

A close-up photograph of a koala clinging to a tree trunk. The koala's grey, woolly fur is the central focus, with its dark eyes and large, black nose clearly visible. Its claws are gripping the rough bark of the tree. The background is a soft, out-of-focus green, suggesting a forest setting.

**Australian National Report
for the Eighth Review
Meeting of the Convention
on Nuclear Safety**

In conformance with article 5 of
the Convention on Nuclear Safety

August 2019

Acknowledgement of Country

The Australian Government respectfully acknowledges Australia's Aboriginal and Torres Strait Islander communities and their rich culture and pays respect to their Elders past and present. We acknowledge Aboriginal and Torres Strait Islander peoples as Australia's first peoples and as the Traditional Owners and custodians of the land and water on which we rely.

We recognise and value the ongoing contribution of Aboriginal and Torres Strait Islander peoples and communities to Australian life and how this enriches us. We embrace the spirit of reconciliation, working towards the equality of outcomes and ensuring an equal voice.

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Introduction

General

- i. This report is issued according to Article 5 of the Convention on Nuclear Safety (CNS, also referred to as the Convention). Australia ratified the CNS in December 1996. Since then, Australia has submitted National Reports to, and actively participated in, every review meeting of the CNS. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) coordinates, on behalf of the Australian Government, the reporting on how Australia meets its obligations under the Convention.
- ii. Australia does not have any 'nuclear installations' as defined in the Convention but has one operating research reactor, the Open-Pool Australian Light Water Reactor (OPAL). Another research reactor, the High Flux Australian Reactor (HIFAR), has been permanently shut down and all fuel elements have been removed. The decommissioning program is not fully developed and decommissioning activities have not commenced. Both reactors are managed by the Australian Nuclear Science and Technology Organisation (ANSTO), an Australian Government entity, and are regulated by ARPANSA. Both reactors are located at the Lucas Heights Science and Technology Centre south of Sydney in the State of New South Wales¹.
- iii. For this report, Australia finds it useful to refer to its research reactors in describing how its obligations under the Treaty are met. Other licensed nuclear activities at ANSTO include: the collection, treatment and storage of radioactive wastes; the handling and storage of new and irradiated nuclear fuel and nuclear materials; and the production of commercial quantities of radiopharmaceuticals and radioisotopes for use in medicine and research within Australia and overseas.

National nuclear activities/policy

- iv. Under Australian legislation, specifically the *Australian Radiation Protection and Nuclear Safety Act 1998* (the Act), the CEO of ARPANSA is prohibited from authorising the construction or operation of nuclear power plants. The *Environment Protection and Biodiversity Conservation Act 1999* and legislation in many Australian states and territories currently have similar prohibitions.
- v. As reported in the 7th CNS Review Report, the Nuclear Fuel Cycle Royal Commission (NFCRC) was established by the South Australian (SA) Government in March 2015 to undertake an independent and comprehensive investigation into the potential for increasing South Australia's participation in the nuclear fuel cycle. It reported to the SA Government on 6 May 2016 with recommendations², including that SA Government pursue removal of existing legislative prohibitions on nuclear power generation to allow nuclear power to contribute to a low-carbon electricity system in the future, if required.
- vi. On 15 November 2016, the SA Government released its Response to the NFCRC Report recommendations³. The recommendation to pursue the removal of existing legislative prohibitions on nuclear power generation was not supported.

¹ Australia is a federation of six states and two self-governing territories

² See <https://yoursay.sa.gov.au/pages/nuclear-fuel-cycle-royal-commission-report-release/>

³ See <http://assets.yoursay.sa.gov.au/production>

Waste Management Development Update

- vii. In December 2015, ANSTO received a type B(U) TN-81 dual purpose transport/storage container from the AREVA (now ORANO) La Hague facility in France containing 20 canisters of reprocessed HIFAR spent fuel waste (CSD-U). The residues relate to a total of 1288 spent fuel elements, equating to approximately 25 years of HIFAR reactor operation. The TN-81 along with a Type A ISO freight container containing six drums of CBF-C2 waste generated during reprocessing operations, is stored currently in the Interim Waste Store at ANSTO's Lucas Heights facility.
- viii. The Australian Government continues to seek an appropriate site for Australia's National Radioactive Waste Management Facility (NRWMF) in order to provide a single purpose built facility to dispose low level waste and temporarily store intermediate level waste. The selection process is based on voluntary nomination by landholders and is being run by the Department of Industry, Innovation and Science in accordance with the *Australian National Radioactive Waste Management Act (2012)*⁴ (the NRWM Act).
- ix. As reported at the 7th CNS review meeting, in 2015 the Australian Government called on landholders across Australia to voluntarily nominate their land to be considered as a site for a NRWMF as provided by the NRWM Act. Twenty-eight applications were received from interested landowners. These were evaluated using a framework to assess initial technical potential against a range of economic, environmental and other criteria. In June 2017, the government announced that three sites in South Australia have been accepted as potential NRWMF sites. These are the Wallerberdina Station close to Hawker, and the Napandee and Lyndhurst properties close to Kimba.
- x. At the time of this report, detailed phase studies are being undertaken to assess each site's environment, cultural heritage and access to infrastructure and enabling services. The Government has commissioned an independent engineering contractor to undertake detailed site characterisation studies at each of the sites to gain a better understanding of each site's suitability for the NRWMF⁵.
- xi. ARPANSA continues to undertake a stakeholder engagement project for the NRWMF to explain the regulatory process under the ARPANS Act. This includes significant outreach activities with the communities that have been identified in the site selection process, to inform the public and local organisations on the regulatory process, ARPANSA's role, and what the public can expect in terms of interaction with the regulator during review and assessment of an application to prepare a site for a waste facility. This work is not required under the ARPANS Act or Regulations but is being undertaken as it is seen to be best regulatory practice.

Statement of Commitment to the CNS

- xii. Australia remains committed to the articles and spirit of the Convention on Nuclear Safety, despite not having nuclear installations, as defined under Article 2 of the CNS Convention, and views participation as an effective review and improvement process for nuclear safety.

⁴ See <https://www.legislation.gov.au>

⁵ See <https://www.industry.gov.au>

Report Structure and Scope

- xiii. This report content and structure is as per the INFCIRC/572/Rev.6 and as such is designed to be a stand-alone document. Therefore information from previous CNS Review meeting Australian reports has been reproduced as appropriate.

Summary



Summary

a) Vienna Declaration Principles

Australia continues to meet three Principles in the Vienna Declaration on Nuclear Safety (VDNS) in respect to the OPAL research reactor. Principle 1 on design, siting and construction is addressed in Articles 17 and 18 (but summarised in Article 18). Principle 2 on ongoing safety assessments is covered in Article 14. Principle 3 on the application of IAEA Safety Standards is covered in Articles 7, 10 and 14 (but summarised in Article 14).

