Submission to the
South Australian
Nuclear Fuel Cycle
Royal Commission

12 August 2015
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COMMONWEALTH GOVERNMENT SUBMISSION

1. The Commonwealth Government welcomes the Royal Commission into South Australia’s further participation in the following areas of the nuclear fuel cycle (‘the Royal Commission’):

   - expansion of exploration, extraction and milling;
   - further processing of minerals or processing and manufacture of materials containing radioactive and nuclear substances;
   - nuclear electricity generation; and
   - management, storage and disposal of nuclear waste.

2. The 2006 Uranium Mining, Processing and Nuclear Energy Review (UMPNER)¹ explored many issues being considered by the Royal Commission. It identified potential economic opportunities, but also found that many would be challenging to realise. UMPNER also concluded that a comprehensive regulatory system and skilled staff would be needed. The removal of legal prohibitions on uranium conversion and enrichment, nuclear fuel fabrication and nuclear power would be necessary for any increased participation in the nuclear fuel cycle.

3. Market conditions have changed since 2006, but the UMPNER findings remain relevant. The Royal Commission presents an opportunity for a fresh independent assessment of South Australia’s participation in the nuclear fuel cycle. It also allows for an informed discussion within the community about opportunities and risks, and how they might be managed.

4. Australia already benefits from involvement in nuclear activities. We host the largest known economically recoverable uranium resources in the world – the majority in South Australia. The Australian Nuclear Science and Technology Organisation (ANSTO) has our only operating nuclear research reactor, which provides the world with life-saving radiopharmaceuticals that help diagnose and treat serious illnesses. ANSTO’s research into future nuclear technologies and its community engagement are also internationally recognised.

5. Australia’s longstanding involvement and research in the nuclear fuel cycle has given us influence in ensuring the technology is used safely and only for peaceful purposes. We were a founding member of the International Atomic Energy Agency (IAEA) and have since held a designated seat on its Board of Governors.² Further, as a party to treaties on nuclear non-proliferation, safety and security and as a member of the Nuclear Suppliers Group, we actively support a robust international approach to nuclear safety, security, non-proliferation and the peaceful uses of nuclear energy. Australia’s reputation and the strength of its international security diplomacy are served by promoting and upholding the objectives of nuclear non-proliferation, and by following international best practice.

6. While the global uranium market is currently oversupplied and the market price is low, the long-term outlook is positive. World demand is expected to grow in line with increasing nuclear electricity capacity, and prices are likely to recover sufficiently to support new mine development. It is important to ensure the regulatory framework remains effective and is streamlined to attract investment and promote greater productivity in the sector. Attachment A provides further information on exploration, extraction and milling.

² Department of Foreign Affairs and Trade, dfat.gov.au/international-relations/security/non-proliferation-disarmament-arms-control/IAEA-peaceful-nuclear-uses/Pages/international-atomic-energy-agency.aspx
7. Participation in the conversion, enrichment and fuel fabrication industries could increase the value of Australian uranium exports – but there are challenges to market entry. These include highly-restricted access to proprietary technology, capital costs of establishing a facility and oversupply of capacity in the global markets. Consistent with Australia’s non-proliferation obligations, any South Australian participation in enrichment or reprocessing would need to adopt international best practices to demonstrate they would be for purely peaceful purposes. More information is at Attachment B.

8. Nuclear electricity generation can deliver large amounts of base-load electricity with very low carbon emissions. While there is no immediate need for new generation capacity in the National Electricity Market, opportunities might emerge in the future. There may also be opportunities for off-grid generation. Establishing a nuclear power programme takes 10-15 years. This means early consideration of the relative merits of nuclear-generated electricity would be needed to inform investment and regulatory decisions.

9. Generation IV technology, the next generation of nuclear reactor designs, is likely to be safer, more fuel-efficient, cheaper and produce less waste. Small Modular Reactors require lower initial capital investment, and have scalability and siting flexibility at locations unable to accommodate larger reactors. Attachment C provides further detail on nuclear electricity generation.

10. The Commonwealth is establishing a facility to dispose of domestic low-level radioactive waste and store intermediate-level domestic radioactive waste. This process is separate to the Royal Commission’s investigation of wider opportunities associated with waste management. However, the Commonwealth’s experience in siting facilities, as well as international approaches, might be of use to the Royal Commission. Further information is at Attachment D.

11. At all stages of the nuclear fuel cycle, the community must have confidence that risks can be managed effectively within a robust, stable and predictable regulatory system. This requires governments and proponents to engage genuinely with the community, including Indigenous landholders and traditional rights holders. Attachment E provides further information on community engagement.

12. Australia has a robust nuclear regulatory framework under which both the Commonwealth and the States and Territories regulate nuclear activities. It protects and promotes health, safety, the environment, non-proliferation and security. This framework is based on IAEA standards and Australia’s international obligations. It can provide a basis for considering the regulatory system necessary for any expanded involvement in the fuel cycle. Further information on the regulatory framework is at Attachment F.

13. In the 2015 Energy White Paper, the Commonwealth committed to a technology-neutral energy policy. Consistent with this technology-neutral approach, the Commonwealth welcomes the Royal Commission’s independent assessment of South Australia’s potential for greater involvement in the nuclear fuel cycle. The private sector, however, is best-positioned to determine the economic viability of expanded involvement in the nuclear fuel cycle.

14. Whether or not immediate opportunities exist, the Commonwealth considers that any possibilities that do emerge should not be closed off by governments where they have a demonstrated net benefit, and the risks can be managed effectively. We are working with the States and Territories on improving the regulation of nuclear industries, including by responding to technical developments and streamlining or removing unnecessary regulation.
Bipartisan support and community confidence in any participation in nuclear activities is also critical.

15. Commonwealth legislation prohibits some of the activities under consideration by the Royal Commission, including construction or operation of nuclear reactors for generating electricity or facilities for enriching uranium, fabricating nuclear fuel or reprocessing spent nuclear fuel. The Commonwealth Government looks forward to considering the Royal Commission’s report, the response of the South Australian Government and the implications for Commonwealth policy and regulatory framework.
ATTACHMENT A: EXPLORATION, EXTRACTION AND MILLING

Attachment A is in response to Issues Paper One: Exploration, Extraction and Milling. It provides: references on prospects for uranium and thorium exploration and mining in Australia; market outlooks for uranium and nuclear energy; and Commonwealth initiatives to support exploration and mining. It also outlines the measures to manage risks, should there be an expansion of uranium mining in South Australia.

A.1 Prospects for exploration and mining and associated industries

16. Australia has approximately 31 per cent of the world’s reasonably assured known uranium resources. South Australia has 78 per cent of Australia’s resources – almost all within the Olympic Dam deposit. Several Commonwealth publications provide information on prospects for uranium and thorium exploration and mining in Australia, including South Australia:

- *Resources and Energy Quarterly*³;
- *Australia’s Identified Mineral Resources*⁴; and
- *Australian Energy Resource Assessment.*⁵

17. The outlook for uranium mining is driven by demand, prices, costs of production and the extent of alternative sources of uranium such as enrichment tails. The market has been oversupplied since the idling of Japan’s nuclear power reactors in 2011, compounding the fall in spot prices that commenced in 2007. Demand for uranium is expected to increase through to 2035, owing to increased nuclear generating capacity.

18. Energy policies in many countries suggest an expanded role for nuclear power. Nuclear generation capacity is likely to increase in China, Russia, India, the United States and South Korea. The United Arab Emirates, Saudi Arabia, Vietnam and Bangladesh are embarking on nuclear power programmes. There are 67 nuclear power reactors under construction. When complete, these will increase global nuclear capacity by 18 per cent. Plans exist for 166 further reactors that, if constructed, would increase capacity by almost 50 per cent.⁶

19. Reactor closures elsewhere will offset part of this increase. The accident at TEPCO’s Fukushima Daiichi Nuclear Power Stations led to some countries reviewing the role of nuclear energy. Germany and Switzerland have indicated they will end their use of nuclear power. The future extent of nuclear energy in Japan remains uncertain.

20. Detailed projections on demand for nuclear energy and uranium can be found in:

- the International Energy Agency’s *World Energy Outlook*⁷;
- the United States Energy Information Administration’s *Annual Energy Outlook*⁸; and

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⁷ See www.worldenergyoutlook.org
⁸ See www.eia.gov/forecasts/aeo/index.cfm
• the joint OECD Nuclear Energy Agency (NEA) and IAEA’s *Uranium Resources, Production and Demand*.

21. There are global challenges to developing new mines in the short to medium term stemming from a mix of low world uranium prices and high development costs. Stringent regulatory approval processes mean uranium mines tend to have very long development lead times. Many of the world’s proposed uranium mines have much higher production costs than prevailing prices. In the longer term, increased demand to meet increased generating capacity might support higher uranium prices – and therefore development of higher-cost mines.

22. Commonwealth initiatives relevant to exploration and mining include:

• the Commonwealth Exploration Development Incentive allows junior companies to provide credits, paid as a refundable tax offset to resident Australian shareholders, for greenfield mineral exploration;

• Geoscience Australia and CSIRO research - in particular, CSIRO’s Mineral Resources Flagship is researching use of in-situ recovery of minerals in hard rock. This could enable development of ore bodies that are inaccessible or uneconomic through conventional mining methods; and

• the Deep Exploration Technologies Cooperative Research Centre (jointly funded by the Commonwealth and South Australia with contributions from CSIRO, Geoscience Australia and the mining industry) is researching cheaper and safer ways to drill, analyse and target deep mineral deposits.

23. The Commonwealth is soon to establish a Mining Equipment, Technology and Services Growth Centre, as part of its Industry Innovation and Competitiveness Agenda. The Growth Centre programme aims to improve engagement between researchers and industry to achieve stronger commercialisation outcomes and improve management and workforce skills.

