



**The Potential Role of
Small Modular Reactors (SMRs)
in the Future Australian Energy Mix**

***A Submission to the Australian
Government's Energy White Paper
Taskforce***

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Nuclear power will improve Australia's energy system resilience, will provide Australia with long-term energy security, will help Australia move to a low-carbon society and will help transform Australia into an innovative country

Low-emissions nuclear power has an important potential role in Australia's electricity generation mix. The development of nuclear power will:

- improve the resilience of Australia's energy system (making energy supply more reliable and affordable)
- provide Australia with long-term energy security
- help Australia move to a low-carbon society and reduce its greenhouse gas emissions over the short, medium and long terms and
- help Australia to become an innovative country.

The installation of nuclear power will provide Australia with an additional measure of energy security. In the long term, Australia may, by example and through aid programmes, also be able to help other countries increase their own energy security.

Over 30 countries presently utilise nuclear power in their generation mix

Over 30 countries presently utilise nuclear power in their generation mix, typically using large, centralised, nuclear power stations that provide economies of scale.

Globally, nuclear power generates more than 11% of total electricity.

Countries differ in their nuclear policies: some are reducing their nuclear capacity; others are expanding; some major fossil fuel exporters such as Saudi Arabia and the United Arab Emirates are developing nuclear industries as part of their industrial diversification strategies.

Alternatives to large, centralised power stations

The development of large power stations, nuclear or otherwise, is unlikely to be required in Australia for the foreseeable future.

There is an international effort to develop smaller, decentralised power stations with the latest safety systems, such as Small Modular Reactors (SMRs).

The advent of SMRs is a technological breakthrough that is particularly suitable for Australia. SMRs can provide a reliable source of base-load electric power.

Strategically located SMRs with outputs in the range of 25 – 300 megawatts will improve system resilience and enhance Australia's energy security.

Affordability of SMRs

Recent studies by the Australian Bureau of Resources and Energy Economics (BREE) have indicated that SMRs could provide one of the lowest levelised cost of electricity (LCOE). Factors contributing to a favourable LCOE are:

- a capacity factor in excess of 95%
- long operational life
- reduced on-site construction time due to factory production
- extended refuelling cycles

SMRs reduce investment risk in a competitive electricity market because they are less capital-intensive than the larger, traditional nuclear power plants units and are faster to build. Additional modules may be installed in an incremental fashion when extra capacity is required.

Siting of SMRs

SMRs can also reduce the burden on the Australian transmission system.

SMRs do not need to be sited in coastal locations because they can be air-cooled. They are particularly suitable for remote locations, such as for towns located at the end of the transmission system, where the transport of fuel for conventional generating plant can be expensive, and for minerals-processing, metals-processing and other energy-intensive industries.

High inherent safety of SMRs

SMRs have been safely used in submarine operations for 60 years.

The latest, land-based SMRs have high inherent safety. No external electrical supplies or pumps are required for emergency cooling, enabling them to remain safe under extreme conditions.

SMRs can be installed underground, further enhancing their physical security against accidents or external events.

Previous bipartisan reports have been ignored

In 2006, after an 18-month study, a multi-party Australian Parliamentary Inquiry produced an 800-page report on the strategic importance of Australia's uranium resources for the development of the non-fossil fuel energy industry in Australia ("the Prosser Report").¹ The Prosser report's findings were bipartisan and unanimous. The Prosser report emphasised Australia's need for 'a mix of low-emission energy sources and technologies, including nuclear power.'

Also in 2006, a report for the former Prime Minister Howard ("the UMPNER Report") found that nuclear power was the least-cost low-emission technology that could provide base-load power and play a role in the future generation mix.

No action has been taken to remove what appears to be an unnecessary and costly burden on the Australian energy economy.

¹ "Australia's Uranium – Greenhouse Friendly Fuel for an Energy Hungry World: A Case Study into the Strategic Importance of Australia's Uranium Resources for the Inquiry into Developing Australia's Non-Fossil Fuel Energy industry", House of Representatives, Standing Committee on Industry and Resources, Parliament of the Commonwealth of Australia, November 2006 ("the Prosser Report").

