other Contracting Parties

Considering the geographical position and size of Australia, it is unlikely that Australian spent fuel management facilities would have impacts on other Contracting Parties.

Article 7 Design and Construction of Facilities

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.

At the design stage, plans and other provisions for decommissioning of a facility are required in conceptual form. They must be revised and updated as the facility moves through the different licensing stages.

Validation of technologies used

Spent fuel from the OPAL reactor is managed in a service pool adjacent to the reactor pool. Like all safety systems in the OPAL reactor, the design of the service pool was subjected to a rigorous safety assessment process by ANSTO and INVAP (the Argentine company that constructed the OPAL reactor) prior to approval

* Commonwealth actions or actions affecting Commonwealth land that have, will have or may have a significant impact on the environment are also required to be referred under the EPBC Act.

by the CEO of ARPANSA. Additionally, approval by the CEO of ARPANSA was required before construction of structures, systems and components which were identified as being important for safety.

Article 8 Assessment of Safety of Facilities

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

The updated ARPANSA *Regulatory Guide: Plans & Arrangements for Managing Safety v5* (REG-LA-SUP-240B, May 2014) sets out the regulatory expectation and therefore the criteria by which the adequacy of a radiation management plan is judged.

Updated and detailed versions of the safety and environmental assessments must be prepared as part of the application for a licence to operate a spent fuel management facility. This application must be approved before operation can commence.

Article 9 Operation of Facilities

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

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

Licence conditions require that:

- operation, maintenance, monitoring, inspection and testing must be conducted in accordance with established procedures;
- engineering and technical support in all safety-related fields must be available throughout the operating life of the spent fuel management facility; and
- incidents significant to safety must be reported to the regulatory authority in a timely manner by the licence holder.

Compliance is ensured through regular inspections by the regulatory authority.

Collection and analysis of operating experience

Under the ANSTO Business Management System and the Work 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 seeking approval for implementation. The Draft ARPANSA Decommissioning Guideline states that it is expected that the operating organisation will progressively update the decommissioning plan throughout the life of the facility and that each separate application for authorisation under the ARPANS Act (siting, construction, operation and eventually decommissioning itself)

will include a decommissioning plan. Each updated plan must take into account recent experience derived from international developments in decommissioning practice.

Article 10 Disposal of Spent Fuel

As Australia has no plans for direct disposal of spent fuel, this provision has no current application to Australia.

H. Safety of Radioactive Waste Management

Article 11 General Safety Requirements

Measures to prevent criticality and ensure removal of residual heat

Criticality is considered in guidance provided by the *Safety Guide: Predisposal Management of Radioactive Waste* published by ARPANSA in September 2008 (ARPANSA, 2008b). 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.

ANSTO holds small amounts of radioactive wastes with fissile material associated with its production of molybdenum-99 for nuclear medicine. Specifically, residual uranium from LEU target plates is captured on filter cups, which are stored at ANSTO's waste management facilities. Criticality of the uranium in these filters is prevented though operating limits and conditions and verified by criticality certificates.

Heat removal and criticality are addressed in the design and operation of relevant facilities. For example, all steps in waste management at ANSTO 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 addressed in facility design.

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

Measures to ensure minimum practical generation of radioactive waste

The predisposal management safety guide (ARPANSA, 2008b) provides detailed guidance on methods of minimising waste generation both at the facility design stage and during operations.

Waste contaminated with short-lived radionuclides 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 NDRP (ARPANSA, 2014b).

In most jurisdictions, licensees are required to prepare plans for the management of waste, including 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 predisposal management safety guide (ARPANSA, 2008b). The guidance includes consultation with responsible personnel and organisations.

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

National legislation to protect individuals, society and the environment

The legislative systems in place in Australia, described in *Section E: Legislative and Regulatory System* of this report, underpin the process of minimising the risk of harm to individuals, society and the environment from exposures to ionising radiation that result from the management of radioactive waste. These systems are based on the document RPS1 (ARPANSA, 2002), which in turn is consistent with the Basic Safety Standards (IAEA, 1996) and ICRP Publication 60 (1990). RPS 1 has been partially superseded by RPS F-1 (ARPANSA, 2014a).

The national standard has since been adopted into legislation by each jurisdiction. However, some of the state and/or territory regulations predate the ICRP Publication 60 recommendations, and the ICRP Lung Model described in ICRP Publication 66, and as such are not up to date with respect to current dose conversion factors.

A review of RPS1 has commenced to bring it up to date so that it is consistent with ICRP Publication 103. This review is expected to be completed within the next year. To date there are no plans to specifically adopt ICRP Publication 66 into legislation in Australia, although it may be considered as part of the review of RPS1.

Assessment of biological, chemical and other hazards

ARPANSA's regulatory guidance documents on management of radioactive waste are intended for use by waste producers to assist in achieving compliance with mandatory Australian requirements.

The predisposal management safety guide (ARPANSA, 2008b) advises that the radioactive waste management plan, safety assessment and management system should include consideration of the physical, chemical and/or biological characterisation of waste. The 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 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 near-surface disposal code (NHMRC, 1992) requires that an assessment of the likely behaviour of the waste in the geochemical environment of a disposal facility be undertaken.

The facility located at Mt Walton East in Western Australia is the only operating near-surface disposal facility for radioactive waste in Australia that accepts packaged wastes. Material accepted by the facility has to comply with the waste acceptance criteria specified by the operator of the facility.

Avoiding greater and undue burdens on future generations

As part of the application of the optimisation principle, RPS1 states that the risks to individuals in the case of potential exposures should be optimised, taking social and economic factors into account. 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.