A.2 Skills

24. During consultation in 2013 with the resources sector, employers cited shortages in critical specialist occupations, such as experienced mining engineers, electricians and underground miners, as a barrier to investment, growth and productivity. Employers also noted increasing competition for skilled and experienced workers from other sectors of the economy and internationally. Recent research by the Department of Employment indicates shortages in trade occupations only.

25. While migration can provide short-term options to meet supply needs, employers in many resource-rich countries are also experiencing recruitment difficulties. This suggests

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9 See [www.oecd-nea.org/ndd/uranium/](http://www.oecd-nea.org/ndd/uranium/)


increasing competition in the international labour market for workers with extensive mining experience.  

26. To increase the number of domestic skilled workers, the Commonwealth is assisting employers that take on apprentices and assisting apprentices to complete necessary qualifications. The Australian Apprenticeship Support Network supports employers and apprentices to improve completion rates. Trade Support Loans of up to $20,000 help apprentices with costs of living. The Australian Apprenticeships Incentives Programme assists employers with the costs of employing an apprentice.

27. The Industry Skills Fund also provides assistance to businesses to take advantage of growth opportunities by improving workforce skills. In South Australia, the Industry Skills Fund has supported businesses to pursue opportunities in developing water purification and treatment equipment with high recovery and energy efficiency; and in advanced manufacturing tailored to the different needs of surface and underground mining.

A.3 Managing risks

28. All mining operations pose some level of environmental risk. Any new uranium mine, or significant alteration to an existing mine, would likely require a whole-of-environment assessment under the Environment Protection and Biodiversity Conservation Act 1999 (‘EPBC Act’) to ensure those risks are appropriately managed. This would include a site-specific assessment of risks and mitigation strategies appropriate to the environment in which the mine is located and the method used to extract the ore (see Attachment F). Approval may also be needed under the relevant state legislation.

29. Given the significant Indigenous land holdings in South Australia and the historical experiences of Indigenous communities following nuclear testing in the Maralinga area, early engagement and ongoing consultation with Indigenous communities and traditional owners is crucial well before any mining approval is sought. Land holder consent must be obtained and negotiations must be held with native title holders, or native title claimants, prior to undertaking exploration activities. Such engagement with native title holders and claimants would need to continue throughout a project’s operations and rehabilitation phases. Attachment E provides further information on community engagement including Indigenous landholders and traditional rights holders.

30. Planning for mine development should also consider closure and site remediation, including consultation on expected land use post-mining. Early consideration ensures the mine design and associated infrastructure facilitates remediation. Leading practice for mine rehabilitation would include appropriate financial provision for site closure works once production ends.

31. Further exploration and mining will have regional effects. These are likely to be broadly similar to the effects of existing mines, but the key is to understand specific local impact. Mining can benefit regional communities where mines and associated services use local

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workforces, and contribute to local demand for goods and services. It can also pose challenges through pressure on infrastructure, rising demand for accommodation, and competition with existing land uses. The use of a fly-in/fly-out (FIFO) workforce can provide a cost-effective means of accessing labour for remote locations, but can raise concerns that local communities benefit less from the mining activity.\footnote{22 More information on FIFO workforce practices can be found in the 2013 inquiry report of the House of Representatives Standing Committee on Regional Australia and the Australian Government response thereto: \url{www.infrastructure.gov.au/department/ips/government_responses/response-cancer-of-the-bush.aspx}}

32. The variety of challenges and opportunities around mine development means careful planning is a must. The Commonwealth provided $1.5 million to the South Australian Regional Mining and Infrastructure Plan.\footnote{23 See \url{http://www.infrastructure.sa.gov.au-major_projects/regional_mining_and_infrastructure_planning_project}}

<table>
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<th>Key Points</th>
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<td>• Australia hosts the largest known economically recoverable uranium resources in the world — the majority (78 per cent) is located in South Australia, mostly in the Olympic Dam deposit.</td>
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<td>• Australian miners are well-positioned to increase uranium extraction and exports should prices rise with increased demand.</td>
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ATTACHMENT B:  FURTHER PROCESSING OF MINERALS AND MANUFACTURE OF MATERIALS CONTAINING RADIOACTIVE AND NUCLEAR SUBSTANCES

Attachment B is in response to Issues Paper Two: Further Processing of Minerals and Manufacture of Materials Containing Radioactive and Nuclear Substances. It outlines the current market dynamics for uranium conversion, enrichment and fuel fabrication. The implications of Australia’s non-proliferation obligations for participation in this part of the nuclear fuel cycle are also discussed. Measures to address health, safety and environmental risks are outlined.

B.1 Domestic and international markets

33. The UMPNER report concluded that participation in the conversion, enrichment and fuel fabrication industries could significantly increase the value of Australian uranium exports. The report added, however, there are significant challenges to market entry. These include access to proprietary technology, capital costs of establishing a facility and oversupply of enrichment capacity in the global market. Further, there would need to be a change to national laws if there were to be construction of facilities for enriching uranium, fabricating nuclear fuel or reprocessing spent nuclear fuel.

34. There is still a significant surplus of world enrichment and conversion capacity today. Total conversion demand is estimated at 60 000 to 64 000 tonnes per year, while global capacity is at 76 000 tonnes per year. Global enrichment requirements are estimated at 51 425 000 separative work units (SWU) in 2015, rising to an expected 59 939 000 SWU by 2020. Capacity is at 61 450 000 SWU in 2015, rising to an expected 87 200 000 SWU by 2020.

35. This market surplus is likely to be prolonged by the temporary shutdown of Japanese nuclear reactors following the 2011 accident at TEPCO’s Fukushima Daiichi nuclear power stations and the construction of new, or upgrade of old, enrichment or conversion facilities in the United States (Honeywell, Eunice), France (Areva’s Comurhex II) and Russia (Seversk). Construction of new reactors in China and other parts of Asia may increase demand, but China has an extensive and expanding enrichment programme. The construction of reactors and restarting of Japanese reactors could change the market, but the global over-supply of enrichment services seems likely to persist, at least in the short to medium term.

36. Access to enrichment technology can also be governed by treaty-level agreements. For example, an agreement between Australia and the United States permits commercial cooperation to exploit the SILEX laser enrichment technology (invented by an Australian company). Under that Agreement, any development in Australia of an enrichment facility based on that technology would require agreement by the United States.

37. Like conversion and enrichment, the fuel fabrication market has become increasingly competitive as reactor fuel designs are standardised and fabricators have begun making fuel for

27 WNA, Uranium enrichment. (Website hyperlink above)
multiple reactor types. The current global capacity of light water reactor fuel fabrication, at 13,500 tonnes per year, exceeds the global requirements of 7,000-8,000 tonnes per year. The fuel market for pressurised heavy water reactors is similarly oversupplied.

**B.2 International context: assuring confidence in Australia’s intentions**

38. The processes for enriching uranium and reprocessing irradiated nuclear fuel can produce the fissile material needed to make nuclear weapons. Any South Australian participation in enrichment or reprocessing technologies would need to reflect Australia’s non-proliferation obligations and assure the global community and regional partners of the peaceful nature of the programme.

39. Concerns about nuclear weapons proliferation have led to various international proposals and guidelines to limit development of new enrichment or reprocessing facilities, and mechanisms to constrain access to equipment and technology for these processes.

40. Development and operation of enrichment or reprocessing facilities in South Australia would need to be modelled on international best practice in relation to nuclear non-proliferation. The main international export control mechanism, the Nuclear Suppliers Group (of which Australia is a member) sets out detailed guidelines in this respect. They include the recommendation that, instead of nationally-controlled facilities, there should be appropriate multinational participation in the development and operation of facilities. There would be a strong expectation internationally that any development of enrichment or reprocessing capacity in South Australia would follow these guidelines.

41. The Nuclear Suppliers Group Guidelines also recommend sensitive enrichment equipment is supplied in a way that recipients could not replicate it.

42. An example of international oversight of enrichment is the European enrichment group, URENCO. Established following the signing of the Treaty of Almelo between the United Kingdom, Germany and the Netherlands, URENCO has enrichment facilities in each of those countries. Subsequent treaty-level agreements with the United States (the Treaty of Washington) and with France (the Treaty of Cardiff) have allowed development or joint ownership of facilities in those countries. All countries have agreed not to transfer technology to other countries without appropriate safeguards. The multinational ownership structure makes it difficult for one party to clandestinely transfer technology.

43. Reprocessing in South Australia would raise international concern if it were possible to accumulate separated plutonium. Engaging in reprocessing activities would only make sense as part of a significant domestic nuclear power programme and/or market openings to reprocess foreign nuclear material on a fee-for-service basis.

44. Neither conversion (converting uranium to and from hexafluoride gas) nor fabricating uranium fuel for use in a reactor is considered particularly sensitive in terms of proliferation risk. Nevertheless, conversion and fuel fabrication facilities would be subject to IAEA safeguards, to verify nuclear material is not being diverted from peaceful use.

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31 IAEA, Nuclear Technology Review 2014, p 16, [www.iaea.org/About/Policy/GC/GCS8/GCS8infDocuments/English/gcS8inf-4_en.pdf](http://www.iaea.org/About/Policy/GC/GCS8/GCS8infDocuments/English/gcS8inf-4_en.pdf)
32 Ibid. p 17.
34 Ibid.
B.3 Manufacture of radioactive material

45. For economic and radiation protection reasons, reactor-based isotopes are best produced at the reactor site.\(^{35}\) The opportunities for South Australia in this field are likely to be driven by the capacity of existing domestic suppliers.

46. Some cyclotron-based isotopes are short-lived (in some cases with half-lives measured in seconds) and therefore not suitable for export; even export to other states within Australia is often problematic. Other cyclotron-based isotopes, such as iodine-125 and gallium-67, are longer-lived – they are currently imported due to the lack of a suitable production cyclotron in Australia. Investment in technology to produce these isotopes might provide opportunities for South Australia.

B.4 Managing risks

47. As mentioned, if there were any further processing of nuclear or radioactive material in South Australia it would need to be accompanied by measures to ensure international confidence in Australia’s intentions. There are several other risks to manage.