Australia does not expect to face difficulties in continuing to apply the VDNS principles and safety objectives to the existing research reactors or potential new builds in the future.

b) Cross Cutting Area Identified in the 7th CNS President Report

As per the recommendation in the 7th CNS President Report progress against the major common themes identified across the country groups has been reported as follows:

- Safety culture – **Article 12**
- International peer review – **This section and Article 6**
- Legal framework and independence of regulatory body – **Article 7**
- Financial and human resources- **Article 11**
- Knowledge management – **Article 11**
- Supply chain – **No issues reported for Australia at the 7th CNS meeting or at the time of this report**
- Managing the safety of ageing nuclear facilities and plant life extension – **No issues reported for Australia at the 7th CNS meeting or at the time of this report**
- Emergency preparedness – **Article 16**
- Stakeholder consultation and communication – **Article 8**

c) Action taken from lessons learnt from the Fukushima Daiichi accident

The safety reassessment of OPAL performed in accordance with the guidance contained in IAEA Safety Report Series No.80 *Safety Reassessment for Research Reactors in the Light of Accident at the Fukushima Daiichi NPP* is completed. This is reported on in **Article 16**

d) Response to Challenge to Australia from the 7th CNS Review Meeting

At the 7th CNS review meeting, held in Vienna in March 2017, Australia was part of country group 7 which also included Croatia, Denmark, India, Ireland, Mali, Netherlands, Peru, Sri Lanka, Switzerland and Ukraine. One challenge was issued to Australia:

Challenge 1: Acquire and maintain adequate resourcing and competence within the regulator to cope with additional/new work and activities. The response to this challenge is reported on in Article 11.

e) Open Status Challenges from the 6th CNS Review Meeting

Two challenges to Australia from the 6th CNS review meeting remain open due to their ongoing nature:

Challenge: *Maintenance of competence within both the operator and regulator, including readiness to cope with expected applications for new (non-reactor) facilities.* - **Reported on in Article 11**

Challenge: *Engagement with the wider Australian community over planned waste facilities* – **Reported on in Summary section – paragraph xi**

f) International Peer Review Missions

- An Integrated Regulatory Review Service (IRRS) team undertook a full scope mission in Australia in 2007. This IAEA effort was an in-depth review of ARPANSA's Regulatory Services Branch. A follow-up mission was then conducted in 2011, when a module on medical exposure and patient protection was introduced. All actions from this mission have been implemented. The reports and closure of recommendations are published on the ARPANSA website⁶.
- A full scope IRRS mission to Australia occurred 4–16 November 2018, which reviewed Australia's national, legal and governmental framework for nuclear and radiation safety against the IAEA's Safety Standards. This mission included participation from all Australian self-governing states and territories⁷, as well as the Commonwealth of Australia (the federal Australian Government). The IRRS team consisted of 15 senior regulatory experts from 13 IAEA Member States, three IAEA staff members and two observers.
- The scope of the IRRS mission to Australia included all modules offered by the IRRS. It included all facilities and activities regulated in Australia, with the exception of the uranium mining industry and the management of waste containing naturally occurring radioactive material (NORM). The mission scope included ARPANSA's role and responsibilities as the Commonwealth regulator for radiation protection and nuclear safety in all modules. In addition, for specific modules (radiation sources control, transport, and medical exposure control), the mission scope included all state and territory regulatory bodies.
- The IRRS team carried out the review in the areas of: responsibilities and functions of the government; the global safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including authorisation, review and assessment, inspection, enforcement, development of regulations and guides including their contents; emergency preparedness and response; control of medical exposures, occupational radiation protection, control of public exposure, environmental monitoring and the interface of safety with nuclear security.
- The IRRS mission included a policy issue discussion on national uniformity of radiation protection and nuclear safety policy and practices across the Commonwealth, states and territories
- This was the first IRRS mission to undertake a comprehensive multi-jurisdictional review of a federated constitution in which all of the jurisdictions are self-governing. This was identified as a

⁶ See <https://www.arpansa.gov.au>

⁷ Queensland, New South Wales, Victoria, Tasmania, South Australia, Western Australia, the Northern Territory, the Australian Capital Territory.

good practice by the team and a model that other federal countries may want to consider when planning for future IRRS missions.

- The mission found four good practices, and made 23 recommendations and 12 suggestions for improvement. These are addressed to the various Australian governments and regulatory bodies. A follow-up mission will be conducted in 2021-22. The report is published on the ARPANSA website⁸.
- Development of an Action Plan that takes account of the IRRS findings as well as any other significant issues identified during the self-assessment is currently on-going. Where findings are related to CNS areas, these have been addressed under the relevant Articles namely **6, 8, 15 and 16**.
- All international review reports and Australia's national reports under the *Convention on Nuclear Safety* and the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* are published in the ARPANSA website. See **Article 8** for further information on transparency.

g) Snapshot of new information in National Report under each Article

A snapshot of new information/changes since the 7th CNS Review Meeting is presented below:

Article 6 - Existing nuclear installations

- There has been no significant safety issue at the OPAL or HIFAR reactor raised in the current reporting period.
- A licence condition was imposed in May 2019 requiring OPAL to assess and report on Design Extension Conditions as per the Specific Safety Requirements No. SSR-3 *Safety of Research Reactors* Requirement 22. This condition has also been applied to the operating licence for the new ANSTO Nuclear Medicine (ANM) Facility which was issued in April 2019.
- One safety significant incident, rated on the International Nuclear Event Scale as a level 3, occurred at the ANSTO Health Radiopharmaceutical Facility in August 2017. As a result ARPANSA issued a direction to ANSTO to initiate an independent safety review of the facility conducted by a team of international and national experts in the fields of nuclear safety, safety and organisational culture, radiation protection and human factors. At the time of this report ANSTO has submitted an action plan for approval in response to the findings of the independent review to ARPANSA.

Article 7 – Legislation and regulatory framework

- The Australian Radiation Protection and Nuclear Safety Regulations 2018 replaced the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the ARPANS Regulations) in December 2018. There was no change to the substance of the regulations, but the numbering and formatting was changed and in some parts the wording was changed to simplify the regulations in accordance with modern drafting practices.
- During the reporting period, in November 2018, ARPANSA published a guide for preparing a decommissioning licence application based on the IAEA safety guide: *Decommissioning of Nuclear*

⁸ See <https://www.arpansa.gov.au>

Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities (SSG-47). This guide is Regulatory Guide: *Decommissioning of Controlled Facilities*⁹.

- ARPANSA also published a guide for applying for a radioactive waste storage or disposal facility in May 2017 based on IAEA Safety Series including GSG-1 *Classification of Radioactive Waste* and SSR-5 *Disposal of Radioactive Waste*. This guide is Regulatory Guide: *Applying for a licence for radioactive waste storage or disposal facility*¹⁰.

Article 8 – Regulatory body

- ARPANSA developed a Workforce Plan (2017–2021) which covers the identification, development and maintenance of competency requirements. In addition, in 2017 ARPANSA undertook a comprehensive review of all positions in the organisation as part of ongoing succession planning.
- As part of the ongoing process to adopt ISO 17020 or equivalent arrangements, ARPANSA implemented a revised qualification system in 2017 with associated defined competencies that all regulatory officers must meet before formal appointment as an inspector.
- The 2018 IRRS mission made the following recommendation which ARPANSA will address as part of its ongoing action plan for the 2018 IRRS mission.
 - *ARPANSA should enhance its human resource management to include an assessment of the number and capabilities of staff required to effectively perform their regulatory and emergency response duties and enhance their training programme based on an analysis of the necessary skills and competencies.*
- In 2019, in response to a recommendation from the 2018 IRRS mission, ARPANSA developed and piloted a custom-built safety culture maturity model within the Regulatory Services Branch (RSB). The model was consistent with the guidance for safety culture assessment of the International Atomic Energy Agency (IAEA) Safety Standard GS-G-3.5 *The Management System for Nuclear Installations* although modified to be more targeted at the role of the regulator rather than the operator. The results of the initial safety culture assessment will be published on the ARPANSA website. The safety culture assessment will be rolled out across the whole agency during the second half of 2019.

