

Inquiry by the House Select Committee on Nuclear Energy into nuclear power generation in Australia

**The suitability of the Australian regulatory framework for a modern nuclear power plant
and a feasible implementation timeline**

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We make this submission based on our experience as follows:

Ian Grant has broad international experience and expertise in nuclear engineering and regulation.

From 2019 to 2023 Ian chaired the IAEA's technical working group on nuclear power infrastructure advising on the services offered to countries embarking on nuclear power programmes.

From 2009 to 2018, he helped to establish and lead the new nuclear regulatory body in the United Arab Emirates and, as Deputy Director General for Operations, oversaw the construction and commissioning of the UAE's first nuclear power plant.

Ian previously held senior leadership roles at the Canadian Nuclear Commission with responsibility for safety assessment and licensing of Canada's fleet of nuclear power plants.

Earlier in his career, he worked on nuclear design and manufacturing with Atomic Energy of Canada Limited and Babcock & Wilcox in the United Kingdom.

Ian holds a Bachelor of Science in Engineering from the University of Glasgow and a Masters degree from Cranfield University in the UK, is a licensed professional engineer in Ontario, and a Fellow of the UK Institution of Mechanical Engineers.

Dr. Robert Ion has over 30 years expertise and experience in nuclear engineering, safety and licensing. Most of his experience is in safety and licensing of new reactor designs in Canada, including on UK and US related projects.

During 2001 to 2015, Robert held various leadership and management roles with Atomic Energy of Canada (AECL) and its commercial successor, Candu Energy. Since 2016, Robert has provided consultancy support on SMR-related projects.

Earlier in his career Robert worked in Romania at the time of that country's preparation to operate their first nuclear power plant.

Robert holds a Bachelor of Science (B.Sc.) degree in Power Engineering from University "Politehnica" of Bucharest in Romania, as well as a Master of Science (M.Sc.) and Doctoral (Ph.D.) degrees in Nuclear Engineering from University of Missouri-Columbia in the US.

In this submission, we present our assessment of the application of the Australian Radiation Protection and Nuclear Safety Agency's ("ARPANSA") current legal and regulatory framework to support the potential deployment of proven nuclear power technology.

Executive Summary

In its 70 years of experience with nuclear science and technology, Australia has established a strong legal and regulatory framework and the institutional capability to provide effective safety oversight of its research reactors. International peer reviews have shown that the national regulatory framework is aligned with best international practice.

We consider that ARPANSA's existing, non-prescriptive regulatory regime supported by the IAEA safety standards is readily adaptable as-is to licensing and oversight of one or more nuclear power plants based on proven reactor technology¹ having a comparable safety profile as the existing research reactor, OPAL.

The main adaptation needed to apply ARPANSA's existing regulatory framework to proven reactor technology is the replacement of the references contained in guidance to the IAEA safety standards for research reactors with the applicable IAEA standards for nuclear power plants.

In addition, the following would be needed to develop the regulatory framework for nuclear safety:

- Acquisition of the additional human resources and skills needed to deal with the work involved in licensing and oversight of a new nuclear installation over and above the continuing oversight of existing facilities and activities;
- Arrangements for external technical support by qualified consultants or technical support organisations to augment in-house resources and provide specialist skills and specific services to support safety reviews and inspections to support the regulatory activities;

¹ . In the context of this submission, by "proven reactor technology" we mean a reactor technology that by the time of a licence application in Australia, is either successfully operating or has received an operating license in a reputable international nuclear regulatory jurisdiction.

- Engagement with the IAEA’s technical assistance programme for support with regulatory infrastructure development;
- Establish cooperative arrangements with one or more established regulatory bodies in other countries, that have experience in licensing a similar facility to that proposed in Australia and which may be formally identified as a reference plant.

We therefore believe that it is feasible for ARPANSA to be ready to receive and initiate the review of a formal construction licence application in less than three years. Considering specifically the timeline that Australia previously achieved in developing OPAL, as well as the schedules for similar projects put forward in other countries, a nuclear power plant based on proven technology could in our opinion be operational within 10-12 years of a government policy decision to proceed.

Discussion

1. The adequacy of ARPANSA’s existing legal and regulatory framework for safety

ARPANSA has a long-established and robust regulatory framework under which it has licensed the construction of the OPAL reactor and has overseen its safe operation by ANSTO since 2007.

ARPANSA’S regulatory framework has been the subject of multiple international peer reviews, including the 2018 IAEA International Regulatory Review Service (“**IRRS**”) Mission, that show it generally conforms with the requirements of the IAEA safety standards and best international practice.