Nuclear power is unnecessarily prohibited in Australia

Australia does not provide a level playing field for competing suppliers of power generation. The construction and operation of nuclear power plants for commercial purposes is prohibited by Australian legislation. This is unnecessary and unjustified.

The Australian legislative prohibitions are partly explained by safety concerns and partly by Australia's abundance of other energy resources. At the time when the prohibitions were enacted, there was also little community appreciation in Australia of the potential climate effects of greenhouse gas emissions.

The Australian legislative prohibitions have remained in place despite the successful negotiation of the Convention on Nuclear Safety (CNS), to which Australia became a party in 1996. The CNS lays down fundamental safety principles with which all member states must comply and on which they must report.

Safe nuclear power plants can and should be designed and built to the latest safety standards, they should be installed in safe locations, they should be operated in accordance with best international practice and they should be regulated by a professional regulatory agency independent of government. This has been the case with the OPAL research reactor operated by the Australian Nuclear Science and Technology Organisation (ANSTO) at Lucas Heights near Sydney since 2006.

Experienced nuclear regulation: ARPANSA

Every country should have a competent and experienced independent nuclear regulator. Australia already has one: the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

ARPANSA is Australia's independent nuclear regulator, established under the *Australian Radiation Protection and Nuclear Safety Act 1998 (Commonwealth)* ('the ARPANS Act').

The objective of the ARPANS Act is "*to protect the health and safety of people, and to protect the environment, from the harmful effects of radiation.*"²

In pursuing its statutory objective of protecting public health and safety, and deciding whether to issue a licence for a nuclear facility, the CEO of ARPANSA is required by the ARPANS Act to "*take into account international best practice in relation to radiation protection and nuclear safety.*"³

Transport of nuclear fuel

The transport of radioactive material is subject to international transboundary movement rules and technical standard rules.

The IAEA Transport Regulations have been adopted by ARPANSA to reflect international best practice and have been incorporated into Australian domestic legislation.⁴ ARPANSA contributes to the IAEA's regulatory revision process.

The IAEA regulations are well understood in Australia from the operations of ANSTO.

Disposal of spent fuel

The disposal of spent fuel must be taken into consideration by ARPANSA when assessing licence applications. ARPANSA has recently updated its Draft Regulatory Guide, *Licensing of Radioactive Waste Storage and Near Surface Disposal Facilities*, after a public consultation process. It is shortly due for completion. ANSTO has considerable knowledge and experience in this field.

² S.3 of the ARPANS Act.

³ S.32(3) of the ARPANS Act.

⁴ See IAEA, Regulations for Safe Transport of Radioactive Material No. SSR-6 (2012 edition) and the Draft Safety Guide that contains user-friendly recommendations on how to meet the requirements of the Regulations.

In 2012, the Commonwealth enacted the *National Radioactive Waste Management Act 2012* to provide for the establishment and operation of a suitable facility for the safe management of radioactive waste in Australia, with priority consideration being given to a site on Muckaty station that had been volunteered by an Aboriginal group in the Northern Territory.

Australia-wide reform

For ARPANSA to be able to regulate nuclear power generation throughout Australia, the Commonwealth would need to amend the ARPANS Act to give ARPANSA exclusive authority for the licensing of all nuclear power facilities, all associated activities and all incidental health, safety and environmental issues throughout Australia, overriding any State laws that may be in conflict.

In constitutional law parlance, the ARPANSA Act would need to be amended to 'cover the field'. The Commonwealth has constitutional power to do this by virtue, inter alia, of its international treaty obligations.

The International Atomic Energy Agency (IAEA)

Australia has been an active member of the 155-member International Atomic Energy Agency (IAEA), a UN agency, since its inception in 1957.

ARPANSA reports annually to the IAEA on its compliance with the requirements of the Convention on Nuclear Safety (as described below).