Article 14 – Assessment and verification of safety

- The next Periodic Safety and Security Review (PSSR) of OPAL is required to be submitted to ARPANSA in 2021. A detailed plan for this review was submitted to ARPANSA for approval in May 2019. The licences for the ANM Facility and ANSTO Health also include a requirement for a PSSR at a specified time after commencement of routine operations.

Article 15 – Radiation Protection

- The 2018 IRRS Mission made the following recommendation:

⁹ See <https://www.arpansa.gov.au/sites>

¹⁰ See <https://www.arpansa.gov.au/sites/default/files/reg-la-sup-240a.pdf>

ARPANSA should make provision for an independent monitoring programme to confirm the monitoring results submitted by licensees and should consider basing the programme on an assessment of the nuclides that make a major contribution to public dose.

ARPANSA is addressing this recommendation as part of the response to the IRRS mission report.

Article 16 – Emergency preparedness

- Three emergency exercises were conducted in the last three years at the Lucas Heights site where the OPAL reactor is located. Two scenarios included evacuation of the reactor building and the treatment of contaminated or injured personnel. One exercise was a site-wide evacuation that included the OPAL reactor. The exercises targeted effectiveness of the interfaces between ANSTO and external responders, adequacy of the processes at the OPAL reactor and site-wide protocols, and capabilities of personnel and equipment. The lessons learnt identified improvements in a number of areas, such as communications, coordination of responding teams, personnel decontamination process, and emergency management.
- As a condition of the licence to operate, the ANSTO ANM facility conducted an emergency exercise based on a scenario agreed with ARPANSA to demonstrate that emergency arrangements of this new facility were commensurate with the emergency preparedness category and that the arrangements interact in an effective manner with the site wide emergency arrangements. The scenario was based on the loss of a critical safety system and was witnessed by ARPANSA.
- The formal safety reassessment in accordance with IAEA Safety Report Series No. 80 *Safety Reassessment for Research Reactors* in the light of the accident at the Fukushima Daiichi Nuclear Power Plant is now complete. No significant safety related actions were required for OPAL as a result.

Article 19 – Operation

- Recent amendments to the OPAL operational limits and conditions (OLCs) include changes to amend the allowable deuterium concentration in the heavy water systems and an amendment of the instrumentation OLCs to align with a revised instrument calibration methodology. In addition changes were made to allow a revision of the analytical limit for reactor power.
- In 2018, the first spent fuel assemblies from the OPAL reactor were shipped to the ORANO La Hague facility in France for reprocessing. The shipment consisted of four TN-MTR casks and totalled 236 spent fuel assemblies. Residual waste from the reprocessing will be returned to Australia in around 2035-2040 as per the waste from HIFAR.



Open Pool Australian Lightwater (OPAL) reactor

Articles

Article 6 – Existing Nuclear Installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Nuclear research reactor that existed at the time the Convention entered into force for Australia

- 6.1. The only research reactor at the time the Convention came into force was the High Flux Australian Reactor (HIFAR) - a 10 MW(t) heavy water, tank type, materials testing reactor. This reactor operated between 1958 and 2007. HIFAR has been shut down and all fuel has been removed. ANSTO is currently managing HIFAR under a 'possess or control' licence while preparing to decommission it in the future. ANSTO is expected to apply for a decommissioning licence once arrangements for the planned NRWMF are finalised.

List of current research reactors

- 6.2. Australia has one operating research reactor, the Open Pool Australian Light-water (OPAL) reactor¹¹. OPAL is a high flux, thermal, multi-purpose pool type reactor. OPAL achieved full power of 20 Megawatts in 2006. The reactor is fuelled with low enriched uranium (LEU). The fuel elements are aluminium-clad uranium silicide plates. It is cooled by light water and has a heavy water reflector surrounding the core.
- 6.3. OPAL is housed in a containment building which also includes the primary cooling circuit and most of the auxiliary plant. The stainless steel reactor pool has a water depth of 12.6 metres and is surrounded by a thick-walled, reinforced high density concrete construction. The reactor core sits at the bottom of the pool and is surrounded by a Zircaloy reflector vessel which also houses all the irradiation rigs and beam tube assemblies. A service pool, contiguous with the reactor pool, stores the irradiated materials and provides for the interim storage of irradiated fuel. A reactor beam hall within the reactor building and a neutron guide hall adjacent to the reactor building contain experimental stations and instrumentation for neutron beam research purposes.
- 6.4. Other activities related to the operation of OPAL include the handling and storage of new and irradiated nuclear fuel and nuclear materials and the production of commercial quantities of radiopharmaceuticals and radioisotopes for use in medicine and research within Australia and overseas.

¹¹ See <http://www.ansto.gov.au/AboutANSTO/OPAL/index.htm>

Overview of significant safety related issues in the last three years

- 6.5. There was no significant safety related issue in the past three years associated with the OPAL or HIFAR reactor. However, events at the ANSTO Health Radiopharmaceutical Facility merit some mention¹²:
- A safety significant event rated as an International Nuclear and Radiological Event Scale Level 3 ‘serious incident’ occurred at the ANSTO Health Radiopharmaceutical Production Facility. The event comprised skin contamination of a worker on 22 August 2017 that exceeded statutory dose limits.
 - On 29 June 2018, ARPANSA directed ANSTO to initiate an independent review under section 41(1A) of the ARPANSA following this and another three less significant separate events with safety implications at ANSTO Health in less than 10 months¹³.
 - In accordance with the direction, ANSTO engaged an independent expert review team that was approved by ARPANSA. The team was drawn from a cohort of international and national experts in the fields of nuclear safety, safety and organisational culture, radiation protection and human factors. The team reviewed ANSTO’s approach to occupational radiation safety of processes and operational procedures at its nuclear medicine facility, in particular those associated with quality control of molybdenum-99 samples. The final report is published on the ARPANSA website¹⁴.
 - On 4 December 2018, ANSTO provided ARPANSA with an action plan for approval that responds to the 85 recommendations made by the independent review team. At the time of this report a fourth iteration of the action plan is under review by ARPANSA.
 - ANSTO Reactor Operators conducted a review against the report with a view to implementing any relevant findings to the OPAL reactor. No significant actions were identified as being required for OPAL as a result.

Overview of planned programs and measures for continued safety

- 6.6. ARPANSA continues to conduct inspections of the OPAL reactor on a quarterly basis to monitor ongoing compliance with the regulations and licence conditions. Additional requirements for ongoing periodic safety and security reviews (PSSR) were stipulated in the OPAL licence in 2015.
- 6.7. The next PSSR of OPAL is required to be submitted in 2021. A detailed plan for this PSSR was submitted to ARPANSA for approval in May 2019.
- 6.8. In addition to the PSSR, requirements for the assessment and reporting of Design Extension Conditions (DECs) for the OPAL Reactor were stipulated in the revised OPAL licence issued in May 2019. This is in response to a suggestion arising from the 2018 IRRS mission.
- 6.9. ANSTO continues to take part in a collaboration agreement with operators of the SAFARI-1 reactor (South Africa) and High Flux Reactor (HFR - The Netherlands) (since 2016). The aim is to work together to increase safety and reliability through cooperation as OPAL, SAFARI-1 and HFR

¹² Note that at the time of submission of this report, a further worker contamination event, which occurred at the new ANSTO Nuclear Medicine facility (ANM), was under investigation by ARPANSA. Information will be provided during the review meeting.