Article 12 Existing Facilities and Past Practices

Existing Facilities

In this report, the term 'existing facilities' is taken to refer to radioactive waste management facilities that were under regulatory control at the time the Joint Convention entered into force in Australia on 3 November 2003. 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 majority of ANSTO's waste management facilities were in existence at the time the Joint Convention entered into force in Australia. These facilities are subject to regulatory requirements including inspection and ongoing review for compliance.

All other existing storage facilities are currently under regulatory control in the appropriate jurisdictions.

Radium Hill

The Radium Hill Low-Level Radioactive Waste Repository in South Australia was operated by the South Australian Government from 1981 to 1998. The material disposed at this repository was mostly naturally occurring radioactive materials from mining and mineral processing operations conducted in South Australia. The site was registered as a premises under Section 29 of the South Australian *Radiation Protection and Control Act 1982* in 2003. The site is now licensed under section 29A of the Act as a facility containing unsealed radioactive substances resulting from past practices. Conditions were attached to the licence to provide for 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. The repository is now closed.

Port Pirie

The site of the former Port Pirie Treatment Plant, also in South Australia, is a legacy site where radioactive tailings remain from the processing of uranium ore concentrate from the Radium Hill uranium mine during a period from 1954 to 1962. The site is also licensed under section 29A of the *Radiation Protection and Control Act 1982* as a facility containing unsealed radioactive substances resulting from past practices. Conditions on the licence provide for the development of an appropriate long-term management plan for the site.

Mt Walton East

The disposal of radioactive wastes at the Mt Walton East facility in Western Australia (Figure 8) 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 near-surface disposal code (NHMRC, 1992). Radiation monitoring at the disposal facility is carried out in accordance with documented requirements given by the regulator. Measurements include absorbed dose rates in air, radon concentration in air, radionuclide concentrations in water, and pre- and post- disposal measurements. Personnel monitoring is carried out during a disposal campaign.

Figure 8: The Mt Walton East Intractable Waste Disposal Facility in Western Australia

Maralinga

The former British Atomic Weapons Test Site at Maralinga, South Australia, was rehabilitated through the 1990s. The organisation responsible for the ongoing management of the site was licensed by ARPANSA to possess and control radioactive material collected during the clean-up from 30 October 2000 until responsibility for regulating the site was transferred to the South Australian Government on 16 November 2009. The site is now licensed under Section 29A of the *Radiation Protection and Control Act 1982* as a facility containing unsealed radioactive substances resulting from past practices. The site is subject to the South Australian regulator's surveillance of environmental radiation and public radiation safety.

Ranger Uranium Mine

In the Northern Territory, the tailings dams for the storage of waste at the Ranger uranium mine form part of the authorisation to operate. The mine has been in operation and regulated since the 1980s. The *Mining Management Act* (NT) requires operators to use best practice; as a consequence companies have used the mining code (ARPANSA, 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. Potential offsite impacts of the operation, including public exposures, are monitored by the statutory officer of the Commonwealth Supervising Scientist. Storage of waste forms part of the authorisation to operate this mine.

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 in Australia on 3 November 2003.

Little Forest Legacy Site

From 1960 to 1968, the Australian Atomic Energy Commission (AAEC), the forerunner of ANSTO, operated a near-surface disposal facility (Little Forest Legacy Site) near the boundary of the Lucas Heights site. Since closure in 1968, this site has been continuously under care and maintenance, inspection and monitoring by AAEC and subsequently ANSTO. Monitoring continues to demonstrate the adequacy of the facility. However, a medium-term management strategy is being developed to ensure ongoing safety prior to determining the long-term strategy for decommissioning the site. Monitoring results are provided to ARPANSA upon request and published in the ANSTO Annual Report. A detailed scientific study of the site, including waste characterisation, has been performed since the previous National Report as part of an ongoing research project implemented by ANSTO's Institute for Environmental Research. The study has used assessment of the available information and monitoring results for the Little Forest Legacy Site, as well as comprehensive sampling and analysis of groundwater, surface soils and vegetation. The results of this work are being summarised in the ANSTO Environmental Monitoring reports and significant findings are being published in the refereed scientific literature. Information on the research project of the Little Forest Legacy Site, including background material, is published on the ANSTO public website. The site is not currently licensed but planning for licencing of the facility is underway.

Abandoned uranium mines

A number of former uranium mines (including El Sherana) in the Northern Territory (NT) and Queensland were abandoned in the past. Some of these sites have been rehabilitated.

Operations at the Rum Jungle Mine site in the NT between 1954 and 1971 produced uranium, copper, nickel and lead, and resulted in significant environmental impacts primarily due to acid mine drainage and heavy metal mobilisation. From 1983 to 1986, Rum Jungle was rehabilitated under an $18.6m cooperative agreement between the Commonwealth and NT. The objectives included reduction of surface water pollution and public health hazards, including radiological hazards.

Between 1961 and 1963, the nearby former Rum Jungle Creek South Mine site was mined for uranium ore as part of the Rum Jungle operation. Between 1990 and 1991, hazard reduction works were successfully undertaken at the site to reduce potential radiological exposure to site visitors while maintaining its use as a recreational reserve.

The rehabilitation program at Rum Jungle met its original objectives, but gradual deterioration of the site's historic reclamation works has been documented over a number of years. The current environmental issues are primarily due to acid mine drainage and heavy metal mobilisation.

Funding has recently been provided to address environmental issues at the former Rum Jungle Mine site, and closure of the nearby former Rum Jungle Creek South Mine site. On 7 October 2009, the Commonwealth concluded a National Partnership Agreement (NPA) with the NT under which $7.05m will be provided over four years from FY2009/10 to support ongoing Rum Jungle rehabilitation activities. The NT Department of Resources is supported by the Rum Jungle Working Group (Commonwealth and NT governments, Northern Land Council).