The IAEA's statutory objective is "*to seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world.*"⁵

There are three pillars of the IAEA's work:

- i. nuclear verification and security;
- ii. safety; and
- iii. technology transfer.

The second pillar, safety, is of the greatest significance to the regulation of nuclear power in Australia.

The IAEA's main work in the field of nuclear power generation is to provide guidance and inspection and monitoring services to its member states. In the future licensing of commercial nuclear power in Australia, ARPANSA will be able to draw on the knowledge and guidance of the IAEA.

The 1996 Convention on Nuclear Safety (CNS)

In the context of nuclear power programmes, the most significant of the IAEA's recommended instruments is the CNS. This was developed by the IAEA following the 1986 accident at the Chernobyl nuclear power plant in the Ukraine. Australia is a party to the CNS.

The CNS established a number of fundamental principles of nuclear safety, aimed at protecting individuals, society and the environment from the harmful effects of ionising radiation.

Each party to the CNS is required to implement the fundamental safety principles that the CNS articulates. These principles emphasise six main factors:

- i. the effective separation of the regulatory body
- ii. the establishment of policies that give due priority to nuclear safety

⁵ The Statute of the IAEA, Article II.

- iii. the implementation of procedures to evaluate site-related safety factors
- iv. several levels of protection (defence in depth) against the release of radioactive materials
- v. safe operational procedures and
- vi. the minimisation of waste.

As a party to the CNS, Australia must report to the IAEA on its compliance.⁶

International best practice

In 2006, ARPANSA licensed the Australian Nuclear Science and Technology Organisation (ANSTO) to operate the 20 MW OPAL research reactor at Lucas Heights, near Sydney. It first satisfied itself that ANSTO would operate in accordance with international best practice, which was required by ARPANSA's constituent legislation.

Ensuring public safety

With nuclear power generation, paramount priority must always be given to public safety. For this purpose, there are four indispensable attributes of an independent regulatory scheme for nuclear power:

- first, it must be open and transparent;
- secondly, it must be genuinely consultative;
- thirdly, the decision-making body must follow 'due process' in all of its decisions and be legally accountable for any failure to do so;
- and finally, there must be a legislative guarantee of public participation in decision-making through representation on the decision-making body itself.

ARPANSA already has the first three attributes; it is required by its legislation to implement a licensing process that is open, transparent, consultative and accountable.

To further enhance public trust in the regulatory system (the fourth attribute mentioned above), ARPANSA's legislation could be changed to provide for permanent participation by the public in ARPANSA's decision-making directorate.

Timing: 2022 for Australia's first SMR

It may take up to eight years for Australia to approve, install and operate its first SMR.

Detailed work on site selection could not commence without a change in the law.

Before there is a change in the law, the Energy White Paper review process would need to recommend a change in government policy to allow all energy generations options to once again be open in Australia. After that, the legislative prohibitions against nuclear power would need to be removed.

With bipartisan support, it would be reasonable to allow two years for this to occur. Any longer would, however, be detrimental to the opportunity that Australia has to become an innovative country in this field.

After the law is changed, another four years is likely to be required for detailed community consultation, detailed site selection, plant selection, engineering and technical studies, the obtaining

⁶ The national compliance reports by Australia are published on the ARPANSA website.

of all planning and regulatory approvals, and completion of financial and feasibility studies. During this period, there should be continuing involvement by the Australian community to ensure that there is never any compromise on public safety.

The community consultation and study stage would culminate with a contract with the selected plant supplier for delivery of the plant.

Detailed engineering, plant procurement, construction of civil works and commissioning of the plant would then require another two years, with operational commencement possible in 2022.

Becoming an innovative country

SMR Nuclear Technology Pty Ltd submits to the Australian government that there is every reason for Australia to become an innovative country in the field of safe nuclear power generation, building on the knowledge and experience of both ANSTO and ARPANSA. Managed correctly, Australia's experience in SMR installation and operation could also become a model for other countries.