48. Health and environmental risks specific to conversion and enrichment facilities are primarily related to storage and management of uranium hexafluoride (UF\(_6\)) gas. Uranium hexafluoride forms highly corrosive hydrofluoric acid when exposed to moisture. Measures to protect against the release of hydrofluoric acid employed at conversion and enrichment facilities are similar to those used by other chemical industries which produce fluorinated chemicals.

49. Radioactive material is transported daily on Australian roads. Australia has the capacity to construct and operate the transport infrastructure needed to meet international standards for all types of nuclear transport. There are well established international regulations and guidelines for the safe and secure transport of nuclear and other radioactive material.\(^{36}\)

50. Reliable commercial shipping services have been a long-standing issue for the Australian uranium industry. This reflects our remoteness from overseas nuclear fuel cycle facilities and a dearth of international shipping carriers and ports that will accept the transhipment of uranium ore concentrates to international markets. Uranium exports are only permitted through ports in Adelaide or Darwin.

51. Nuclear enrichment and reprocessing facilities would have to be designed to preclude the possibility of a criticality event.\(^{37}\) Broadly, a criticality event can be caused by bringing together too much enriched uranium and causing a limited uncontrolled reaction. There are clear international standards and guidelines to prevent such events.\(^ {38}\)

52. The risks associated with fuel fabrication facilities are minimal, as the level of uranium enrichment permitted by international standards largely precludes inadvertent criticality.

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\(^{35}\) ANSTO has demonstrated over many years that their production does not require the use of high enriched uranium.


events.\textsuperscript{39}

53. The IAEA would need to allocate additional resources to inspect any enrichment or reprocessing facilities. These additional resources would be minimised if the facility is designed to allow easy verification of compliance with IAEA safeguards.

54. From a nuclear and radiation safety perspective, risks can be addressed by ensuring facilities are well regulated and properly managed – using well-established global safety standards that have been implemented in many countries already. Attachment F to this submission provides an overview of international nuclear regulatory practices.

55. The technology base for enriching uranium, reprocessing irradiated nuclear fuel or fuel fabrication is considerable. These activities would require the development of a new and highly-skilled workforce, including through education and training programmes for the operation and maintenance of relevant facilities. The necessary regulation could be built on existing Commonwealth frameworks for health, environment, import/export, safety, security, safeguards and transport (see Attachment F).

Key Points

- Uranium conversion, enrichment and fuel fabrication markets are all oversupplied and expected to be for some time.
- There are significant challenges to market entry, including access to proprietary technology.
- Consistent with Australia’s non-proliferation obligations, any South Australian participation in enrichment or reprocessing would need to adopt international best practices to demonstrate they would be for purely peaceful purposes.

\textsuperscript{39} Ibid.
Attachment C is in response to Issues Paper Three: Electricity Generation from Nuclear Fuels. It outlines some of the factors to consider in establishing nuclear-generated electricity in Australia such as the National Electricity Market, future nuclear technologies and skills requirements. A case study on the United Arab Emirates’ (UAE) nuclear power programme is provided as an example.

56. The generation and supply of electricity across eastern and southern Australia is through the National Electricity Market (NEM). The National Electricity Law and Rules set out the architecture and governance of the NEM. While national laws currently prohibit the construction of a nuclear power plant, the NEM framework is technology-neutral and would not discriminate against connection of nuclear generators if constructed.

57. Through a bidding process, generators offer to supply the NEM specific amounts of electricity at a particular price, with the lowest bids put into operation first. This provides a signal for investment decisions on building and retiring generating plant.

58. There is currently surplus capacity in the NEM. Based on anticipated demand growth, no new generation capacity will be required to meet reliability requirements until at least 2023-24. The surplus has resulted in soft wholesale electricity prices, and the Commonwealth has stated it will not reduce the surplus by paying generators to exit the market.

59. These market conditions could change over the time it takes to establish a nuclear power programme. There might also be opportunities to install off-grid nuclear generators. Early consideration of the relative merits of nuclear electricity generation is necessary to inform investment decisions and regulatory arrangements.

C.1 Nuclear technologies

60. Nuclear reactor technology sold in the international market mainly comprises large-scale plants (1000-1600 MWe) using Generation III technology. Generation III technology uses advanced light water reactors which are generally variants on earlier Generation II technology, but with major advances in safety and simplicity of design. In Australia, these plants would be suitable only as an alternative to coal-fired base-load plants, given their large scale. Over the next 40 years, Generation IV technology is likely to displace Generation III (see box below).

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43 The IAEA estimates that planning for nuclear power can take 10 to 15 years until commission of the first plant owing to the need to establish infrastructure, capabilities and regulatory arrangements; see IAEA, Nuclear Safety Infrastructure for a National Nuclear Power Programme Supported by the IAEA Fundamental Safety Principles (INSAG-22), p 3 and Annex I http://www-pub.iaea.org/MTCD/publications/PDF/Pub1350_web.pdf
44 See www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Power-Reactors/Advanced-Nuclear-Power-Reactors
Generation IV technology

Generation IV technology is the next generation of nuclear reactor designs, which will use fuel more efficiently, reduce waste production, be economically competitive, and meet stringent standards of safety, security and proliferation resistance.

The Generation IV International Forum (GIF) is a consortium of advanced nations working together in long-term research on advanced nuclear technologies. For more than a decade, the GIF has led international collaborative efforts to develop next-generation nuclear energy systems that can help meet the world’s future energy needs.

Research is focused on six reactor designs. Four of the six designs are also designated for hydrogen production, potentially powering transportable energy systems in the form of hydrogen fuel cells. Four of the six designs are fast reactors, offering vastly more efficient use of uranium resources and the ability to burn actinides, the long-lived component of high-level nuclear wastes. Fast reactors will allow operators to run closed fuel cycles, significantly reducing the volume of radioactive waste produced.

Some of these reactor designs could be demonstrated within the next decade, with commercial deployment beginning in the 2030s. France and Russia are developing advanced sodium fast reactor designs for demonstration in the next 5-10 years. A prototype lead fast reactor is also expected to be built in Russia over the next 10 years.

61. Small Modular Reactors (SMRs) are being developed and are expected to be comparable in scale to gas turbine technology, with capacities from 25 MWe to 300 MWe. SMR technology will be modular, so capital investment could be phased, allowing revenue streams to be realised after the first module is installed. Research institutes, including the National Nuclear Laboratory in the United Kingdom, and the Small Modular Reactor Research and Education Consortium (SmrREC) in the United States, are investigating the economics of deploying multiple SMRs.

62. SMR technology could be commercially available in the next 5-10 years. Once a certified design is selected and construction is approved, the lead time to bring an SMR on-line is expected to be 2-3 years, compared to 4-5 years for Generation III technology.

63. China is developing a demonstration SMR. A high-temperature gas-cooled plant is being constructed at Shidaowan, near Weihai city in Shandong province, initially comprising twin reactor modules driving a single 210 MWe steam turbine. Commercial operation is scheduled for 2017. A further 18 SMR units are proposed at the site. Chinese organisations have also developed a number of other SMR designs.

C.2 Nuclear electricity costs

64. Costs of nuclear power plants are driven primarily by upfront capital costs, which are amortised over the life of the plant and recovered through electricity tariffs.

65. The 2013 Australian Energy Technology Assessment (AETA) found that the levelised costs of nuclear power plants are driven primarily by upfront capital costs, which are amortised over the life of the plant and recovered through electricity tariffs.

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48 Ibid.
cost of electricity\textsuperscript{54} in 2030 for Generation III large-scale reactors is $130 per megawatt hour, and for SMRs, $150 per megawatt hour. These costs are higher than coal-fired power at $95 per megawatt hour (pulverised coal supercritical plant based on brown coal) and gas-fired technologies at $100 per megawatt hour (combined cycle plant burning natural gas). The AETA did not consider the cost of plant decommissioning, spent fuel storage or waste disposal.

66. Nuclear power delivers large amounts of base-load electricity with very low carbon emissions.\textsuperscript{55} When this is taken into account, the cost of nuclear could become competitive with alternative low-emissions generation technologies.\textsuperscript{56}

C.3 Managing risks

\textit{Safety}

67. Between 2004 and 2008, the European Commission assessed implied doses to the EU population arising from reported discharges from EU nuclear power stations and reprocessing sites.\textsuperscript{57} The results showed doses from the operation of nuclear power plants were below the statutory limits and impacts on the population and the environment were very low – noting that doses from nuclear power plant operations vary significantly for different reactor types.

68. While large nuclear accidents with serious consequences are uncommon, accidents such as at TEPCO’s Fukushima Daiichi nuclear power plants demonstrate that an incident could have severe consequences without the proper contingency plans in place.

69. An IAEA Action Plan on Nuclear Safety was developed following the IAEA’s Fukushima Ministerial Conference on Nuclear Safety in June 2011.\textsuperscript{58} A key lesson is the importance of independent and effective regulation.\textsuperscript{59} Since 2011, the IAEA has reviewed all its safety standards and is now publishing revised versions in light of lessons learnt from the Fukushima accident. In September 2015, the IAEA will publish a comprehensive report on the causes of, consequences and lessons learnt from the accident.\textsuperscript{60} The impacts on Australia from the Fukushima accident, including lessons learnt, have been considered in an Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Technical Report.\textsuperscript{61}

\textit{Security and safeguards}

70. IAEA safeguards would apply to any nuclear reactor built in Australia. Current light water reactor designs present a relatively low risk for weapons proliferation. However, many

\textsuperscript{54} Levelised cost of electricity is the price at which electricity must be generated from a specific plant to break even, taking into account the costs incurred over the life of the plant such as capital, fuel costs and maintenance. However, it does not consider site or company specific factors that might influence cost.