The NPA was expanded in May 2011 to include sites related to the former Rum Jungle operation; Rum Jungle Creek South Mine site (about five kilometres south-east of Rum Jungle), Mt Burton and Mt Fitch (both downstream of Rum Jungle).

A subordinate Implementation Plan details payments and reporting requirements. Broadly, reporting of actual activities undertaken to meet the NPA's objective is required against:

- site maintenance;
- environmental monitoring;
- stakeholder engagement; and
- development of site management and rehabilitation strategies.

Recognising Rum Jungle's social and cultural importance, quarterly consultation meetings are held with the site's traditional Aboriginal owners. Broad engagement of other stakeholders (e.g. environmental NGOs, the local Coomalie Council) is ongoing.

Article 13 Siting of Proposed Facilities

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. 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 for the selection of a site for a proposed facility will have regard for the national near-surface disposal code (NHMRC, 1992). This code 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 socio-economic, ecological and land use factors as well as natural physical characteristics of the proposed site.

ARPANSA has also developed a Regulatory Guide on Siting of Controlled Facilities (REG-LA-SUP-240L, August 2014), to assist in the preparation of an application for a siting license. The guidance is applicable for the siting of nuclear or radiation facilities at new sites and also for the collocation of new facilities at existing sites. It highlights the need to consider all existing facilities and services which could potentially increase the risk to the public or the environment in emergency situations. Applying relevant lessons learned from the Fukushima Daiichi accident, the guidance emphasises the need to consider other nearby (collocated) on- or off-site facilities which could contribute to or be impacted by emergency situations and which may also require local services, taking into consideration all interdependencies.

For commonwealth licence holders, the ARPANS Act requires that an impact assessment be taken into account by the CEO of ARPANSA in deciding whether to issue a facility licence authorising the preparation of a site. This assessment must include an evaluation of:

- site related factors likely to affect the safety of the facility during its operating lifetime;
- public protection;
- international best practice; and
- protection of the environment.

There is a separate national regulatory framework for protection of the environment established under the EPBC Act, which is binding on all jurisdictions. The definition of environment in the EPBC Act makes reference to people and communities as part of ecosystems and requires social and economic impacts, in addition to environmental impacts, to be considered. If a proposed action is referred to the Commonwealth

Minister for the Environment, and the Minister decides that the proposed action requires approval, an assessment process (including an environmental impact assessment) must be carried out.

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 regulatory processes. For example, the waste treatment and packaging facility was subject to environmental impact assessment under the EPBC Act and to safety assessment processes under the ARPANS Act. Under the ARPANS Act the application for a licence for the proposed interim store at the ANSTO site must include an assessment of the impact of the facility on the safety of people and the environment. Separate authorisation is required for closure of a waste management facility.

Public consultation

Public consultation is required as part of the environmental approval process under the EPBC Act. Consultation with the relevant jurisdictions is mandatory and would normally take place as part of public consultation.

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 the public has been undertaken at a number of stages of previous proposals to establish waste facilities. For previous proposals, policy has required that community consultation be undertaken by the proponent as part of the project; the proponent has also undertaken community consultation as part of the legislated process for obtaining environmental approval for the proposal; and the radiation regulator has undertaken public consultation again as part of the legislated process for the assessment of the licence application.

For the future National Radioactive Waste Management Facility, public consultation will be undertaken as required by the EPBC Act and ARPANS Act. Additional consultation will support the nomination of volunteer sites as potential sites for the facility, and once a preferred facility site is identified, a regional consultative committee will be established.

Consultation with other Contracting Parties

Considering the geographical position and size of Australia, it is not foreseeable that waste management facilities in Australia would have impacts on other Contracting Parties (outside Australia) that would require consultation.

Article 14 Design and Construction of Facilities

Limiting possible radiological impacts

In each Australian jurisdiction, the radiological impact of the design and construction of a radioactive waste management facility is assessed 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 must 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. Facility proposals that are designated 'nuclear actions' will also be subject to environmental assessment under the EPBC Act and may require the approval of the Commonwealth Environment Minister.

In the case of a near-surface disposal facility, the near-surface disposal code (NHMRC, 1992) sets out requirements for the facility design that include packaging of waste, structural parameters, engineered barriers, cover specifications, backfill, surveying, water management, drainage, waste parameters, buffer zone and restricted occupancy zone. The revised version of this code will maintain these requirements.

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, as part of the process of replacing the user disposal code (NHMRC, 1986) by a new schedule in the NDRP (ARPANSA, 2014b). As of October 2014, this process requires only administrative actions for completion.

Consideration of decommissioning

At the design stage of a waste management facility, preliminary plans and other provisions for decommissioning of the facility must be developed. These must be revised and updated as the facility moves through the licensing stages.

In the case of a near-surface disposal facility, the near-surface disposal code (NHMRC, 1992) requires that prior to commencement of operations, the operator prepare draft or conceptual plans for closure and decommissioning of the facility and rehabilitation of the site and that these plans be submitted for approval. These plans must be reviewed every five years and resubmitted 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 used

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 near-surface disposal code (NHMRC, 1992) requires that the structure be constructed in accordance with best engineering practice.

In the case of uranium mining operations, the mining code (ARPANSA, 2005) requires the use of ‘best practicable technology’ as part of an 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.

Article 15 Assessment of Safety of Facilities

As part of Commonwealth legislative and regulatory requirements, an assessment of safety and environmental impact of a proposed radioactive waste management facility during the operational period is required for approval before construction of a Commonwealth facility can commence. The assessment of safety and environmental impact must be reviewed and updated if required prior to the operation of the facility. Regulators would also consider security in addition to safety.

In the case of a near-surface disposal facility, the national standard, the near-surface disposal code (NHMRC, 1992), requires an assessment, prior to construction, of the projected long-term integrity of the site after closure. Site rehabilitation plans must include the proper provision of site markers and exclusion barriers, which 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 that may encourage

occupation of the site. The operator must remain responsible for the site and all necessary site rehabilitation work until the completion of the work has been approved by the regulator.