¹³ See <https://www.arpansa.gov.au/about-us>

¹⁴ See https://arpansa.govcms.gov.au/sites/g/files/net3086/f/independent_review_of_ansto_health.pdf

are similar reactors. Meetings are held every 12 to 18 months to exchange ideas, experiences and good practices.

- 6.10. ARPANSA has working relationships with a number of overseas regulators, including with the US Nuclear Regulatory Commission and the Dutch Authority for Nuclear Safety and Radiation Protection to exchange information and lessons learnt. Overseas consultants are also engaged on short term projects to learn from and adapt good regulatory practices from international counterparts.

Article 7 – Legislative and Regulatory Framework

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

Australian Radiation Protection and Nuclear Safety Act 1998 (the Act)

- 7.1. The Act applies only to Australian Government entities and their contractors. It enables the regulatory framework to govern the safety of, among others, OPAL and HIFAR. The Act was amended in 2015 to provide the CEO with additional powers to direct a licence holder, issue improvement notices, and compel the provision of information.

2. The legislative and regulatory framework shall provide for:
 - (i) the establishment of applicable national safety requirements and regulations;

The Australian Radiation Protection and Nuclear Safety Regulations 2018 and other regulatory guidance documents

- 7.2. The Australian Radiation Protection and Nuclear Safety Regulations 2018 replaced the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the Regulations) on the 9 December 2018. There was no change to the effect of the regulations, but the numbering and formatting has changed and in some parts the wording has changed to simplify the regulations in accordance with modern drafting practices.
- 7.3. The Regulations set up a framework for licensing, inspection and enforcement. The Regulations also contain licence conditions and specify dose limits.
- 7.4. In assessing licence applications, ARPANSA must, under the Act, take into account international best practice in radiation protection and nuclear safety. In 2016, ARPANSA established a register of relevant international standards on its website¹⁵. For the purpose of nuclear safety, these primarily comprise all relevant IAEA Safety Standards adapted as necessary to suit the Australian context.
- 7.5. ARPANSA also publishes regulatory guides to assist licence applicants and licence holders. These include guidance to prepare licence applications such as the *Regulatory Guide on Plans and Arrangements for Managing Safety* and other activity specific guides. These guidance documents are published on ARPANSA's website¹⁶. ANSTO is consulted during the development or amendment of regulatory guides applicable to OPAL and HIFAR. In addition new regulatory guides are also opened for public comment prior to publishing.
- 7.6. In April 2016, ARPANSA published a guide for undertaking a PSSR that builds on IAEA safety guide *Periodic Safety Review for Nuclear Power Plants and Ageing Management for Research Reactors* (SSG-10. Published as Regulatory Guide: *Periodic Safety and Security Review for Research*

¹⁵ See <https://www.arpansa.gov.au/regulation-and-licensing/regulation/international-best-practice>

¹⁶ See <https://www.arpansa.gov.au/regulation-and-licensing/licensing/information-for-licence-holders/regulatory-guides>

Reactors, it was developed in collaboration with the Australian Safeguards and Non-Proliferation Office (ASNO).

- 7.7. In the last reporting period, in November 2018, ARPANSA published a guide for preparing a decommissioning licence application based on the IAEA safety guide: *Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities* (SSG-47). This guide is Regulatory Guide: *Decommissioning of Controlled Facilities*¹⁷. ARPANSA also published a guide for applying for a radioactive waste storage or disposal facility in May 2017 based on the IAEA Safety Series including GSG-1 *Classification of Radioactive Waste* and SSR-5 *Disposal of Radioactive Waste*. This guide is Regulatory Guide: *Applying for a licence for radioactive waste storage or disposal facility*¹⁸.

(ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

Licensing

- 7.8. The Act prohibits the siting, construction, operation, possession and control, or decommissioning of nuclear installations by a Commonwealth entity without a licence issued by ARPANSA. Applicants for a licence are required to submit, among others, 'plans and arrangements' to demonstrate how the applicant will maintain effective control, manage safety and security, and protect the environment. Licences may contain conditions that the licence holder must comply with.

(iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

Inspections

- 7.9. The Act provides powers of entry for inspectors to enter OPAL (and any other licensed facility) and inspect it at reasonable times. Inspectors are authorised to undertake searches and exercise a range of powers. An inspection manual¹⁹ is available to guide inspectors on the exercise of their powers. ARPANSA has developed a risk-informed approach to the planning of its inspection program, which is designed to emphasise its safety assurance role.
- 7.10. A baseline inspection program defines the minimum level of planned inspections to evaluate performance over a defined period (using a risk based approach). The program aims to monitor all facilities to provide assurance that performance of the licence holder meets safety and security objectives. There are eight inspection areas. Each of these areas must be inspected at least once during the baseline period. Although the approach will be the same, the specifics will vary and each facility will have to be looked at individually. The nature and scope of inspections is tailored to the facility.

¹⁷ See <https://www.arpansa.gov.au/sites>

¹⁸ See <https://www.arpansa.gov.au/sites/default/files/reg-la-sup-240a.pdf>

¹⁹ See <https://www.arpansa.gov.au/sites/default/files/arpansa-reg-ins-man-280w.pdf>

(iv) *the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.*

Enforcement

- 7.11. The aim of ARPANSA's regulatory activities is to verify that licence holders and controlled persons comply with the Act, the Regulations and licence conditions.
- 7.12. ARPANSA adopts a graded and risk-based approach to compliance and enforcement as reflected in Regulatory Guide: *Graded approach to dealing with licence holder non-compliance*²⁰ and the ARPANSA Compliance and Enforcement Manual which details options for enforcement²¹. When non-compliance is identified the regulatory response is graded and proportionate to the actual or potential significance of the non-compliance. The minimum response necessary is used to achieve the desired result which in most cases will be a return to compliance.

Encourage and Assist Compliance

- 7.13. ARPANSA may provide information to encourage and support a licence holder return to compliance, while being mindful that the ultimate responsibility for safety rests with the operator. ARPANSA may accept a written commitment from the licence holder that action will be taken to rectify non-compliance within a defined timeframe. If resolution efforts prove unsuccessful in achieving a return to compliance, the regulatory response may be escalated.

Improvement Notice (s80A)

- 7.14. Under section 80A of the Act, an inspector may issue an improvement notice in response to non-compliance or where non-compliance is likely to occur.

Direction by the CEO of ARPANSA (s41)

- 7.15. Section 41 of the Act gives the CEO the power to issue a direction. Under section 41(1), before issuing a direction the CEO must believe on reasonable grounds that a controlled person is not complying with the Act or regulations in respect of a thing, and that it is necessary to protect the health and safety of people or to avoid damage to the environment.
- 7.16. Under section 41(1A), the CEO has the power to issue a direction if the CEO believes on reasonable grounds that there is a risk of death, serious illness, serious injury or serious damage to the environment, arising from radiation, in connection with a controlled facility, controlled material or controlled apparatus and there is an urgent need to minimise the risk. A copy of any direction issued by the CEO must be provided to the Minister, who must table it in each House of Parliament. In 2018 ARPANSA issued a direction under section 41(1A)) to ANSTO. See Article 6 for more information.