\textsuperscript{55} Manfred Lenzen, Is nuclear power zero-emission? No, but it isn't high-emission either, The Conversation, 21 May 2015, theconversation.com/is-nuclear-power-zero-emission-no-but-it-isnt-high-emission-either-41615


\textsuperscript{58} IAEA, Action Plan on Nuclear Safety, http://www-ns.iaea.org/actionplan/


\textsuperscript{60} See statement of the IAEA Director-General to the IAEA Board of Governors, June 2015, https://www.iaea.org/newcenter/statements/introductory-statement-board-governors-63

Generation IV reactor designs adopt a closed fuel cycle involving reprocessing. The proliferation implications of reprocessing are dealt with in Attachment B.

71. Security measures for any nuclear power plants would be required pursuant to the permit issued by the Australian Safeguards and Non-proliferation Office (ASNO) (see Attachment F), and be based on the standards recommended by the IAEA\(^{62}\), plus advice from Australian security agencies.

C.4 Skills

72. The OECD NEA, the IAEA and the United Kingdom Department for Business, Innovation and Skills have examined the skills and education required for a nuclear energy programme.\(^{63}\)

73. Right now, some specific knowledge and skills needed for a nuclear power programme are unlikely to be found domestically. But our existing nuclear science and engineering teaching and research base, including at ANSTO, is well-placed to support an expansion of domestic capacity that would be required to operate a potential nuclear energy programme.

74. As in many areas of science and technology, Australia would face challenges maintaining an appropriate skills base to support a nuclear power programme. Year 12 participation rates in science subjects essential to nuclear technology, for example, physics, chemistry, and advanced mathematics, were at their lowest in 20 years in 2012.\(^{64}\) While science enrolments in higher education have increased by nearly 30 per cent since 2007, study beyond first year in key disciplines such as physics and chemistry needs to grow.\(^{65}\)

75. The Commonwealth released in June 2015 a consultation paper: *Vision for a Science Nation*. It identifies current and potential actions and policies to improve Australia’s science, technology, engineering and mathematics performance.\(^{66}\) The Commonwealth is currently considering the outcomes of this consultation process.

C.5 Establishing a nuclear power programme

76. The UAE’s decision to include nuclear power in its energy mix is provided as an example of the process used to establish a new nuclear power programme (see box below).


\(^{64}\) Kennedy et al., 2014. The Continuing Decline of Science and Mathematics Enrolments in Australian High Schools. [*Teaching Science*, vol.60, pp.34-46.]


Case study: The UAE

The UAE is installing four nuclear power plants in close consultation with the IAEA.67 The UAE Government decided in 2008 that nuclear energy was the best option to counter an electricity supply deficit caused by a growing economy and depleting natural gas supplies, while also considering economic and environmental implications. It is projected that nuclear energy will produce nearly a quarter of the nation’s electricity needs by 2020.68

In January 2009, a United States-UAE bilateral agreement for peaceful nuclear cooperation was signed, the ‘123 Agreement’, which establishes a required legal framework for commerce in civilian nuclear energy between the two countries.69 Under the Agreement, the UAE committed to forgo domestic uranium enrichment and reprocessing of spent fuel, as well as sign the IAEA Additional Protocol. The UAE also has nuclear cooperation agreements in place with a number of other countries, and has become party to IAEA Conventions in areas of nuclear safety, security and liability. A bilateral nuclear cooperation agreement with Australia, enabling supply of Australian uranium to the UAE, came into force in April 2014.70

In 2009, the UAE President approved a federal law, ‘Concerning the Peaceful Uses of Nuclear Energy’, which established the Federal Authority for Nuclear Regulation (FANR), the UAE’s nuclear regulatory body.71 An international advisory board (IAB) was also established to provide an independent assessment of the UAE nuclear programme, reporting directly to the leadership of the nation, to help ensure that it meets the highest standards of safety, security and non-proliferation.

The Emirates Nuclear Energy Corporation (ENEC) was launched in December 2009 as an Abu Dhabi public entity. It is responsible for the deployment, ownership and operation of nuclear power plants. In December 2009, ENEC awarded the Prime Contract for the construction of four Generation III nuclear power plants to a consortium led by the Korean Electric Power Corporation (KEPCO).72 In 2010, a site was chosen, on the basis of its environmental, technical and business qualities.73 After an 18-month review, the construction licences for units 1 and 2 were issued in July 2012.74 An application for the construction of units 3 and 4 was submitted to FANR in March 2013, and licences were issued in September 2014.

In 2015, ENEC submitted its application for an operating licence for units 1 and 2.75 Unit 1 is over 73 per cent complete and on schedule for its 2017 start-up.76 Units 2, 3 and 4 are scheduled to follow at 12-month intervals. An operating company, Nawah Energy, is to be set up in 2017 to run the four units, with 82 per cent ENEC equity and 18 per cent KEPCO.77

Transparency has long been recognised as an important principle underpinning the UAE’s nuclear programme, alongside non-proliferation, safety and security and sustainability. ENEC’s commitment to transparency sees the company undertake regular public outreach programmes,78 where it informs and educates UAE residents about nuclear energy. There is strong public support for the programme.

Although the UAE has relied significantly on overseas-sourced expertise, skilling up of its own workforce is a major priority.

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68 Ibid.
71 UAE Federal Authority for Nuclear Regulation, fanr.gov.ae/en/Pages/default.aspx
72 UAE Permanent Mission to the IAEA, uae-mission.ae/Editor/Fact_Sheet_Barakah%20NPP.pdf
73 World Nuclear News, UAE has its first nuclear site, 23 April 2015, http://www.world-nuclear-news.org/m_uae_has_its_first_nuclear_site_2304102.html
74 UAE Permanent Mission to the IAEA, uae-mission.ae/Editor/Fact_Sheet_Barakah%20NPP.pdf
75 ENEC, www.enec.gov.ae/news/content/enec-submits-operating-license-application-to-fanr-for-barakah-units-1
77 WNA, Nuclear Power in the United Arab Emirates, (website hyperlink above).
78 ENEC, ENEC to Host Open Public Forums in Abu Dhabi and Silla, enec.gov.ae/media-centre/news/content/enec-to-host-open-public-forums-in-abu-dhabi-and-silla
The UAE is building its nuclear workforce through nuclear-related workshops, courses, the hosting of an IAEA Nuclear Energy Management School, the IAEA technical cooperation programme, a Cyber Learning Platform (CLP4NET) installed at Khalifa University and ENEC scholarship programmes. In April 2014, ENEC inaugurated a Simulator Training Centre at the site of the UAE’s nuclear power facility. The simulator replicates the actual conditions and environment that reactor operators would experience in a real time situation. Each student requires more than 800 hours of advanced simulator training for the senior reactor operator certification, which FANR controls and issues. In September 2014, ENEC graduated 46 students from its scholarship programme, held at KEPCO’s facilities in South Korea, the Institute of Applied Technology in Abu Dhabi, and the ENEC Simulator Training Centre. In 2014, ten Emirati citizens became the country’s first fully qualified local operators.

Key Points

- No immediate need exists for new generation capacity in the National Electricity Market, but opportunities might emerge in the future.
- Recent advances mean future nuclear energy technologies will be safer, produce less waste and have lower proliferation risks.
- Australia’s existing nuclear science and engineering teaching and research base could be built on to support a potential nuclear power programme.
ATTACHMENT D: MANAGEMENT, STORAGE AND DISPOSAL OF NUCLEAR AND RADIOACTIVE WASTE

Attachment D is in response to Issues Paper Four: Management, Storage and Disposal of Nuclear and Radioactive Waste. This Attachment outlines the Commonwealth’s experience in establishing a national waste disposal facility to dispose of domestic low-level and store domestic intermediate-level waste. It also provides information on other countries’ approaches to storing waste from their nuclear energy programmes. The risks associated with storing wastes from the nuclear fuel cycle are also outlined.

77. Radioactive waste arises from a range of nuclear-related activities, including electricity generation, the production of nuclear medicine and research and development activities. Waste is divided into categories reflecting the precautions needed in its management. The purpose of radioactive waste management is to isolate the material from people and the environment until it no longer poses a hazard.

78. Nuclear activities in Australia generate low and intermediate-level radioactive waste. The Commonwealth is committed to the safe and secure management of this waste in accordance with international best practice. It is establishing a national radioactive waste management facility to be sited on land volunteered for this purpose by the landholder. The national facility will have capacity to manage all of Australia’s low and intermediate-level radioactive waste that meets the facility’s waste acceptance criteria. The Commonwealth anticipates opening the facility in the early 2020s.

79. The National Radioactive Waste Management Act 2012 for establishing a national facility prohibits foreign-generated radioactive waste and high-level radioactive waste being accepted at the national facility.

80. Australia does not currently conduct activities that generate high-level radioactive waste, such as from nuclear power generation. Further, Australia does not directly dispose of spent nuclear fuel from ANSTO’s research reactor. Spent fuel is sent overseas to partner countries for reprocessing, with some of the resulting intermediate-level waste returned to Australia.

81. If there was development of nuclear power in South Australia, there would need to be arrangements to manage the resulting spent nuclear fuel and high-level radioactive waste. Australia’s comparatively stable geology may be suitable for deep, underground disposal of long-lived, higher-activity radioactive waste and spent nuclear fuel, but detailed technical and scientific work has not been undertaken.

82. Australia is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Joint Convention declares that radioactive waste should, where safe, be disposed of in the country which generated the waste. It also recognises that in some cases, safe and efficient waste management might be fostered through agreements between countries to use facilities in one country to benefit others.

79 The term “radioactive waste” is defined internationally as “radioactive material in gaseous, liquid or solid form for which no further use is foreseen..., and which is controlled as radioactive waste by a regulatory body...” (Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Article 2(h)). There is no meaningful distinction between the terms “radioactive waste” and “nuclear waste”.

D.1 Australian experience

83. Australia’s report to the 5th Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management provides an overview of waste in Australia and its management at Commonwealth, State and Territory levels. A timeline of significant events relating to radioactive waste management policy in Australia through to 2011 has been compiled by the Australian Parliamentary Library. A table summarising the events until December 2014 is also at the end of this Attachment.