In addition to the requirements of the near-surface disposal code (NHMRC, 1992) for safety and environmental assessments of the operational phase, the safety assessment must:

- identify pathways through which radionuclides could be released after closure of the facility; and
- include a quantitative treatment of scenarios for inadvertent intrusion after institutional control.

The code also requires the establishment of 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.

Article 16 Operation of Facilities

A licence to operate a radioactive waste management facility is required prior to operation of such a facility. The regulatory authority cannot grant the licence until, amongst other requirements, the proposed facility meets the requirements for design and construction, and an assessment of safety and environmental impact has been undertaken and approved. These requirements are presented in the ARPANSA regulatory guide for licensing of radioactive waste storage and disposal facilities *[Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2 (OS-LA-SUP-240L, March 2013)]*. 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 ARPANS Act and to internal safety review in accordance with the requirements of the ANSTO safety system.

Operational limits and conditions

In the case of a near-surface disposal facility, the national standard, the near-surface disposal code (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 site-specific data for environmental parameters and exposure scenarios particular to that site.

The near-surface disposal code (NHMRC, 1992) also provides requirements for and restrictions upon the management of the site during the institutional control period. At the end of the established institutional control period the status of the site is to be reviewed to determine whether any further management or control should be instituted. Records and inventory of the waste disposed at the site are required to be preserved in two locations, including the appropriate state or federal government archives, at least until the end of the institutional control period. During the institutional control period the site is to be maintained and secure. Post-institutional control requirements are for the removal of infrastructure, and for the assessment of the site for any proposed new use.

The near-surface disposal code (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.

These requirements may be subject to change in the revised national near-surface disposal code currently in preparation. Updated guidance is also available in the ARPANSA regulatory guide for licensing of radioactive waste storage and disposal facilities [*Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2* (OS-LA-SUP-240L, March 2013)].

There are no limits on the surface dose rate of packaging that is accepted for near-surface disposal at the Mt Walton East disposal facility in Western Australia. However, the limits on the surface dose rate of packaging set by the provisions of the *Code for the Safe Transport of Radioactive Material (2008)* apply to material that is transported to the facility, and therefore, by implication, to material that can be accepted by the facility. The near-surface disposal code (NHMRC, 1992) places no limits on surface dose rates, but provides limits on radionuclide concentrations for near-surface disposal for the waste categories defined in the Code.

The predisposal management safety guide (ARPANSA, 2008b) includes generic waste acceptance criteria for the disposal of radioactive waste in near-surface and deep borehole facilities. The 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 responsible person's compliance with the legislation and the required level of radiation safety. These monitoring activities may lead directly to investigations and inspections, followed by enforcement activities when breaches of the relevant legislation have been identified.

Inspections and investigations are formal regulatory functions that 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, out of control radiation sources, damage or malfunction of a radiation source, loss or theft of a radiation source, contamination by a radioactive substance, unintentional or accidental release of a radioactive substance, and any 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, particularly by means of a technical audit and ongoing monitoring as required by the conditions of registration.

Availability of engineering and technical support

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

ARPANSA has prepared regulatory guidance[*] for use in the Commonwealth jurisdiction by applicants for licences for near-surface disposal facilities and storage facilities. The guidance advises that applicants

[*] ARPANSA regulatory guidance for licensing of radioactive waste storage and disposal facilities *Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2*
www.arpansa.gov.au/pubs/waste/WasteGuide-March2013.pdf

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 in operators for subsequent campaigns.

Applying waste characterisation and segregation procedures

The regulatory authority in each jurisdiction is responsible for the characterisation and segregation of radioactive waste in their jurisdictions. The predisposal management safety guide (ARPANSA, 2008b) provides specific advice on the management of wastes typical of Australia's current waste inventory and advises on approaches to the characterisation and segregation of waste and suggests segregation on the basis of radionuclide half-life and/or by level of radioactivity and the radio-toxicity of the radionuclides present, based on the exemption levels used in the NDRP (ARPANSA, 2014b). Alpha emitting waste can also be segregated from non-alpha emitting waste. Non-radiological considerations for segregation are also discussed.

For example, in Queensland, certain requirements must be met before radioactive material may be accepted for storage as waste at the state's radioactive waste store. 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 accepted into the store. Radioactive waste that is not acceptable for storage in the state's waste store is required to be stored elsewhere or disposed of as per the requirements of the Queensland *Radiation Safety Act 1999*.

Reporting of incidents significant to safety

Australian regulators all require licensees to report incidents significant to safety. In addition, ARPANSA maintains the national Australian Radiation Incident Register.

There are 11 types of radiation incidents specified in the NDRP (ARPANSA, 2014b) that must be reported to the Australian Radiation Incident Register which apply to all incidents, not only for waste management facilities. The types of radiation incidents relevant to waste management that must be reported 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;
- contamination with, or dispersal of, radioactive material;
- out of control (lost or stolen) radioactive sources;
- nuclear incidents such as criticality incidents;
- transport of radioactive material, including where a package is damaged during freight handling or transport; and
- other incidents that the Authority considers warrant reporting, including near-miss situations that can serve as a warning to other users.

A radiation incident is defined as: 'Any unintended or ill-advised event when using ionising radiation apparatus, specified types of non-ionising radiation apparatus or radioactive substances, which results in, or has the potential to result in, an exposure to radiation to any person or the environment, outside the range of that normally expected for a particular practice, including an event resulting from operator error, equipment failure, or the failure of management systems that warranted investigation.'

In accordance with the ARPANS Act and Regulations, radiation incidents with significant implications for safety that occur at locations under Commonwealth jurisdiction are reported[†] to the Parliament of Australia in ARPANSA's quarterly reports.