²⁰ See <https://www.arpansa.gov.au/sites/g/files/net3086/f/reg-com-sup-270i.pdf>

²¹ See https://www.arpansa.gov.au/sites/default/files/arpansa-reg-com-man-270w_compliance_enforcement_manual.pdf

Amendment of Licence (s36)

7.17. Under section 36 of the Act, the CEO may impose additional licence conditions, remove or vary licence conditions that were imposed by the CEO or extend or reduce the authority granted by the licence. Depending on the nature of the non-compliance, it may be considered appropriate to amend the licence to facilitate compliance or address any new risks that have been identified.

Suspension or Cancellation of Licence (s38)

7.18. Under section 38 of the Act, the CEO may decide to suspend or cancel a licence in circumstances where a condition of the licence has been breached by the licence holder or by a person covered by the licence where there are reasonable grounds to believe that an offence has been committed against the Act or regulations by the licence holder or by a person covered by the licence, or where the licence was obtained improperly.

Referring Matters to the Director of Public Prosecutions

7.19. The laws administered by ARPANSA create a number of offences. The Office of the Commonwealth Director of Public Prosecutions (CDPP) is an independent prosecution service responsible for prosecuting alleged offences against Commonwealth Law. The decision to refer a matter to the CDPP for prosecution will be made by ARPANSA in light of the facts and the Prosecution Policy of the Commonwealth. The CDPP will then make the ultimate decision whether or not to commence a prosecution in accordance with the Prosecution Policy of the Commonwealth.

Injunction

7.20. Under section 43 of the Act, the CEO can make an application to the Federal Court of Australia for an injunction in circumstances where a controlled person has engaged, is engaging, or proposing to engage in any conduct that would be an offence against the Act, or where there has been or is proposed to be a refusal or failure to do a thing, which refusal or failure would be an offence against the Act.

For a full summary of how Australia meets the Vienna Declaration on Nuclear Safety Principle 3 See Article 14

Article 8 – Regulatory Body

1. *Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.*

ARPANSA

- 8.1. The Act establishes the office of the CEO of ARPANSA. The CEO has both regulatory and non-regulatory functions. The non-regulatory functions include promoting national uniformity in radiation protection policy and processes among states and territories, providing scientific advice, providing radiation monitoring and calibration services, and undertaking research.
- 8.2. The RSB assists the CEO to perform his regulatory functions. The RSB has primary responsibility for the day-to-day regulatory oversight of the safety and security of OPAL and HIFAR. In addition to licensing, compliance monitoring and enforcement, the RSB also investigates accidents and incidents and prepares regulatory guidance material. The RSB's functions also include regulatory oversight of other facilities such as radioisotope production facilities, radioactive waste management facilities, accelerators, and irradiators. The delivery of regulatory outcomes is governed by the *Policy for ARPANSA's Regulatory Activities*²².

Human resources and competencies

Response to the Challenge from the 7th CNS Review Meeting: Acquire and maintain adequate resourcing and competence within the regulator to cope with additional/new work and activities.

- 8.3. At the 7th CNS review meeting Australia reported that RSB's staff numbers decreased from 28 to 23, due to retirements and resignations. This staff number remains at 23 which is considered adequate for regulatory oversight of the licence holders following the implementation of the Regulatory Delivery Model (now superseded by the Inspection Manual, Review and Assessment Manual and Compliance and Enforcement Manual), that applied resources to inspection and compliance monitoring using a graded, risk-informed approach.
- 8.4. RSB personnel have competency in a wide variety of technical fields related to radiation protection and nuclear safety. The CEO of ARPANSA can also for specific purposes draw on expertise from other branches of ARPANSA (e.g. dosimetry, emergency management, communication) and is also supported by the Corporate and Legal Offices, and by the Office of the CEO. ARPANSA's corporate policies and procedures apply across the whole Agency, including RSB. ARPANSA's overall staffing level at the time of submission of this report was just over 130 full-time equivalents (FTE) and is capped at 134 FTE.
- 8.5. If ARPANSA requires specialist technical advice to support regulatory activities and this is not available within the agency or in other partner organisations, financial resources and contracts are available to source such expertise externally. For example, external expertise was employed to conduct independent modelling for the assessment of the OPAL submission to increase the analytical limit used in the safety analysis contained in the SAR from 26MW to 28MW, and approved by ARPANSA in 2018.

²² see <https://www.arpansa.gov.au/regulation-and-licensing>

- 8.6. ARPANSA has developed a Workforce Plan (2017–2021) that notes the identification, development and maintenance of competency requirements. In addition, in 2017, ARPANSA undertook a comprehensive review of all positions in the organisation as part of ongoing succession planning. This included identification of vulnerable areas and priority areas for strengthening resilience of some key competencies.
- 8.7. The 2018 IRRS mission noted the following good practice in relation to ARPANSA’s succession plan: *ARPANSA has a well-developed strategy to compensate for the departure of qualified staff that systematically assessed succession risks for every position in the organization and prioritised the development of competencies that were found to be vulnerabilities to the long-term capability of the organisation.*
- 8.8. RSB staff competence has been maintained through targeted training. This is done through annual formal training as well as on-the-job training and supervision. Staff also undertake ongoing professional development through participation in international meetings, workshops and technical consultancies.
- 8.9. ARPANSA has initiated a process to adopt ISO 17020 or equivalent arrangements for all regulatory processes. As a part of that work, ARPANSA has developed and implemented a Qualification Card system with associated defined competencies that all regulatory officers must meet before being appointed as an inspector. Competencies of each candidate are formally assessed prior to their appointment under section 62 of the Act.
- 8.10. The 2018 IRRS mission made the following recommendation which will be addressed by ARPANSA as part of its response to the IRRS mission report:

Recommendation: *ARPANSA should enhance its human resource management to include an assessment of the number and capabilities of staff required to effectively perform their regulatory and emergency response duties and enhance their training programme based on an analysis of the necessary skills and competencies.*

Statement of adequacy of resources

- 8.11. Regulatory Services Branch’s full-time staffing level is considered to be adequate for direct oversight of the licence holders at the time of this report. The previous shortfall was managed by allocating resources to inspection and compliance monitoring using a graded, risk-informed approach under the Regulatory Delivery Model. The cost for ARPANSA’s regulatory activities are recovered from the licence holders through licence charges and application fees as relevant. ARPANSA tracks expenditure of resources on regulatory activities, and the annual charges are adjusted accordingly. Proposed changes that are not simply machinery in nature (an example of a machinery change is indexation), are communicated to licence holders and their responses taken into account.

Quality management

- 8.12. ARPANSA has a Quality Management System (QMS) to develop and maintain policies, procedures, forms and guides of a regulatory nature. The QMS provides assurance to stakeholders that regulatory processes are open and accountable and services are provided in an effective and efficient manner and subject to continuous improvement. The QMS meets the requirements of AS/NZS ISO 9001 standard.
- 8.13. At the time of this report, ARPANSA is planning to achieve certification to AS/NZ ISO 9001. In 2016, RSB started working towards compliance with ISO 17020:2012 standard (on competence of

inspection bodies). This work is ongoing. The QMS is being integrated with the Integrated Management System under development across the agency.