84. Current radioactive waste management arrangements in Australia are inefficient, expensive and pose avoidable future risks to health, safety and the continued operations of Australia’s nuclear sciences and nuclear medicine production.

85. Studies from the 1990s and 2000s identified a range of sites suitable for the disposal of low and short-lived intermediate-level wastes. Western Australia already operates a small disposal facility for a range of hazardous wastes, including low-level radioactive wastes, at Mount Walton East.

86. A clear lesson from past Commonwealth attempts to establish a radioactive waste management facility is that it requires a partnership between governments and local communities. The National Radioactive Waste Management Act 2012 specifies a voluntary site nomination process open to landholders across the country. It also requires a Regional Consultative Committee to facilitate ongoing communication between the Government, the operator of the facility and the local community.

87. The National Radioactive Waste Management Act 2012 requires a National Repository Capital Contribution Fund once an operating license is issued for the national facility. Through the Fund, fees from users of the facility would be directed toward enhanced public services and/or infrastructure in the State or Territory where the facility is located. The Commonwealth is required to credit the Fund with $10 million prior to commencement of operations at the facility.

88. The Commonwealth has also undertaken to negotiate a package of benefits directly with the local community hosting the national facility. This recognises potential construction and operational impacts of the national facility, and will ensure the local community derives a clear benefit – beyond employment opportunities – from its establishment.

D.2 International experience

89. There is broad global scientific consensus that radioactive wastes can be safely managed through disposal. Near-surface disposal is used for low-level waste. The proposed management method for long-lived and high-level radioactive waste, including spent fuel disposed of as waste, is deep geological disposal. These approaches isolate waste from the biosphere for the period required for their decay to safe levels.

90. There are research and feasibility projects being undertaken internationally to establish

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best practice methods for the disposal of higher-activity wastes, with some countries now establishing deep-geological facilities for this purpose. The IAEA and OECD NEA have mechanisms in place that would allow Australia access to the latest developments.

91. Specific arrangements in each country depend on the scale of the nuclear industry or use of radioactive materials. Countries with similar volumes and types of waste to Australia are yet to proceed to disposal of higher-activity wastes.

**Low-level waste**

92. Low and some intermediate-level wastes are already disposed of safely and with no adverse environmental impacts in a range of countries. Australia’s policy of near-surface disposal of low-level radioactive waste is consistent with the approach taken in these countries.

93. Some countries, such as Switzerland, that are investigating deep geological disposal for higher-activity waste are also considering the disposal of low-level waste alongside these higher-activity wastes. This approach is suited to countries that do not have access to geological conditions suitable for near-surface disposal of lower-activity wastes.

**Higher activity wastes and spent nuclear fuel**

94. Two approaches exist for managing spent fuel from nuclear power programmes. The first is direct disposal of the spent fuel. The United States, Finland and Sweden are pursuing this approach. The second involves reprocessing spent fuel, with the uranium and plutonium being extracted for subsequent re-use and the fissile products and actinides being immobilised – generally by way of vitrification – prior to disposal. France is perhaps the best example of this approach.

95. Reprocessing enables the re-use of energy-rich materials and results in a smaller volume of waste for ultimate disposal. However, reprocessing involves further handling of highly radioactive material, with the associated safety risks, and is not cost-competitive with the once-through fuel cycle. Reprocessing can also be used to extract fissile material for nuclear weapons. Attachment B to this submission addresses this aspect.

96. A range of countries, led by Finland and Sweden, are at varying stages of developing deep geological facilities to dispose of spent fuel and high-level radioactive waste. Notably those countries with the most advanced projects are those where there has been intensive and far-reaching community engagement. The OECD NEA’s Forum on Stakeholder Confidence (FSC) has produced a number of publications detailing the elements of successful community engagement and lessons learnt.

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86 Forum on Stakeholder Confidence, [https://www.oecd-nea.org/fsc/](https://www.oecd-nea.org/fsc/)
89 France has demonstrated that these safety risks can be well managed.
90 See [www.oecd-nea.org/fsc/](http://www.oecd-nea.org/fsc/)
Case study: Finland

Finland is leading the world in developing a deep geological repository for disposing of spent fuel. The facility, which will be some 400 metres underground in 2 billion-year-old igneous rock, is being constructed and will be operated by Posiva Oy, a company jointly owned by the operators of Finland’s current nuclear power plants.

Screening studies of the entire area of Finland were performed, followed by preliminary site investigations. During 1993-2000, detailed site investigations and an environmental impact assessment procedure were carried out for four sites, with local support being highest in two of these sites. Posiva applied for a decision-in-principle for the final disposal facility at one of those two sites, selected largely based on issues related to ease of construction.

For the decision, the Government requested statements from the municipal council representing the local level of administration (which had a right to reject the proposal) and from the Radiation and Nuclear Safety Authority (STUK). The municipal council expressed its willingness to host the facility in a vote of 20:7. A Government decision-in-principle was approved by Parliament by a 159 to 3 vote in May 2001.

Exploratory excavations began in 2004, and the construction license application for the final repository was submitted to the Government in December 2012. The Finnish regulator, STUK, reviewed the application and indicated that it was satisfied with the safety case. However, under Finnish law, the final decision on the application lies with the Government, and is expected this year. The operating licence application is expected in 2020, with a view to operation from 2022.

Finland’s success in developing a permanent repository can be attributed to key relationships between Posiva and the local municipality, active public engagement (Posiva organised several open discussion events in all candidate municipalities), its establishment of an independent repository siting body, and its adoption of a rigorous safety and technical standard.

D.3 Managing risks

97. One factor distinguishing radioactive from other hazardous wastes (such as those containing arsenic or mercury) is that radioactivity is hazardous for finite periods. An inverse relationship exists between the radioactivity of a particular material and its half-life. For example, the most abundant naturally occurring isotope of uranium, uranium-238, has a half-life of 4.51 \times 10^9 years: almost the age of the Earth. Although it will be around for longer than the Earth, it is only weakly radioactive. Conversely, nitrogen-16, which is created in the operation of nuclear reactors, has a half-life of seven seconds – meaning that it is intensely radioactive, but for a very short period.

98. This consideration allows division of wastes arising from the nuclear fuel cycle:

- Fission products: radioactive isotopes of elements created when uranium fissions inside a nuclear reactor, generally with half lives up to about 30 years. The most well-known of these isotopes include iodine-131 and caesium-137. Initially, they are responsible for the great majority of the radioactivity present in spent fuel and in the waste derived from its reprocessing. However, their relatively short half-life means that after 300 years, their activity will be less than 0.1 per cent of the original level. Consequently, the period for which they need to be isolated from the environment – although long in terms of human lifetimes – is in geological terms rather short.

- The actinides: the very heavy elements created when uranium captures additional material during the nuclear reaction. The most well-known is plutonium, but there are also elements such as americium and neptunium. These elements, although initially...
much less radioactive than fission products, have significantly longer half-lives. It is therefore the actinides which lead to the need for spent fuel and the waste derived from its reprocessing to be isolated from the environment for thousands of years.

99. A number of concepts have been proposed to separate these actinides from general waste streams and a number of technological solutions implemented. The designers of Generation IV reactors (see Attachment C) are planning for them to be used to consume the separated actinides. However, to date, various technical factors and cost have prevented their widespread deployment.

100. The technical measures needed to keep waste isolated from people and the environment are well understood. Factors particularly relevant to waste disposal facilities are the geological environment and its stability over the time that waste needs to be isolated, and the physical and chemical characteristics of wastes accepted at the facility. Careful consideration of these factors minimises the risk of material migrating from the disposal facility.

101. Any facility used to dispose of nuclear material, such as that in spent fuel, would be subject to safeguards.

**Key Points**

- The Commonwealth’s process for a national radioactive waste facility is separate to the Royal Commission’s investigation of wider opportunities for waste management.
- It is prohibited to store foreign-generated radioactive waste or high-level radioactive waste at the national facility.
- Australia may have suitable geological sites for underground storage of spent nuclear fuel and radioactive waste, but detailed technical and scientific work is needed.
<table>
<thead>
<tr>
<th>Milestone</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>Commonwealthistate Consultative Committee on Radioactive Waste Management (‘Committee’) is established.</td>
</tr>
<tr>
<td>1985</td>
<td>Committee recommends a national programme be initiated to identify potentially suitable sites for a national near-surface radioactive waste repository.</td>
</tr>
<tr>
<td>1986</td>
<td>Studies indicate most states and the Northern Territory contained potentially suitable locations for a repository.</td>
</tr>
<tr>
<td>1988-9</td>
<td>A Commonwealth-funded feasibility study for a possible national waste repository in the Northern Territory.</td>
</tr>
<tr>
<td>May 1991</td>
<td>Northern Territory indicates it is no longer willing to host a repository under the Commonwealth-State cooperative process.</td>
</tr>
<tr>
<td>August 1991</td>
<td>Commonwealth, State and Territory governments begin the process to identify specific objectives and target dates for appropriate low and medium-level radioactive waste repositories.</td>
</tr>
<tr>
<td>September 1991</td>
<td>Commonwealth seeks the participation of all governments in a coordinated search for a site for a single national radioactive waste repository.</td>
</tr>
<tr>
<td>June 1992</td>
<td>Commonwealth announces, with the support of state and territory governments, a project to construct a near-surface repository for disposal of Australia’s low-level and short-lived, intermediate-level radioactive waste is to be initiated.</td>
</tr>
<tr>
<td>November 1995</td>
<td>Commonwealth releases its report for Phase 2 of the site selection process for the low-level waste repository.</td>
</tr>
<tr>
<td>1997</td>
<td>Committee agrees in-principle on the need for a national intermediate-level waste store. The Committee also endorses co-locating the intermediate-level waste store with the low-level waste repository.</td>
</tr>
<tr>
<td>November 1997</td>
<td>Commonwealth publishes a discussion paper National Radioactive Waste Repository Site Selection Study, Phase 3: Regional Assessment, as part of an information kit and consultation process.</td>
</tr>
<tr>
<td>February-June 1998</td>
<td>Possible sites for a low-level waste repository are identified.</td>
</tr>
<tr>
<td>May 2000</td>
<td>The location of a low-level waste repository is narrowed down to five sites in the central-north of South Australia.</td>
</tr>
<tr>
<td>August 2000</td>
<td>Commonwealth commences search for a site for an intermediate-level waste storage facility.</td>
</tr>
<tr>
<td>February 2001</td>
<td>Commonwealth announces it will establish a facility on Commonwealth land for intermediate-level radioactive waste from Commonwealth agencies. The facility would not be co-located with the repository for low-level waste.</td>
</tr>
<tr>
<td>May 2003</td>
<td>A site at Arcoona Station in South Australia is announced as the location for the low-level waste repository.</td>
</tr>
<tr>
<td>July 2003</td>
<td>Commonwealth compulsorily acquires the site at Arcoona Station.</td>
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<tr>
<td>Milestone</td>
<td>Event</td>
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<tr>
<td>June 2004</td>
<td>Federal Court overturns the acquisition.</td>
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<tr>
<td>July 2004</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
</tr>
<tr>
<td>July 2005</td>
<td>Commonwealth announces three sites on Defence land in the Northern Territory would be investigated for siting a waste management facility for low and intermediate-level waste.</td>
</tr>
<tr>
<td>September 2007</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
</tr>
<tr>
<td>March 2009</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
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</tr>
<tr>
<td>May 2011</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
</tr>
<tr>
<td>April 2012</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
</tr>
<tr>
<td>June 2014</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
</tr>
<tr>
<td>December 2014</td>
<td>Commonwealth announces it will abandon the National Repository Project and a new siting process would begin for a combined low and intermediate level-waste management facility.</td>
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</tbody>
</table>
ATTACHMENT E: COMMUNITY ENGAGEMENT