ARPANSA’s non-prescriptive, outcome-based regulatory approach is readily adaptable to licensing and oversight of another nuclear installation of a complexity and risk profile comparable to OPAL.

We therefore consider that ARPANSA’s existing regulatory framework and experience base, with adaptations as discussed in the following sections, provides a robust foundation for licensing and oversight of a proven reactor technology in Australia.

2. Adoption of the relevant IAEA standards

The IAEA Safety Standards that ARPANSA currently references as its technical criteria for OPAL are those applicable to research reactors. For a proven reactor facility that is intended for electricity generation or other industrial uses, the IAEA Safety Standards and guides for nuclear power plants are the appropriate references.

The IAEA Safety Standards for research reactors and power plants have much in common. The differences between them arise mostly out of recognition of the unique features and uses of research reactors.

The IAEA Safety Standards for nuclear power plants are well-known and are widely used by other countries as references for their regulations and guidance. We see no issues with ARPANSA adopting these IAEA standards as references reflecting best international practice in this field.

The main issue that we identify in this area is that the current IAEA safety standards for nuclear power plants are based mostly on experience with large, water-cooled reactors, whereas some SMR and advanced reactors employ different technologies. Therefore, while the fundamental principles still apply, some requirements may have limitations or gaps when applied to evolutionary or innovative designs.

The IAEA has assessed this issue² and has identified the limitations and gaps in its safety standards as applied to evolutionary and innovative reactor designs. Various initiatives are under way to develop standards and safety assessment methods, which we expect will progress further to support a decision on a potential Australian facility.

The availability of established standards, along with prior regulatory approvals and construction and operating experience are major factors that shape our advice on the selection of a proven reactor technology.

3. Human resources

The licensing and oversight of a new nuclear installation in Australia based on a proven light water reactor will result in additional human resource requirements for the regulatory body to deal with the workload over and above the continuing oversight of existing facilities and activities.

The additional permanent staffing needed for regulatory oversight of a proven reactor installation we estimate as being roughly equivalent to the number of staff that ARPANSA's Regulatory Services Branch currently employs on oversight of OPAL, i.e. approximately 20.. However, the detailed staffing needs should be subject to further evaluation by the organizations concerned.

The regulatory activities during the initial phases of a project, including reviewing licence applications, performing safety assessments, issuing licences, and overseeing construction and commissioning, lead to temporary workload peaks. These workload peaks will create short-term demands for human resources and for specialist skills beyond the long-term requirement.

Based on our experience of successful practice in other countries that have recently launched nuclear power programmes,³ we consider that the human resource needs of the regulatory body in

² International Atomic Energy Agency, Applicability of IAEA Safety Standards to Non-Water Cooled Reactors and Small Modular Reactors, Safety Reports Series No. 123, IAEA, Vienna (2023), <https://www.iaea.org/publications/15228/applicability-of-iaea-safety-standards-to-non-water-cooled-reactors-and-small-modular-reactors>

³ International Atomic Energy Agency, Experiences of Member States in Building a Regulatory Framework for the Oversight of New Nuclear Power Plants: Country Case Studies, IAEA-TECDOC-1948, IAEA, Vienna (2021),

the initial phases and transitioning into the long term can be met through a combination of some or all the following strategies:

1. Redeployment of some existing experienced staff in ARPANSA to key roles in a new project;
2. Recruitment and development of graduates from Australian universities;
3. Recruitment of experienced personnel from abroad;
4. Contracting technical support organizations to augment in-house resources and to provide needed specialist skills on specific work packages.

The recruitment and development of a skilled workforce takes time. Prompt action to acquire the needed human resources would need to follow any decision to proceed with a nuclear programme. Nevertheless, some of the current factors that we see as favouring the above HR strategies include the fact that a clear policy choice to implement a civil nuclear plant will generate interest among young Australians who are entering university and college, and among experienced personnel abroad. Interest in and support for the national development of nuclear science and engineering skills will also benefit from the momentum that is building in the AUKUS submarine programme. For instance, the University of New South Wales and Flinders University now offer nuclear engineering education at the undergraduate and masters levels. ANU has offered a Master of Nuclear Science course since 2007 (including nuclear reactors and the nuclear fuel cycle). Also, the ANU are offering an undergraduate Nuclear Systems Engineering course from 2025.

4. External technical support

Based on our knowledge of countries that have successfully launched a nuclear programme, we consider that it is feasible for the Australian regulatory body to contract with one or more expert technical support organisations to support its regulatory activities for a new nuclear facility. Contracted services can help to deal with short term workload peaks by augmenting in-house resources and by providing specialist skills.