Collection and analysis of operating experience

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

In South Australia the responsible persons conducting mining or mineral processing operations that are licensed under the *Radiation Protection and Control Act 1982* are required to provide the regulator with the results of periodic assessments and reviews of operational experience. Both quarterly and annual reports are provided for uranium mining operations. These reports provide detailed information about 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 (excluding disposal facilities)

The predisposal management safety guide (ARPANSA, 2008b) 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 that 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 mining code (ARPANSA, 2005) to submit a mine management plan (or equivalent) addressing all facets of mine management including decommissioning and site rehabilitation. The code is applied as a condition of licence by jurisdictions.

Preparation and update of closure plans for disposal facilities

The national standard, the near-surface disposal code (NHMRC, 1992), requires that prior to the commencement of operations, the operator must prepare draft or conceptual plans for decommissioning a disposal facility and rehabilitating the site, and submit the plans to the regulator for approval. The plans must be reviewed every five years and resubmitted 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.

Article 17 Institutional Measures after Closure

Record keeping

The near-surface disposal code (NHMRC, 1992) requires that detailed records of all waste consigned to and received at the facility be kept by the operator and the regulator. 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.

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

The code also stipulates that site records of disposal structures, the location and contents of waste packages or containers and details of backfilling and cover materials 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.

Records of the location, design and inventory of radioactive wastes at the former Radium Hill uranium mine 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 for State Development. Records relating to waste disposed at Maralinga are held by the Commonwealth and can be accessed by the South Australian regulator.

Institutional control

As mentioned under Article 15, the near-surface disposal code (NHMRC, 1992) requires 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, conditions requiring post-closure environmental monitoring were imposed in the licence to possess the Maralinga atomic weapons test site subsequent to its rehabilitation.

Any unplanned release of radioactive materials into the environment that is detected during the institutional control period would trigger regulatory assessment of the resulting impact(s) followed by intervention measures and changes to the control procedures as required.

As mentioned under Article 12, ANSTO has one closed facility (Little Forest Legacy Site) that was used for disposal of radioactive material between 1960 and 1968. This facility is secure and is routinely monitored for groundwater, airborne and surface contamination. The results are publicly available in the ANSTO Annual Reports.

I. Transboundary Movement

Article 27 Transboundary Movement

Requirements on import

Current Commonwealth Government policy prohibits the import of radioactive waste. Additionally, the *National Radioactive Waste Management Act 2012* only allows for the management of radioactive waste that is of domestic origin at the National Radioactive Waste Management Facility.

Legislation restricting the import of radioactive substances, including waste, appears in Regulation 4R(2) of the *Customs (Prohibited Imports) Regulations 1956:*[*]

> **4R Importation of radioactive substances**
>
> (2) The importation into Australia of a radioactive substance is prohibited unless:
>
> (a) a permission in writing to import the substance has been granted by the Minister for Health or an authorised officer; and
>
> (b) the permission is produced to a Collector.

This Regulation defines 'radioactive substance' as any radioactive material or substance including radium, any radioactive isotope or any article containing any radioactive material or substance.

Permissions are normally granted by officers in ARPANSA who have been appointed by the Minister for Health. The Customs Regulations establishing the import control give the Minister the power to vary or revoke applications that have been granted by authorised officers. If the authorised officer has formed an opinion that the permission should not be granted, the application must be referred to the Minister for Health for the final decision, which may be to grant, or refuse to grant, the permission. There is no overlap or conflict of decision-making authority.

Requirements on export

Australia has controls on the export of specific types of radioactive material and to certain destinations. In particular, authorisation is required from the relevant Commonwealth Government minister in the following circumstances:

- for the export of radioactive waste to Pacific Island states;
- for the export of high activity sources as defined in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources (2004); and
- for the export of fertile and fissile materials.

Australia's *Customs (Prohibited Exports) Regulations 1958*[†] prohibit the export of most uranium and thorium source material, most special fissionable material and other fissionable materials (as set out in Schedule 7 to Regulation 9) without the prior written permission of the Minister for Resources and Energy.

[*] www.comlaw.gov.au/Details/F2010C00785
[†] www.comlaw.gov.au/Details/F2011C00191

The export of radioactive waste to the Pacific Island Developing Countries is prohibited 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, taking into account the international obligations of Australia. 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 Bq/g or an activity below 1000 Bq.

Return to manufacturer

The Commonwealth Government and state and territory jurisdictions allow the trans-boundary 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 national *Code for the Safe Transport of Radioactive Material (2014)* (ARPANSA, 2014c), which follows the IAEA transport requirements *Regulations for the Safe Transport of Radioactive Material 2012 Edition* (IAEA SSR-6, 2012).

J. Disused Sealed Sources

Article 28 Disused Sealed Sources

Australia chaired and was represented at an IAEA technical meeting in 2009 on the implementation of the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources* (2004) with regard to long-term strategies for the management of sealed sources. The objective of the meeting was to consider legal and technical issues and possible strategies related to the management of sealed sources, in particular when these sources are reaching the end of their life cycle, or when orphan sources are detected at borders or during transit. The meeting agreed that holders of disused sources should not be permitted to retain them indefinitely. An emphasis was placed on harmonising strategies based on more effective communication and cooperation among states, regulators, suppliers, shippers, users and waste management organisations.

In order to improve the long-term management of disused sealed sources, Australia is supportive of initiatives to explore possible synergies between the Code of Conduct and the Joint Convention.

Legislative requirements for dealing with disused sealed sources

The focus of Australia's legislative 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 1956.* 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 be located in) 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.[*]

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*. 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 obligations under the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources* (2004).