Attachment E provides domestic and international examples of how to engage communities, particularly Indigenous communities, to facilitate confidence in and understanding of the impact of nuclear fuel cycle activities.

102. It is important for the community to have confidence that risks are being appropriately managed and people and the environment are being protected. Any expanded role in the nuclear fuel cycle will require long-term investment, including foreign investment. Attracting investment and improving community confidence requires bipartisan support and a stable, predictable and robust regulatory system.

103. Communities need confidence their needs and expectations are being properly considered. Industry needs to show it is listening to, understands and is responsive to the potential regional social and economic impacts of its activities. Engaging early with communities likely to be affected is important. A long-term programme of community dialogue and engagement should be factored into consultation frameworks and planning.

104. Overseas experience shows engagement with local communities by operators of existing facilities and proponents of new facilities is essential. International best practice is to implement decision-making that enables societal input to early decision-making processes and informs timescales for implementation, location and performance criteria.

105. The potential for radiological contamination of soils, groundwater aquifers, plants and animals from nuclear-related activities could impact nearby communities and other industries such as agriculture. Independent advisory and scientific research bodies could provide assurance that such risks are being managed satisfactorily. For example, the Alligator Rivers Region Technical Committee independently reviews the quality of the science underpinning regulation of the Ranger uranium mine. Other activities could include community outreach, commissioning research and making findings publicly available, and advising government on the latest scientific information to support decision-making.

106. Transparency and accountability in governments’ decision-making processes also contribute to building community confidence. There are a number of examples of successful siting processes for radioactive waste and spent fuel management facilities. Attachment F to this Submission also outlines the important elements of the regulatory system for transparency and accountability.

E.1 Indigenous community engagement

107. Industrial activities have the potential to impact on Indigenous communities and their connection to their country. Indigenous people hold land title over more than 20 per cent of South Australia. Any potential expansion of activity in the nuclear fuel cycle needs thorough,

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timely and ongoing engagement with Indigenous Australians, particularly given the historical experiences of Indigenous communities following nuclear testing in the Maralinga area.

108. Nuclear testing by the United Kingdom in the 1950s and 60s resulted in radioactive contamination at Maralinga and displacement of the Maralinga Tjarutja traditional owners. Between 1993 and 2000, rehabilitation works were undertaken to decontaminate Maralinga and return the area to the Maralinga Tjarutja traditional owners. Following rehabilitation, all areas at Maralinga returned radioactivity dose levels well within acceptable limits for all land uses. In 2009, the rehabilitated area was officially returned to the Maralinga Tjarutja traditional owners.

109. It is important that Indigenous land owners are supported to leverage their land assets for the social and economic benefit of themselves, their families and their communities. It is also important for Indigenous Australians to have the opportunity to benefit from use of their land assets in the mainstream economy.

110. South Australia has nine Indigenous Protected Areas (IPAs) covering an area of 6,189,018 ha, and one consultation IPA covering an additional 1792 ha. These are primarily located in north-west, south-west and central South Australia. IPAs are based on a voluntary, non-binding agreement between the Indigenous land holder and the Commonwealth to promote biodiversity and cultural resource conservation.

111. The existence of IPAs does not prevent development. However, any activity within an IPA must be compatible with the protection category under which the IPA is declared. A proponent would need to negotiate an agreement with the traditional land owners. Reviewing existing agreements provides lessons for future engagement with Indigenous communities, suggesting that recognition of Indigenous people’s dual aspiration for market engagement and practice of cultural values can maximise Indigenous benefits.

112. Capacity development in Indigenous communities would be especially helpful for community organisations to effectively manage agreement negotiations and benefit distribution. Cultural obligations of stewardship over ancestral lands present Indigenous communities with dilemmas when considering activities that disturb the natural and cultural landscape and specific sites. Cultural and spiritual views are often not well understood (by non-indigenous people) and engagement processes which acknowledge and draw out these views are valuable.

113. Specific to uranium mining, the Uranium Council (and formerly the Uranium Industry Framework) has developed educational material to better inform Indigenous Australians about uranium mining. In relation to Ranger mine, the Supervising Scientist has developed a series of short movies in the local Kunwinjku language to explain environmental protection concepts to local indigenous stakeholders.

E.2 Managing conflicting land uses

114. Access to land taking into account environmental, heritage, and cultural values and land ownership is fundamental for uranium mining.

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99 See Supervising Scientist Protecting the Environment, [https://www.youtube.com/watch?v=WvKarc209Ns](https://www.youtube.com/watch?v=WvKarc209Ns), and; Supervising Scientist Protecting People, [https://www.youtube.com/watch?v=ouqYIjdPpE](https://www.youtube.com/watch?v=ouqYIjdPpE)
115. In December 2013, the then Standing Council on Energy and Resources (now the COAG Energy Council) agreed to the Multiple Land Use Framework. The Framework allows government, community and industry to effectively and efficiently address land access and use challenges and expectations. The overall principle is that land should not be put to a single use without considering the implications or consequences for other potential land uses. The objective is to maximise the net benefits to present and future generations from a combination of land uses.

116. Under the direction of the COAG Energy Council, the Land Access for Resources Working Group will develop a set of specific actions that promote community confidence and engagement to address impediments to land access.

<table>
<thead>
<tr>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>• At all stages of the nuclear fuel cycle, the community must have confidence that risks are being appropriately managed and people and the environment are protected.</td>
</tr>
<tr>
<td>• Any potential expansion of nuclear fuel cycle activities needs early, thorough and ongoing engagement with communities likely to be affected, including Indigenous Australians.</td>
</tr>
<tr>
<td>• To maximise Indigenous benefits, Indigenous people’s dual aspiration for market engagement and practice of cultural values needs to be recognised.</td>
</tr>
</tbody>
</table>

ATTACHMENT F: AUSTRALIA’S NUCLEAR REGULATORY FRAMEWORK

Attachment F outlines Australia’s existing nuclear regulatory framework and some of the considerations for regulating any expanded role in the nuclear fuel cycle.

117. Unlike comparable countries, such as Canada and Sweden, Australia has no single regulator for nuclear fuel cycle activities or other use of radioactive material. Instead, Commonwealth, State and Territory entities regulate activities including mining, operating research reactors, producing nuclear or radioactive material, managing spent nuclear fuel and radioactive waste disposal.

118. Across all jurisdictions and regulators, the regulatory framework provides for the:

- protection of the environment, community and workers from the harmful effects of radiation;
- security of radioactive material; and
- physical security of and application of non-proliferation safeguards to nuclear installations and materials. 101

119. Existing regulations prohibit the construction or operation of nuclear reactors for generating electricity or facilities for enriching uranium, fabricating nuclear fuel or reprocessing spent nuclear fuel.

120. The regulatory framework is based on internationally-recognised standards and fulfils obligations under treaties and conventions that Australia has ratified. In particular:

- As a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), Australia has entered into treaty-level agreements with the IAEA to apply safeguards to all nuclear facilities and activities. IAEA safeguards verify that nuclear materials are not diverted from peaceful uses to nuclear weapons programmes.
- The nuclear safety and radiation protection framework is based on various treaties and on recommendations of the International Commission on Radiological Protection (ICRP) and requirements in IAEA Safety Standards.
- Consistent with obligations under the Convention on the Physical Protection of Nuclear Material (CPPNM) and the International Convention for the Suppression of Acts of Nuclear Terrorism, Australia implements a control and protection regime for nuclear material transport, storage and use. This regime is based on standards established by the international community for the security of nuclear materials and nuclear facilities.

101 Nuclear materials for these purposes are uranium, plutonium and thorium.
102 See www.iaea.org/publications/documents/treaties/npt
104 See www.icrp.org and http://www-ns.iaea.org/standards/
105 See http://www-ns.iaea.org/conventions/physical-protection.asp?sl=6&li=42
121. The alignment of domestic regulation with these international frameworks is periodically reviewed, for example, through review meetings of parties to the Convention on Nuclear Safety.