Advisory committees

- 8.14. The CEO of ARPANSA receives advice on radiation protection and nuclear regulatory matters from three committees. These are the Radiation Health and Safety Advisory Council, the Nuclear Safety Committee and the Radiation Health Committee. Each committee's functions are established under the Act.
- 8.15. The Radiation Health and Safety Advisory Council has the following functions:
- to identify emerging issues relating to radiation protection and nuclear safety and to advise the CEO on them
 - to examine matters of major concern to the community in relation to radiation protection and nuclear safety and to advise the CEO on them
 - to advise the CEO on the adoption of recommendations, policies, codes and standards in relation to radiation protection and nuclear safety
 - to advise the CEO, at the CEO's request, on other matters relating to radiation protection and nuclear safety
 - to advise the CEO on such other matters relating to radiation protection and nuclear safety as the Council considers appropriate
 - to report to the CEO on matters relating to radiation protection and nuclear safety
- 8.16. The Nuclear Safety Committee has the following functions:
- to advise the CEO and the Council on matters relating to nuclear safety and the safety of controlled facilities
 - to review and assess the effectiveness of standards, codes, practices and procedures in relation to the safety of controlled facilities
 - to develop detailed policies and to prepare draft publications for the promotion of uniform national standards in relation to the safety of controlled facilities
 - to report to the CEO on matters relating to nuclear safety and the safety of controlled facilities
- 8.17. The Radiation Health Committee has the following functions:
- to advise the CEO and the Council on matters relating to radiation protection
 - to develop policies and to prepare draft publications for the promotion of uniform national standards of radiation protection
 - to formulate draft national policies, codes and standards in relation to radiation protection for consideration by the Commonwealth, the States and the Territories
 - to review national policies, codes and standards in relation to radiation protection to ensure that they continue to substantially reflect world best practice
 - to consult publicly in the development and review of policies, codes and standards in relation to radiation protection

2. *Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.*

Independence and Conflict of Interest

- 8.18. Although ARPANSA and ANSTO are government entities, they are separated by portfolios managed by separate ministers. ARPANSA is within the Health portfolio, while ANSTO is a government-owned business within the Industry, Innovation and Science portfolio. Besides this structural separation, ARPANSA's independence is further assured through requirements in the Act. These include:
- A requirement to report quarterly and annually to Parliament on the operations of ARPANSA and any finding of breach of licence condition or legislation
 - A requirement to report to Parliament about any serious accident or malfunction that occurs at a nuclear installation, including the OPAL and HIFAR reactors
 - A requirement for the Minister to table in Parliament any direction that he or she makes to the CEO of ARPANSA
 - The right of the CEO to, at any time, cause a report about matters relating to the CEO's functions to be tabled in Parliament
- 8.19. The CEO of ARPANSA is ultimately responsible for the regulatory decisions. The CEO, or delegate, makes regulatory decisions to fulfil the object of the Act, being 'to protect the health and safety of people, and of the environment, from the harmful effects of radiation', without regard to any external pressures but being mindful of consequences of the regulatory decisions for third parties. The Minister can issue directions to the CEO. However, a direction must be tabled in Parliament and the Minister can only direct the CEO if it is in the public interest to do so. In the 20 years ARPANSA has been in existence, no such direction has been issued. On independence as well as conflict of interest, see the aforementioned Policy for ARPANSA's Regulatory Activities.
- 8.20. The CEO of ARPANSA has multiple functions in addition to being the nuclear and radiation regulator, and is required by Section 15 (2) of the ARPANS Act to take all reasonable steps to avoid any conflict of interest between their regulatory function and other functions. Establishment of the RSB which has delegated regulatory functions for licensing, inspections, compliance management, and enforcement, provides structural clarity to the regulatory function. All staff members across the agency are required to make annual declarations of interests that could potentially conflict with the performance of their duties. The General Counsel makes the final determination of whether a conflict (perceived or real) exists and what mitigation strategy to put in place. In addition, the CEO ensures that any regulatory function exercised over other parts of ARPANSA is independently overseen by external personnel. On the matter of conflict of interest, see *Regulatory Intersection with Other Functions* on ARPANSA's website²³.

Openness and transparency

- 8.21. The Australian Radiation Protection and Nuclear Safety Regulations provide that if a facility licence application relates to a nuclear installation, the CEO of ARPANSA must invite people and bodies to make submissions about the application, provide a period for making submissions, and provide procedures for making submissions. This was done for the OPAL Reactor and the ANM Facility.

²³ See <https://www.arpansa.gov.au/regulation-and-licensing>

- 8.22. ARPANSA continues to undertake a detailed stakeholder engagement project for the NRWFM. This is not required under the Act or Regulations but ARPANSA believes this is best practice. Activities include engaging in significant outreach activities with the communities that have been identified in the site selection process, to inform the public and local organisations on the regulatory process, ARPANSA's role, and what the public can expect in terms of interaction with the regulator during review and assessment of an application to prepare a site for a waste facility.
- 8.23. The RSB's regulatory processes are fully transparent. The regulatory assessment reports that form the basis for licensing decisions for nuclear installations are published on ARPANSA's website and are available for public scrutiny. The CEO also publishes a 'statement of reasons' for all licence decision in relation to nuclear installations. Inspection reports and findings of breach are also published on the web. The Act makes it mandatory for the CEO to report to Parliament quarterly and annually on operations of the CEO, ARPANSA and the advisory bodies. Such reports include findings of breach. The CEO can also at any time table a report in Parliament on any matter that relates to the CEO's functions.
- 8.24. Annual self-assessments under the Regulator Performance Framework are published on the ARPANSA website²⁴. The RSB Safety Culture Assessment will be published once finalised. Minutes of the NSC²⁵, RHC²⁶ and RHSAC²⁷ are also published on the ARPANSA website.

Safety culture

- 8.25. ARPANSA places a very strong emphasis on safety culture. Safety culture is one of the three 'cross-cutting' areas in the performance objectives and criteria that inspectors' use.
- 8.26. In 2019 in response to a recommendation from the 2018 IRRS mission, ARPANSA, in conjunction with an external consultant in safety culture and organisational psychology, developed and piloted a custom-built safety culture maturity model in the RSB. The model ranks performance in five elements each with four sub-elements. Maturity is ranked on a five point scale from 'pathological' to 'holistic'.
- 8.27. The model was based on the OECD Nuclear Energy Agency (NEA) publication Safety Culture of an Effective Nuclear Regulatory Body. The model was adapted from the 'Safety Culture Maturity Matrix' and framework developed by Bel V (2018). Bel V is a subsidiary of the Belgian Federal Agency for Nuclear Control (FANC), which acts as an expert for the safety assessments of nuclear projects and carries out inspections of nuclear installations in Belgium. Bel V reviewed and commented on the ARPANSA model.
- 8.28. The assessment was carried out in the spirit of International Atomic Energy Agency (IAEA) General Safety Requirements No. GSR Part 2 *Leadership and Management for Safety*. The model is consistent with the guidance for safety culture assessment of IAEA Safety Standard GS-G-3.5 *The Management System for Nuclear Installations*. However, it has been modified to be more targeted at the role of the regulator rather than the operator.
- 8.29. Survey results for the five elements showed an overall positive safety culture, ranging in maturity from 'Individual' to 'Cooperative' levels. The more detailed sub-elements spanned a broader

²⁴ See <https://www.arpansa.gov.au/about-us/corporate-publications/regulator-performance-framework>

²⁵ See <https://www.arpansa.gov.au>

²⁶ See <https://www.arpansa.gov.au/about-us/advisory-council>

²⁷ See <https://www.arpansa.gov.au/RHC>

range of responses and highlight successful attributes of RSB's safety culture maturity, as well as areas which deserve attention.