In some countries, such as the United Arab Emirates (UAE), the regulatory body contracted on a commercial basis for services from international consulting companies having the relevant expertise and experience. In other cases, such as Türkiye, support has been provided in part by the technical support organisation of the vendor country under the terms of the supply agreement.

We expect that Australia, as an IAEA member state, would also benefit from technical assistance provided by the IAEA. The IAEA's technical assistance programme for embarking countries

<https://www.iaea.org/publications/14776/experiences-of-member-states-in-building-a-regulatory-framework-for-the-oversight-of-new-nuclear-power-plants-country-case-studies>

includes advisory services, peer review missions, and training and development for staff covering a range of legal, regulatory, and technical and scientific topics.

5. Regulatory cooperation

The IAEA International Safety Advisory Group (INSAG) describes how, and the extent to which, the safety assessment performed for an existing reference plant can be used to support licensing of a new facility by the host country regulator.⁴ Insofar as the designs are similar, the design safety assessment for the reference plant can be directly applicable. Locally determined factors, such as site conditions, or the operating organisation, require more independent assessment by the host country regulator.

For example, the vendor of the UAE facility identified a reference plant in the Republic of Korea that had already been licensed by the Korean authorities. The UAE regulatory body, with support from its Korean counterpart, was able to use the safety assessment for the reference plant to inform its own licensing decisions, thereby gaining the dual benefits of enhancing safety by building on the work of experts who were familiar with the technology while facilitating the timely completion of its licence reviews.

Pre-licensing engagements between ARPANSA and vendors/designers that cover a range of technology aspects are also an excellent means to build regulators' familiarity with a reactor design. Such pre-licensing engagements are already employed by the CNSC (Vendor Design Reviews) and the NRC (pre-application reviews).

6. Other nuclear infrastructure issues

The IAEA publication “Milestones in the Development of a National Infrastructure for Nuclear Power” is widely accepted by member states as the framework for nuclear infrastructure governance for both new and expanding nuclear power programmes.⁵

The IAEA's Milestones guidance identifies nineteen nuclear infrastructure “issues”. It advises countries embarking on a new nuclear power programme to work through a three-phase approach to planning and development of each of the infrastructure issues needed to support a successful programme.

⁴ International Nuclear Safety Group, Licensing the First Nuclear Power Plant, INSAG Series No. 26, IAEA, Vienna (2012), <https://www.iaea.org/publications/10356/licensing-the-first-nuclear-power-plant>

⁵ International Atomic Energy Agency, Milestones in the Development of a National Infrastructure for Nuclear Power, IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1), IAEA, Vienna (2015), <https://doi.org/10.61092/iaea.hff3-zuam>

This submission has concentrated on the feasibility of adapting the Australian legal and regulatory framework for oversight of a new nuclear project involving an SMR or microreactor and finds that this can be readily achieved.

In preparation for any policy decision to proceed with such a project, we consider it highly advisable for the Australian authorities to arrange for an assessment of the remaining issues against the Milestones criteria to identify any gaps and to formulate a comprehensive implementation plan.

7. Potential timeline

IAEA Safety Standard SSG-16 gives an indicative time span of between four and ten years to develop the national safety infrastructure starting from the decision to implement nuclear power up to the point of readiness to contract for the supply of a nuclear power plant. These IAEA estimates, however, apply to countries that are newly embarking on a nuclear programme with minimal existing infrastructure.

We consider that the IAEA guidelines substantially overestimate the time and effort that would be needed to adapt and apply ARPANSA's existing regulatory framework to a proven reactor technology considering the expertise and experience that has been built up in Australia over 20 years of oversight of construction, commissioning, and operation of the OPAL research reactor. Based on this, Australia could be ready to initiate the review of a construction licence application within three years of a policy decision to proceed with a civil nuclear programme with the first nuclear power plant operational approximately 8 years thereafter.

Conclusions

Based on all the above, ARPANSA can build on the existing, strong domestic regulatory framework for its research reactor and make use of IAEA standards and the experience gained in other regulatory jurisdictions in licensing a proven NPP design.

It is thus feasible for ARPANSA to be ready to receive and initiate the review of a formal construction licence application within three years of a policy decision. Other important issues can and would need to be addressed in parallel within this timeframe, such as the establishment of the owner/operator organization, selection of the technology vendor, identification of a suitable site, financing, and human resources development.

Considering specifically the timeline that Australia previously achieved in developing OPAL, as well as the schedules achieved for similar projects in other countries, a nuclear power plant based on proven technology could be operational in Australia within 10-12 years of a government policy decision to proceed.