122. The National Directory for Radiation Protection (NDRP)\(^{108}\) promotes national uniformity in relation to radiation protection and security of radioactive sources. The NDRP is a repository of best practice radiation protection requirements that Australian health ministers have agreed to implement.

123. Where appropriate, assessment of radiation doses to the public also includes the dose derived from the consumption of foods, including bush foods. In accordance with best practice, assessment of doses to plants and animals is required irrespective of whether these are subsequently used for food. The ICRP provides\(^{109}\), and the IAEA is preparing\(^{110}\), guidance documents for assessing non-human radiation doses.

F.1 Commonwealth regulators

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

124. ARPANSA administers the Australian Radiation Protection and Nuclear Safety Act 1998 (‘ARPANS Act’). The objectives of the ARPANS Act are to protect the health and safety of people and the environment from the harmful effects of radiation.

125. Under the ARPANS Act, ARPANSA:

- regulates, through licensing, the safety and security of nuclear installations or prescribed radiation facilities operated by Commonwealth entities such as the ANSTO facilities at Lucas Heights or the proposed National Radioactive Waste Management Facility, and of radioactive materials held by entities such as CSIRO and the Australian National University;
- monitors licence holder compliance with the ARPANS Act, licence conditions and may mandate corrective actions;
- evaluates and approves security plans;
- promotes national uniformity of safety, radiation protection and source security across the Commonwealth, States and Territories to ensure consistent application of safety and protection criteria and to facilitate mobility of material, sources and services across jurisdictions; and
- carries out research into radiation protection, nuclear safety and medical use of radiation.

126. ARPANSA also issues import permits for radioactive substances under Regulation 4R of the Customs (Prohibited Imports) Regulations 1956 and export permits for high-activity radioactive sources under Regulation 9AD of the Customs (Prohibited Exports) Regulations 1958.

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\(^{109}\) [Environmental Protection – the Concept and Use of Reference Animals and Plants, ICRP Publication 108](http://www.icrp.org/publication.asp?id=ICRP%20Publication%20108); [Environmental Protection: Transfer Parameters for Reference Animals and Plants, ICRP Publication 114](http://www.icrp.org/publication.asp?id=ICRP%20Publication%20114), and; [Protection of the Environment under Different Exposure Situations, ICRP Publication 124](http://www.icrp.org/publication.asp?id=ICRP%20Publication%20124)

ARPANSA issues a licence only after a satisfactory assessment against international principles for safety and protection. The ARPANS Act prohibits ARPANSA from licensing a Commonwealth entity to operate a uranium enrichment plant, nuclear fuel fabrication plant, nuclear power plant, or spent fuel reprocessing facility.

For nuclear installations, the ARPANS Act requires ARPANSA to invite public submissions before making a decision whether or not to issue a licence.

Department of the Environment

The Department of the Environment administers the Environment Protection and Biodiversity Conservation Act 1999 (‘EPBC Act’). Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance may not be undertaken without approval from the Minister for the Environment: that is they are deemed controlled actions. Nuclear actions are one of nine matters of national environmental significance.

Current activities that are controlled nuclear actions and regulated under the EPBC Act include uranium mines, uranium ore milling facilities, the ANSTO research reactor and radioactive waste management facilities.

If the Minister decides an action is a controlled nuclear action, an assessment of the environmental impacts is required. The assessment includes consideration of impacts to the whole of environment. Public consultation occurs during the assessment and referral processes. As part of the assessment, the Department of the Environment also consults with Commonwealth and State Government agencies, including ARPANSA.

Under the EPBC Act, bilateral agreements for assessment are in place with all States and Territories to accredit their environmental assessment processes. This means State or Territory environmental assessments can be used by the Minister for the Environment to make a decision to approve or refuse a project. The Commonwealth is also working to implement bilateral agreements for approval, which will accredit State and Territory approval processes under the EPBC Act.

The EPBC Act prohibits the Minister for the Environment approving construction or operation of a nuclear fuel fabrication facility, a uranium enrichment facility, a nuclear power plant or a spent nuclear fuel reprocessing facility.

Through Intergovernmental Working Arrangements, the Commonwealth and Northern Territory share responsibility for regulating uranium and thorium mining in the Northern Territory. The Commonwealth has retained title to uranium and thorium but authority to regulate uranium and thorium mining has been delegated to the Northern Territory.

The Northern Territory Department of Mines and Energy, the day-to-day regulator, works with the Commonwealth Supervising Scientist. The Supervising Scientist provides public assurance through monitoring and oversight of regulation and environmental performance of

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112 Defined under the EPBC Act as: Establishing or significantly modifying a nuclear installation, a facility for storing radioactive waste or a large-scale waste disposal facility; transporting used nuclear fuel or radioactive waste; mining or milling uranium ores; and decommissioning or rehabilitating any facility or area in which nuclear action was undertaken.
uranium mining in the Alligator Rivers Region of the Northern Territory, including the Ranger mine. The Commonwealth Supervising Scientist is established under the Environment Protection (Alligator Rivers Region) Act 1978.

**Australian Safeguards and Non-Proliferation Office (ASNO)**

136. ASNO administers the Nuclear Non-Proliferation (Safeguards) Act 1987 (‘Safeguards Act’). The Safeguards Act gives effect to Australia’s obligations under the NPT and related international agreements, the CPPNM and the International Convention for the Suppression of Acts of Nuclear Terrorism. Unless ASNO has authorised the activity, the Safeguards Act prohibits the possession and transport of nuclear material and associated items, the establishment, operation and decommissioning of nuclear facilities or the communication of certain information related to sensitive nuclear technologies or weapons production. The Safeguards Act applies to all nuclear facilities in Australia.

137. Under the Safeguards Act, ASNO regulates the security of nuclear facilities and material to prevent the unauthorised removal or theft of nuclear material, minimise the risk of sabotage and ensure safeguards meet IAEA requirements. Permits and authorities granted by ASNO include conditions on accounting for, controlling and applying physical protection to nuclear material and associated items, both in use and in transport. ASNO works with permit holders on security plans for nuclear facilities and other places holding nuclear material, and for transportation of nuclear material (primarily uranium ore concentrates).

138. The Safeguards Act provides for inspection by Australian and IAEA inspectors to ensure compliance with the Act and with Australia’s international safeguards obligations. The IAEA inspects ANSTO facilities two to three times a year to verify nuclear material inventory, check facility design information and confirm the absence of undeclared nuclear activities. Once or twice a year, the IAEA seeks access to other locations, including uranium mines, to gain assurance about the wider range of nuclear activities in Australia.

139. Bilateral nuclear cooperation agreements implemented by ASNO facilitate the export of Australian uranium ore concentrates for use in overseas civil nuclear power. Application of IAEA safeguards provides the primary assurance that Australian uranium, and any nuclear material derived from it, is not diverted for use in nuclear weapons. The agreements include a requirement for application of internationally-agreed standards of physical security to nuclear material in the country concerned. ASNO works with bilateral partners to track how Australian obligated material is used. Thorium ore, and material derived from it, are covered by the same arrangements.

**Department of Industry and Science**

140. Exports of uranium and other nuclear materials are subject to control under Regulation 9 of the Customs (Prohibited Exports) Regulations 1958 and can only occur with the permission of the Minister for Industry and Science. Permission to make individual shipments is given only if a bilateral safeguards agreement is in place with the recipient country.

141. Under the Atomic Energy Act 1953, administered by the Department of Industry and Science, the Commonwealth has retained title to uranium and thorium in the

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113 For this purpose, a nuclear facility is a reactor, a critical facility, a uranium conversion plant, a nuclear fuel fabrication plant, a spent fuel reprocessing plant, an isotope separation facility (including an enrichment facility), a separate storage facility or a location where nuclear material in amounts greater than one ‘effective kilogram’ is customarily used. See Schedule 3 of the Safeguards Act for details.
Northern Territory. This Act permits the Minister for Industry and Science to authorise mining in the Ranger Project Area.

**Australian Maritime Safety Authority (AMSA) and Civil Aviation Safety Authority (CASA)**

142. The safe transport of radioactive materials by air and sea are subject to the *Civil Aviation Act 1988* and the *Navigation Act 2012* respectively. These Acts facilitate the safe and secure handling and transport of radioactive materials in order to reduce the risk of accidents. The standards applied under those regulatory systems are ultimately derived from IAEA standards applying to the transport of radioactive material.

143. AMSA is the primary regulatory authority under the *Navigation Act 2012*, which covers all regulated Australian vessels and any foreign flag commercial vessels carrying material to and from Australia. CASA is the primary regulatory authority under the *Civil Aviation Act 1988*, which covers all Australian-registered civil aircraft and foreign-registered civil aircraft carrying material to and from Australia.

144. CASA activities include the compliance assurance for the air transport of radioactive material in accordance with guidelines set by the IAEA and the International Civil Aviation Organization. Civil Aviation Safety Regulation Part 92 prescribes the minimum safety requirements for the consignment and carriage of dangerous goods, including radioactive material, by air. CASA has specialist inspectors to carry out audit and surveillance of the carriage of dangerous goods, publishes advisory circulars on this subject, and undertakes educational activities for both the aviation industry and the travelling public.

145. Under the International Convention for the Safety of Life at Sea, which Australia has ratified, the safety of sea transport of radioactive material is covered by the application of the International Maritime Dangerous Goods (IMDG) Code. Marine Order 41, made under the *Navigation Act 2012*, mandates the IMDG Code and covers the classification, packaging, stowage and segregation, documentation and other transport provisions for packaged dangerous goods.

146. The *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* implements Australia’s obligations under the International Convention for the Prevention of Pollution from Ships. Under this Act, it is an offence to jettison harmful substances, including radioactive materials, into the sea.

**Department of Defence**

147. The Defence Export Control Office (DECO) regulates the export and supply of nuclear goods, software and technology that are included on the Defence and Strategic Goods List (DSGL) and other goods that may be used in weapons of mass destruction programmes. These items require a permit from DECO to be exported from Australia. The relevant legislation administered by Defence includes the *Defence Trade Controls Act 2012*, the *Weapons of Mass Destruction (Prevention of Proliferation) Act 1995* and Regulation 13E of the Customs (Prohibited Exports) Regulations 1958.