8.30. This study led to two recommendations, four areas for improvement and one good practice, including:

- RSB should explore how to foster a positive culture where all employees are encouraged and provided opportunities for influence in decision-making and feel included at work.
- Strategies for enhancing individual responsibility and accountability should be investigated in relation to procedural adherence and the management system. The core objective in this activity would be to examine such things as the interface between employees and the management system that impacts on efficiency and effectiveness in meeting key outcomes.
- Communication and the relationship with licensees were found to be a good practice. RSB employees clearly recognise the value of cultivating and maintaining high quality interactions with licence holders in order to promote their safety performance.

8.31. At the time of this report, the safety culture assessment report was being finalised along with an action plan to address the areas for improvement and recommendations. The report will be published on the ARPANSA website for transparency once finalised. The model will then be rolled out to all organisational levels and functions of ARPANSA.

8.32. For a more detailed discussion on safety culture and holistic (systemic) safety, see Article 10.

Article 9 – Responsibility of the Licence Holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

- 9.1. The Regulations place prime responsibility for safety on the licence holder. This is primarily done through section 60, which provides as follows:

Managing safety

- (1) *The holder of a facility licence must take all reasonably practicable steps to manage the safety of the facility described in the licence, including:*

- (a) *having in place plans and arrangements described in paragraph 46(1)(d); and*
- (b) *ensuring that such plans and arrangements are implemented to the extent reasonably practicable.*

- 9.2. Other provisions in the Act and Regulations reinforce that primary responsibility for safety rests with the licence holder. These include requirements on the licence holder to proactively investigate and rectify any breaches, prevent, control and minimise accidents, and report accidents to ARPANSA within 24 hours.
- 9.3. ANSTO's responsibility for safety is defined in its Work Health, Safety and Environment (WHSE) Policy and the supporting safety management system which is certified to ISO 9001 and 14001 standards. This system establishes responsibilities for health, safety and environmental protection. To support the safety management system, ANSTO has safety assessment, approval and audit systems overseen by internal committees that are independent of line management responsible for OPAL operation. The overarching safety body, the Safety Assurance Committee (SAC), has external membership to ensure independent oversight.
- 9.4. As part of the application for a facility licence to authorise the operation of OPAL, ANSTO submitted a suite of safety related documentation including how appropriate effective control is maintained (resourcing, technical expertise etc.) and emergency response is handled. This suite of safety documents is reviewed as part of the ongoing inspection program. Any proposal to change ANSTO's arrangements for managing safety that has significant implications for safety requires ARPANSA's prior approval.
- 9.5. ARPANSA inspectors regularly monitor and review the operations of ANSTO's nuclear operations. The inspectors undertake planned inspections of the nuclear facilities and frequent site visits. Inspectors use these opportunities to emphasise and stress the licence holder's primary responsibility for safety.

Article 10 – Priority to Safety

Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety

- 10.1. ARPANSA requires applicants for a licence and licence holders to demonstrate a commitment to a strong safety culture. The *Regulatory Guide: Plans and Arrangements for Managing Safety*²⁸, against which licence applications are assessed, states:

The Licence Holder or Applicant is responsible for establishing safety as the organisation's highest priority, consistent with international best practice in radiation protection and nuclear safety and overriding, if necessary, the demands of production or project schedules.

- 10.2. The plans and arrangements are required to provide sufficient details on how the applicant will exercise effective control and manage safety, including measures to foster a safety culture. Specific plans are required to be submitted on how the applicant will monitor and assess safety, including undertaking independent safety assessments for radiation protection, radioactive waste management, security and emergency preparedness.
- 10.3. Once a licence is issued, the Regulations require the licence holder to take all reasonably practicable measures to manage safety. Specifically, the licence holder must continue to have in place plans and arrangements that are reviewed and updated at least once every three years. The licence holder must also take all reasonably practicable measures to implement the plans and arrangements. Non-compliance with these requirements may be a breach of licence condition.

ANSTO's safety policies

- 10.4. As part of its business management system, ANSTO has a Work Health Safety and Environmental (WHSE) policy, under which it operates in a manner that places the protection of human health and safety and the environment as its highest priority, promotes a positive safety culture and environmental awareness; and strives for continual improvement in safe work practices using a blame-free learning approach. In addition to the WHSE policy, ANSTO also supports a positive safety culture through risk management and quality management policies and systems.

ANSTO safety management and culture

- 10.5. ANSTO implements its safety policy and strategies through a work health and management system that covers radiological, nuclear and occupational health and safety. The system makes every member of ANSTO's staff responsible for ensuring compliance with the organisation's work health, safety and environment policy and strategies, and line management accountable for safety.
- 10.6. Safety assurance at ANSTO is achieved by several mechanisms. Changes at the OPAL reactor that have any impact on nuclear safety are reviewed by the Reactor Assessment Committee (RAC). Additional assurance of safety is achieved through routine inspections by staff, who are

²⁸ See <https://www.arpansa.gov.au/regulation-and-licensing/licensing/information-for-licence-holders/regulatory-guides>

independent of the function being assessed, and the review of safety performance by senior management and the ANSTO Board. In undertaking its assessments, the RAC has regard to applicable IAEA Safety Standards.

Safety Performance Indicators

- 10.7. ANSTO has, in consultation with ARPANSA established Safety Performance Indicators (SPIs) for OPAL. These SPIs measure and set objective targets for 16 safety related functions of plant operation. Performance against the SPIs is reported monthly within ANSTO and quarterly to ARPANSA.

For a full summary of how Australia meets the Vienna Declaration on Nuclear Safety Principle 3 - See Article 14

Article 11 – Financial and Human Resources

1. *Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.*

Financial Resources

- 11.1. In making a licence decision, the CEO of ARPANSA must consider whether the applicant has shown a capacity to comply with the Regulations and any licence condition that may be imposed. ANSTO must provide evidence of adequate resources, including financial capability, before it is issued with an operating licence as per *Regulatory Guide: Applying for a licence for a nuclear installation*²⁹. Since ANSTO is a government agency, its funding for nuclear safety and reliability of its installations, including decommissioning, will be underwritten by the Commonwealth Government throughout its life.
- 11.2. The bulk of ANSTO's operating revenue is provided by the Australian Government. ANSTO also generates revenue from the sale of goods and services, particularly radiopharmaceuticals. ANSTO has demonstrated to ARPANSA's satisfaction that it has adequate financial capability to support the safety of OPAL and HIFAR, including in the event of an emergency.

2. *Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.*

Human resources - ARPANSA

- 11.3. The RSB's Facility Safety Section is primarily responsible for the compliance and inspection program for safety related aspects of the operation of OPAL. A dedicated lead inspector for OPAL is supported by several other staff who assist the lead inspector.
- 11.4. Regulatory staff must complete on the job training in relevant technical areas before being eligible to be appointed as an inspector. In addition, inspectors must have either obtained or be working towards a nationally recognised accreditation, namely, Certificate IV in Government Investigations (or equivalent).
- 11.5. Competencies that this program offers are the ability to exercise regulatory powers, promote and assess compliance with legislation, investigate non-compliance, conduct and record interviews, conduct a search and possible seizure and prepare evidence. Additional training is conducted periodically for all regulatory staff in inspection reporting, conflict of interest and legal awareness.
- 11.6. ARPANSA has developed a Workforce Plan (2017–2021) which notes the identification, development and maintenance of competency requirements. In addition, in 2017, ARPANSA undertook a comprehensive review of all positions in the organisation as part of ongoing succession planning. This included identification of vulnerable areas and priority areas for strengthening resilience of some key competencies.