Criteria for the approval of an application to export high-activity radioactive sources are the same as those set out in the IAEA *Guidance on the Import and Export of Radioactive Sources* (2005). Namely, that the intended recipient is authorised to receive and possess the radioactive source, the importing State has the necessary governmental infrastructure to safely and securely manage the radioactive source, and after consideration of the risk of the radioactive source being diverted for malicious use. ARPANSA requires the following information to be provided before it will give permission for the export of a high-activity

[*] Further information on the import control schemes can be found at www.arpansa.gov.au/Regulation/permits/medical.cfm, and www.arpansa.gov.au/Regulation/permits/index.cfm

radioactive source: the name of the exporter and the details of the regulatory regime under which the source is managed, the details of the recipient who will receive the source, and details of the source proposed to be exported.

Radiation portal monitors are operated at the Lucas Heights Science and Technology Centre (which houses ANSTO, one of the major holders of sources in Australia), and at some scrap metal handling facilities.

Re-entry of disused sources

Sealed radioactive sources are refurbished 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 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. There are currently no manufacturers of radioactive sources in Australia.

K. Planned Activities to Improve Safety

A national audit of radium legacy wastes was performed in 2007. Most of the radium was from medical applications and from the luminising industry. This waste is gradually being conditioned and will ultimately be stored centrally until a suitable disposal facility becomes available.

The Commonwealth Government intends to establish a facility under the *National Radioactive Waste Management Act 2012*. The facility will manage Australia's radioactive waste; i.e. waste held by the Commonwealth and any State or Territory jurisdiction.

The ARPANSA Radiation Health and Safety Advisory Council (RHSAC) has provided advice and recommendations to the CEO of ARPANSA on improved strategies for safe management of intermediate-level waste.[*] The development of policy for disposal of Australia's ILW is now on the national agenda.

Nationally, an amendment to the NDRP (ARPANSA, 2014b) is being finalised that will update and facilitate consistency in arrangements for disposal and discharge of radionuclides for which no authorisation is required. The amended limits and requirements for disposal of low-level radioactive waste which is not otherwise exempt will ultimately be adopted by all Australian jurisdictions. The proposed amendment includes a new schedule of exemption values for disposal to landfill, air and sewer for many commonly used isotopes.

A revision of RPS1, to take account of the publication of more recent recommendations by ICRP Publication 103 and the revised IAEA Basic Safety Standards, is in progress. The new C-1 *Code for Radiation Protection in Planned Exposure Situations as Applied to Workers, the Public and the Environment* is expected to be published in 2015. The national near-surface disposal code (NHMRC, 1992) is currently being reviewed and will be updated and reissued, together with an accompanying safety guide.

A safety guide *Radiation Protection of the Environment*, based on ICRP Publication 91: *A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species* (ICRP, 2003) has been developed by ARPANSA and is currently undergoing stakeholder consultation. This guidance will be particularly relevant to the expansion of uranium mining in Australia. As the guidance will be advisory, its introduction by radiation regulators can occur as soon as publication takes place; however, implementation timeframes will vary across jurisdictions. The purpose of the safety guide is to provide best practice guidance on how to assess environmental exposures and demonstrate protection of the environment from the human activities that give rise to such exposures.

CSIRO is investigating appropriate segregation and characterisation techniques for the 10,000 drums of low-level uranium-processing waste currently stored at Woomera, South Australia, to aid in identifying those below exemption levels and for consolidation to reduce the volume for storage and disposal.

An interim store for ILW is currently under construction at the ANSTO site. This will be used to temporarily store the vitrified and cemented waste packages that will be returned to Australia from reprocessing of spent fuel in France and the UK. ANSTO is also in the process of constructing a new radioactive waste treatment facility (SYNROC) to process (treat and condition) intermediate level liquid wastes produced to a solid and stable form suitable for final disposal.

Western Australia has relocated its interim waste storage facility since the 2011 National Report. The facility has been rebuilt on the same site approximately 200 metres from the original location.

[*] Scoping Review of Issues Related to the Management of Intermediate Level Radioactive Waste in Australia (2010) www.arpansa.gov.au/pubs/rhsac/waste_report_RHSAC.pdf

L. Annexes

Annex A – Inventory of Radioactive Wastes

The following current inventory of radioactive waste held in Australian storage and disposal facilities is produced from data provided by each jurisdiction. In all cases, if the date of activity measurement was unknown it was conservatively assumed that the activity provided was the activity on 1/7/2014. Where the activity of a source was unknown, the activity has not been included in the totals.

Inventory of disused sealed sources held in Australian storage facilities:

***Site**: Australian Capital Territory* ***Activity Reference Date**: 2/05/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	720*	unknown*
Am-241/Be	1	1.7E+00
Cd-109	7	3.5E-09
Co-60	22	1.3E-04
Cs-137	10	2.5E+00
Fe-55	12	5.4E-04
Kr-85	20	4.0E-01
Ra-226	3	7.2E-04
Sr-90	6	4.9E+00
U (nat)	3	7.1E-04

*smoke detectors

***Site:** Northern Territory* ***Activity Reference Date:** 1/01/2000*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	49	3.7E-03
Am-241/Be	4	2.2E+00
Co-60	3	5.6E+00
Cs-137	3	2.5E+00
Sr-90	3	4.1E+00