148. The nuclear-related items listed on the DSGL are derived from the control lists of the

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114 For example, AC 92-7(0): Applications for competent authority approval: Radioactive material
115 Like the ARPANS Code for the Safe Transport of Radioactive Material and CASA standards, the IMDG Code is in turn derived from the IAEA Safety Series No. SSR-6 Regulations for the Safe Transport of Radioactive Material.
Nuclear Suppliers Group (NSG), a group of nuclear supplier countries, including Australia, that seek to contribute to the non-proliferation of nuclear weapons. NSG member states have agreed that the supply of nuclear-related items on the DSGL should be monitored and controlled.

149. The Woomera Prohibited Area (WPA), given its size, remoteness and quiet electromagnetic environment, is one of Australia’s most important military testing areas. The Department of Defence, through the Defence Act 1903 and the Defence Force Regulations 1952, controls access to Defence establishments and training areas, including the WPA. Any future development of nuclear related activities in or near the WPA may be limited by safety and security considerations, ability to maintain Defence capability, and the requirement to evacuate during Defence testing. This would also apply to other Defence establishments in South Australia.

150. A table summarising the Commonwealth nuclear regulatory agencies, their roles and related legislation is at the end of this Attachment.

F.2 States and Territories

151. The States and Territories are responsible for environmental, radiation and public safety protection, including the regulation of uranium mining and milling. Each jurisdiction administers its own radiation protection legislation. State and Territory regulators do not have jurisdiction over Commonwealth places or entities. As noted above, ARPANSA endeavours to develop uniform standards across all jurisdictions.

F.3 Considerations for regulating any expanded role in the nuclear fuel cycle

152. The IAEA has developed a suite of safety standards covering all nuclear and radiation-related activities, from uranium mining through to waste disposal. While those standards are not directly binding under international law, Australia has committed to the implementation of a robust regulatory system taking those standards into account through ratification of the Convention on Nuclear Safety and of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The OECD NEA\(^\text{116}\) also provides guidance on good practice for regulatory systems for nuclear facilities.

153. Under the conventions, countries must prepare and submit a triennial report on all measures taken to implement each obligation to a meeting of contracting parties. Any state-based regulator would need to coordinate this through the Commonwealth.\(^\text{117}\)

**Independence of the regulator**

154. An effective nuclear regulator must be independent of regulated entities,\(^\text{118}\) as is the case now in Australia. The importance of an effective and independent regulator for the safe management of power reactors featured prominently in the reports on lessons learnt from the


\(^{117}\) This is currently done for Australia’s reporting under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

The 2011 accident at the Fukushima Daiichi nuclear power plants.\textsuperscript{119}

155. The IAEA Safety Standards requirements provide that governments shall ensure that the regulatory body is effectively independent in its safety-related decision making, and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making.\textsuperscript{120}

International contribution of regulatory bodies

156. ARPANSA and ASNO are regulators but also offer critical expert support for Australia’s engagement in international fora on subjects such as nuclear safety, security and safeguards. The Office of the Supervising Scientist engages regularly on best practice environmental protection and routinely assists international partners including the IAEA. This helps in return to maintain regulatory expertise in Australia.

Federal considerations

157. In some other countries with federal systems of government, such as the United States and Canada, licensing and regulation of the safety of nuclear installations is by bodies established by the federal or central governments.\textsuperscript{121} A national approach minimises duplication and compliance costs, and facilitates strong contingency planning and emergency management, although the extent of the Commonwealth’s powers in Australia are, of course, governed by the Constitution.

Developing a skilled and specialised workforce

158. A specialised and skilled workforce is critical for the operation, security and regulation of nuclear fuel cycle facilities. There would likely be a skills shortage with any expansion of nuclear fuel cycle activities in Australia. Greater Australian involvement in the nuclear fuel cycle over the longer term would assist in building Australia’s skill base.

Nuclear liability

159. The IAEA and the OECD Nuclear Energy Agency have developed an international regime covering compensation for damage from nuclear activities – civil nuclear liability.\textsuperscript{122} Most countries undertaking nuclear activities have developed national legislation consistent with that regime, irrespective of whether they are parties to the relevant international conventions.

160. Exceptionally, Australia has no special legislation covering civil nuclear liability. There are significant differences between liability under general law and liability under the international nuclear liability regime, particularly in relation to the responsibility of the facility operators and the standard of proof required. Further involvement in the fuel cycle would require the adoption of nuclear liability legislation to ensure operators are held liable for incidents and are able to provide adequate compensation, and that claims for compensation for an accident in Australia are dealt with in Australia.

\textsuperscript{119} IAEA, Strengthening Nuclear Regulatory Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant. \url{www.iaea.org/sites/default/files/regeffectiveness0913.pdf}

\textsuperscript{120} See paragraph 2.8 of IAEA General Safety Requirements Part 1 (website hyperlink above).

\textsuperscript{121} The United States Nuclear Regulatory Commission (NRC) may allow States to regulate some radioactive material, but the NRC cannot give up its authority for regulating the construction and operation of nuclear installations.

End of life costs

161. The IAEA recommends the legal framework developed for nuclear power plants include provision for financial aspects of spent fuel and waste management and decommissioning nuclear facilities.\(^\text{123}\) In OECD countries, national law generally provides that these costs must be accounted for in the cost of electricity. The expected cost is typically 5-10 per cent of the levelised cost of electricity.\(^\text{124}\)

### Key Points

- Australia has a robust nuclear regulatory framework for existing activities that protects and promotes health, safety, the environment, non-proliferation and security.
- This regulatory framework is based on IAEA standards and Australia’s international obligations. It can provide a basis for considering the regulatory system necessary for any expanded involvement in the nuclear fuel cycle.
- There would likely be a skills shortage with any expansion of nuclear fuel cycle activities, but over the long term, greater involvement in the nuclear fuel cycle would assist in building Australia’s skills base.

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### Summary of Commonwealth nuclear regulators

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<th>Commonwealth Department/agency</th>
<th>Regulatory role</th>
<th>Supporting legislation/regulation</th>
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<tr>
<td><strong>Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)</strong>&lt;br&gt;Agency within the Health portfolio</td>
<td>- Protect the health and safety of people and the environment from the harmful effects of radiation.&lt;br&gt;- Prepare and publish radiation protection codes of practice.&lt;br&gt;- Regulate nuclear installations, prescribed radiation facilities and radiation sources and apparatus operated or transported by Commonwealth entities.&lt;br&gt;- Issue licences, monitor licence holder compliance with conditions and mandate corrective actions.&lt;br&gt;- Issue permits for the import of radioactive substances and the export of high-activity radioactive sources.&lt;br&gt;- The ARPANS Act prohibits ARPANSA licencing a uranium enrichment plant, nuclear fuel fabrication plant, nuclear power plant, or spent fuel reprocessing facility.</td>
<td>Australian Radiation Protection and Nuclear Safety Act 1998 (ARPANS Act) and Regulations 1999.&lt;br&gt;Customs (Prohibited Imports) Regulations 1956&lt;br&gt;Customs (Prohibited Exports) Regulations 1958</td>
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<tr>
<td><strong>Department of the Environment</strong></td>
<td>- Administer the EPBC Act - under the EPBC Act, any actions that have or are likely to have a significant impact on a matter of national environmental significance (MNES) may not be taken without an assessment and then approval from the Minister for the Environment. Nuclear actions are a MNES.&lt;br&gt;- The EPBC Act prohibits the Minister for the Environment approving a uranium enrichment plant, nuclear fuel fabrication plant, nuclear power plant, or spent fuel reprocessing facility.&lt;br&gt;- The Supervising Scientist provides monitoring and oversight of uranium mining in the Alligator Rivers Region of the Northern Territory.</td>
<td>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)&lt;br&gt;Environment Protection (Alligator Rivers Region) Act 1978</td>
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| Australian Safeguards and Non-Proliferation Office (ASNO) Agency within the Foreign Affairs and Trade portfolio | • Administer the Safeguards Act, which puts into law Australia’s obligations under the Nuclear Non-Proliferation Treaty and related international agreements.  
• Regulate the security of nuclear facilities and material to prevent the unauthorised removal or theft of nuclear material, minimise the risk of sabotage and ensure safeguards meet IAEA requirements.  
• Issue permits for controlling and protecting nuclear material and items during use and transport.  
• Administer Australia's bilateral nuclear cooperation agreements. | Nuclear Non-Proliferation (Safeguards) Act 1987 (Safeguards Act) |
| Department of Industry and Science | • Export permits for nuclear materials granted by the Minister for Industry and Science.  
• The Atomic Energy Act permits the Minister for Industry and Science to authorise mining in the Ranger Project Area in the Northern Territory and retains Commonwealth ownership to uranium and thorium. | Atomic Energy Act 1953  
Customs (Prohibited Exports) Regulations 1958 |
| Australian Maritime Safety Authority (AMSA) Civil Aviation Safety Authority (CASA) Agencies within the Infrastructure and Regional Development portfolio | • Ensure the safe transport of radioactive materials by air and sea including the appropriate documentation, classification, packaging, stowage and segregation. | Protection of the Sea (Prevention of Pollution from Ships) Act 1983  
Civil Aviation Act 1988  
Navigation Act 2012 |
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<th>Commonwealth Department/agency</th>
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| Department of Defence          | • Regulate the export and supply of nuclear goods, software and technology that are included on the Defence and Strategic Goods List and other goods that may be used in weapons of mass destruction programmes.  
• Control non-Defence access to Defence establishments and training areas, including the Woomera Prohibited Area. | Defence Act 1903  
Defence Trade Controls Act 2012  
Customs (Prohibited Exports) Regulations 1958  
Defence Force Regulations 1952 |