***Site**: Commonwealth (ANSTO, CSIRO, ARPANSA)* ***Activity Reference Date:** 1/07/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Ac-227	13	8.1E+00
Am-241	116	2.5E+02
Am-241/Be	58	1.4E+03
Am-241/Li	1	3.7E+01
Ba-133	24	5.7E-01
C-14	10	1.4E-04
Cf-252	12	3.9E-01
Cl-36	14	1.4E-05
Cm-244	6	1.4E+01
Co-57	12	3.6E-03
Co-60	2231	9.7E+05
Cs-137	144	1.7E+04
Eu-152	2	8.9E-04
Fe-55	5	1.4E-01
H-3	18	9.4E+02
Hg-203	7	1.9E+01
I-129	1	3.7E-03
Ir-192	18	2.2E+01
Kr-85	20	1.6E+00
Mn-54	6	4.4E-04
Na-22	13	5.3E-04
Ni-63	18	5.8E+00
Pb-210	7	1.9E-01
Pm-147	1	2.0E-02
Po-210	3	4.8E-24
Pu-238	5	7.1E+00
Pu-238, 239, 241	44	1.8E+02
Pu-238/Be	1	3.4E+02
Ra-226	101	4.1E+01
Ra-226/Be	10	2.2E+01
Sr-90	64	5.7E+00
Sr-90/Y-90	10	9.5E-04
Thorium radioisotopes	15	9.0E-08
U-238	7	0.0E+00
Zn-65	6	6.1E-09
Miscellaneous sources	120	1.5E+00

Site: *New South Wales* ***Activity Reference Date:*** *1/07/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	139	3.5E+01
Am-241/Be & Cs-137	2	1.1E+02
Am-241/Be & Cm-242	1	unknown
Am-241/Be & Ra-226/Be	1	0.0E+00
C-14	1	2.7E+00
Co-60	3	2.3E+00
Cs-137	5	1.1E-03
H-3	46	1.1E+03
Kr-85	1	3.5E+01
Ra-226	1	3.0E-03
Ra-226/Be	2	0.0E+00
unknown	4	0.0E+00

Site: *Queensland* ***Activity Reference Date:*** *09/05/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	3360	2.0E+01
Am-241/Be	38	4.0E+02
Ba-133	19	8.1E-02
C-14	18	5.6E-02
Cm-244	1	3.6E-01
Co-60	216	4.7E-01
Cs-137	157	4.6E+03
Fe-55	5	2.2E-02
H-3	37	6.9E+01
Kr-85	1	2.8E-02
Ni-63	5	7.7E-01
Pb-210	6	6.8E-03
Pu-238	6	5.2E+00
Ra-226	673	1.2E+02
Ra-226/Be	5	9.7E-01
Sr-90	162	4.3E+01
Tl-204	28	1.2E-04
Th-232	1	6.0E-04
U-233	2	6.8E-02

Site: *South Australia* ***Activity Reference Date:*** *1/07/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	8	5.9E+00
Am-241	1600*	5.6E-02
Am-241/Be	14	4.2E+02
Co-60	2	8.0E+01
Cs-137	13	1.2E+01
Pu-238	2	9.9E+01
Ra-226	11	1.4E+00
Ra-226/Be	4	7.4E-01
Sr-90	1	1.3E-01

*smoke detectors

Site: *Tasmania* ***Activity Reference Date:*** *1/07/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	14	6.1E+00
Am-241/Be	4	1.3E+01
Co-57	1	unknown
Co-60	5	8.3E-04
Cs-137	58	9.2E+01
Fe-55	1	3.2E-04
Gd-153	2	4.1E-12
H-3	4	2.4E+01
Ir-192	3	4.5E-01
Pu-238	13	2.2E+01
Ra-226	36	1.3E+01
Ra-226/Be	6	6.9E-01
Sr-90	9	4.3E+00

Site: *Victoria*** ***Activity Reference Date:*** *16/09/2014*

Radionuclide	Number of Sources	Total Activity (GBq)
Am-241	514	3.5E+02
Am-241/Be	10	15.3E+00
Ba-133	5	2.4E-05
C-14	2	3.6E-05
Cd-109	1	1.9E-01
Cm-244	1	3.7E-01
Co-57	4	1.8E+00
Co-60	79	5.8E-01
Cs-137	42	1.28E+02
Eu-152	1	3.7E-02
Fe-55	2	2.4E+00
Ge-68	11	1.3E+00
Kr-85	4	1.6E+00
Ni-63	2	8.5E-01
Pb-210	1	7.4E-04
Ra-226	174	7.0E-01
Ra-226/Be	1	2.7E-01
Ru-106	1	8.0E-03
Sr-90	117	18.6E+00
Th-232	1	4.2E-04
Tl-204	15	6.1E-02
U-238	2	5.9E-03

** Increased reporting of sources held in storage pending disposal accounts for the changes since the 2011 National Report to the Joint Convention.

Inventory of disused sealed sources disposed of at Mt Walton East Intractable Waste Disposal Facility, Western Australia

***Activity Reference Date**: 1/07/2011*

Radionuclide	Number of Sources***	Total Activity (GBq)
Am-241	2732	7.4E+01
Am-241/Be	5	8.2E+00
Ba-133	10	3.5E-02
C-14	1	8.3E-03
Cf-252	1	6.4E-04
Co-60	55	2.3E+00
Cs-137	142	2.6E+02
H-3	2810	4.4E+05
Ni-63	5	1.5E+00
Ra-226	21	5.8E+00
Ra-226/Be	3	5.7E-01
Sr-90	12	3.5E+00
Th-232	12	1.2E-02
Tl-204	3	1.1E-02

In addition, 25 sources containing combinations of the following radionuclides:

Radionuclide	Total Combined Activity (GBq)
Am-241	8.3E+00
C-14	7.0E-06
Co-60	1.1E+01
Cs-137	6.1E+01
H-3	6.3E+03
Ra-226	9.2E-02
Sr-90	2.2E-05
Tl-204	5.9E-06

***The records that are available for more recent disposal campaigns are more detailed than those for earlier campaigns.

Inventory of unsealed radioactive waste:

Uranium Mining and Milling Sites

Jurisdiction	Site Name	Volume (m^3)	Mass
Northern Territory	Ranger		43.1 Mt
South Australia	Beverly	2400	
South Australia	Honeymoon	4515	
South Australia	Pt Pirie	120000	
South Australia	Radium Hill	250200	
South Australia	Olympic Dam	59000000	$2x10^{11}$ kg

Disposal Sites

Jurisdiction	Site Name	Volume (m^3)
Commonwealth	ANSTO - Little Forest	1718
Commonwealth	Parks Australia North	22000
South Australia	Maralinga	432000
Western Australia	Mt Walton East	124

Storage Sites

Jurisdiction	Site Name	Suitable for near-surface disposal	Volume (m^3)
Commonwealth	CSIRO - Woomera	yes	2100
Commonwealth	ARPANSA	yes	0.28
Commonwealth	ARPANSA	no	6.50
Commonwealth	ANSTO - Lucas Heights	yes	1936
Commonwealth	ANSTO - Lucas Heights	no	451
Australia Capital Territory	Store	no	0.01
New South Wales	Store	yes	5.46
New South Wales	Store	no	7.12
Queensland	QRWS	no	0.9
South Australia	EPA Store	yes	1
South Australia	Uni SA, Mawson Lakes	yes	1.4

Annex B – References to National Laws, Regulations, Standards, etc.[*]

Commonwealth Government

- ***Australian Nuclear Science and Technology Organisation Act 1987***
- ***Australian Radiation Protection and Nuclear Safety Act 1998 (No. 133)***
- ***Australian Radiation Protection and Nuclear Safety Regulations 1999 (No. 37)***
- Australian Radiation Protection and Nuclear Safety Agency. *Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (republished 2002).* Radiation Protection Series No. 1 (ARPANSA, 2002).
- Australian Radiation Protection and Nuclear Safety Agency. *Recommendations: Intervention in Emergency Situations Involving Radiation Exposure*. Radiation Protection Series No.7 (ARPANSA, 2004)
- Australian Radiation Protection and Nuclear Safety Agency. *Code of Practice and Safety Guide: Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*. Radiation Protection Series No. 9 (ARPANSA, 2005).
- Australian Radiation Protection and Nuclear Safety Agency. *Safety Guide: Management of Naturally Occurring Radioactive Material (NORM)*. Radiation Protection Series No.15 (ARPANSA, 2008a).
- Australian Radiation Protection and Nuclear Safety Agency. *Safety Guide: Predisposal Management of Radioactive Waste*. Radiation Protection Series No.16 (ARPANSA, 2008b).
- Australian Radiation Protection and Nuclear Safety Agency. *Safety Guide: Classification of Radioactive Waste*. Radiation Protection Series No. 20 (ARPANSA, 2010).
- Australian Radiation Protection and Nuclear Safety Agency. *Safety Guide: Use of Radiation in Schools.* Radiation Protection Series No. 18 (ARPANSA, 2012a).
- Australian Radiation Protection and Nuclear Safety Agency. *Safety Guide: Approval Processes for the Safe Transport of Radioactive Materials.* Radiation Protection Series No. 2.2 (ARPANSA, 2012b).
- Australian Radiation Protection and Nuclear Safety Agency. *Protection Against Ionising Radiation*. Radiation Protection Series No. F-1 (ARPANSA, 2014a).
- Australian Radiation Protection and Nuclear Safety Agency. *National Directory for Radiation Protection.* Radiation Protection Series No. 6, republished February 2014, including Amendments 1–6 (ARPANSA, 2014b).
- Australian Radiation Protection and Nuclear Safety Agency. *Code for the Safe Transport of Radioactive Material (2014)*. Radiation Protection Series No. C-2 (ARPANSA, 2014c).
- Australian Radiation Protection and Nuclear Safety Agency. *Regulatory Guide: Licensing of Radioactive Waste Storage and Disposal Facilities v2* (OS-LA-SUP-240L, March 2013).
- Australian Radiation Protection and Nuclear Safety Agency. *Regulatory Guide: Plans & Arrangements for Managing Safety v5* (REG-LA-SUP-240B, May 2014).
- Australian Radiation Protection and Nuclear Safety Agency. *Regulatory Guide: Siting of Controlled Facilities v2* (REG-LA-SUP-240L, August 2014).
- ***Environment Protection and Biodiversity Conservation Act 1999***
- ***Environment Protection and Biodiversity Conservation Regulations 2000***

[*] Principal instruments appear in bold type.

- National Health and Medical Research Council. *Code of Practice for the Disposal of Radioactive Wastes by the User (1985).* Radiation Health Series No. 13, 1986 (NHMRC, 1986).
- 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 (NHMRC, 1992).
- National Road Transport Commission and Federal Office of Road Safety. *Australian Dangerous Goods Code*. 6th ed., 1998.

Australian Capital Territory

- ***Radiation Protection Act 2006***
- ***Radiation Protection Regulation 2007***
- ***Work Health and Safety Act 2011***
- ***Work Health and Safety Regulation 2011***

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 2013***
- ***Radiation Control Act 1990***

Northern Territory

- ***Dangerous Goods Act***
- ***Mining Management Act***
- ***Radiation Protection Act***
- ***Radiation Protection Regulations***
- ***Radioactive Ores and Concentrates (Packaging and Transport) Act***
- ***Radioactive Ores and Concentrates (Packaging and Transport) Regulations 1980***
- ***Work Health and Safety (National Uniform Legislation) Act 2011***
- ***Work Health and Safety (National Uniform Legislation) Regulations***

Queensland

- ***Radiation Safety Act 1999***
- Radiation Safety (Radiation Safety Standards) Notice 1999
- ***Radiation Safety Regulation 1999***
- 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.*
- ***Nuclear Facilities Prohibition Act 2007***
- ***Environmental Protection Act 1994***
- ***Environmental Protection (Waste Management) Regulation 2008***
- ***Mining and Quarrying Safety and Health Act 1999***

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