Human resources - ANSTO

- 11.7. ARPANSA requires ANSTO to demonstrate adequate managerial structure and resources to ensure positive safety attitudes and high standards of human performance and competence. This includes

²⁹ See <https://www.arpansa.gov.au/sites/default/files/legacy/pubs/regulatory/guides/REG-LA-SUP-240G.pdf>

demonstrating clear lines of authority as well as systems for staff selection, training, and personnel stability.

- 11.8. OPAL is operated with a rotating roster of at least two reactor operators and a shift manager. Shift managers have, as a minimum, an appropriate university degree, often in engineering or physics. Reactor operators and shift managers undergo a period of intensive training at the start of their employment and are required to demonstrate competence in reactor operation and safety through an accreditation process. Reactor operators and shift managers are re-accredited every three years.
- 11.9. In addition to reactor operators and shift managers, OPAL has significant human resources in utilisation, engineering, maintenance, nuclear analysis and technical support under the management of the Group Executive, Nuclear Operations.
- 11.10. The arrangements for qualification training, accreditation and retraining of OPAL staff are summarised in the OPAL Safety Analysis Report and detailed in a Training Manual. OPAL reactor training is designed to provide personnel with the knowledge and skills needed to perform their roles, a healthy respect for nuclear safety and radiation protection issues, and an awareness of the impact that actions have on safety and performance. The three components of training at the OPAL reactor are induction, role-specific, and ongoing training.
- 11.11. OPAL operations are supported by staff from other parts of ANSTO who provide services in radiation protection, waste management and engineering as well as finance and procurement, site services, human resources and general administration as required. These services are stipulated by a service level agreement (SLA) between the ANSTO internal service providers and the various ANSTO functional areas, including OPAL. This SLA stipulates the scope, nature, frequency and standard of the services provided.
- 11.12. ARPANSA's inspections of OPAL include training. ARPANSA inspectors are invited to observe shift operator and manager accreditation panels to ensure that the process is robust.

Article 12 – Human Factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

- 12.1. ARPANSA's human factors requirements are detailed in the *Regulatory Assessment Criteria for the Design of New and Modification of Existing Controlled Facilities*³⁰. Systems and procedures must be designed with systemic consideration of human factors at the individual and organisational levels to reduce the potential for human error and violations, facilitate correct actions by operators, and reduce operator stress. Human factors must also be taken into account in any probabilistic safety assessment.
- 12.2. ARPANSA has developed a set of *Holistic Safety Guidelines*³¹ to provide guidance on key technological, human, and organisational aspects that are necessary to create and maintain optimal safety. Guidelines contain a range of key principles considered relevant to holistic (or systemic) safety. The key principles of holistic safety are arranged under seven 'characteristics'. Within each 'characteristic' are 'attributes' that more specifically outline the ways in which the key principles of holistic safety can be achieved.
- 12.3. The seven characteristics are human aspects, non-technical skills, defence-in-depth, management system, resilience, safety culture, and security. Human factors are covered in every inspection of the OPAL reactor
- 12.4. In 2019, ARPANSA, in response to a recommendation from the 2018 IRRS mission, developed and piloted a custom-built safety culture maturity model in the Regulatory Services Branch (RSB). See Article 8 for more information.

OPAL

- 12.5. OPAL has had a Human Factors (HF) Program from its inception that will continue to evolve until the reactor is decommissioned. The program aims to optimise the human-machine interface to avoid operational/maintenance errors and violations. The HF design plans for OPAL were proposed by ANSTO and reviewed by ARPANSA. The HF commitments are defined in various sections of the OPAL Safety Assessment Report (SAR). All safety related events/incidents are reported and investigated following the *Incident Management and Incident Response Process*. This process also captures incidents and abnormal occurrences, suggestions for improvement, and includes human factor and organisational related issues.
- 12.6. ANSTO is required by the Regulations to analyse the causes of incidents (abnormal safety occurrences) and lessons learned. Since the last CNS report, there have been a number of nuclear safety related events reported for OPAL, but none have been identified as significant by ARPANSA. In its Quarterly Report to ARPANSA, ANSTO provides a list of incidents that have occurred within OPAL in the previous quarter. These incidents are reviewed and discussed by both organisations at a quarterly meeting.

³⁰ See https://www.arpansa.gov.au/sites/default/files/legacy/pubs/regulatory/guides/RGL_RG-5.pdf

³¹ See <https://www.arpansa.gov.au/holistic-safety/guidelines>

Article 13 – Quality Assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programs are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

- 13.1. ARPANSA's Regulatory Services Branch has a Quality Management System (QMS). The RSB is also working towards compliance with ISO 17020 which, when completed will integrate with a planned agency-wide Integrated Management System certified to ISO 9001.
- 13.2. ARPANSA is currently developing an Integrated Management System (IMS) to capture all regulatory processes as well as processes that support regulatory activities. This system comprises quality, safety, security, risk, compliance and corporate governance.
- 13.3. As per *Regulatory Guide: Plans and Arrangements for Managing Safety*, a licence applicant must demonstrate that arrangements are in place to establish and manage a facility and the interdependencies between such arrangements should be documented in a management system. The management system must be designed to support the object of the Act and integrate safety, health, environmental, security, quality, societal and economic elements.

OPAL

- 13.4. The administrative control of OPAL is undertaken in accordance with the Nuclear Operations Business Management System (BMS). This system sits within the ANSTO Quality Policy and ANSTO Business Management System (ABMS) framework. The ABMS covers ANSTO policies, overarching processes and supporting guidance. The ABMS (and hence, the Nuclear Operations BMS) is ISO 9001 certified.
- 13.5. The lead document of the Nuclear Operations BMS is the *Nuclear Operations Business Management System Manual* and below this lie a range of manuals, procedures, instructions, and forms for operational and maintenance activities. The documents include response to alarms and emergency operating instructions. ARPANSA reviewed these documents as part of the licence application assessment process and regularly undertakes inspections to determine if OPAL operation is consistent with the documentation contained in the Nuclear Operations BMS.
- 13.6. ANSTO undertakes regular internal management system audits in accordance with its ISO 9001 quality system and ISO 14001 environmental system certifications that verify activities are compliant with the Nuclear Operations BMS and to identify process improvements. ANSTO is also subject to regular surveillance and re-certification audits by an accredited external organisation in order to maintain its ISO 9001 quality system and ISO 14001 environmental management system certifications.

Article 14 – Assessment and Verification of Safety

Each Contracting Party shall take the appropriate steps to ensure that:

- i. comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;*

Safety Assessment Reports (SAR)

- 14.1. ARPANSA’s licensing process is staged. A separate licence is required for each stage of a nuclear reactor’s lifecycle from the preparation of a site to decommissioning. ARPANSA requires a preliminary SAR (PSAR) to be included in an application for a licence to construct a reactor. A final SAR (FSAR) is an updated version of the PSAR and must be submitted when applying for a licence to operate a reactor. The SAR is treated as a living document and is required to be updated throughout the life of the reactor.
- 14.2. The SAR must include deterministic safety analyses to determine if the safety limits and objectives will be met for design-basis accidents. A probabilistic safety assessment may supplement the deterministic safety assessment of design-basis and beyond-design-basis accidents. The operational limits and conditions (OLC) are determined from the safety analyses. Design extension conditions are currently being assessed as per the requirements of the licence.
- 14.3. ARPANSA’s requirements for each phase of a nuclear reactor’s lifecycle can be summarised as follows:

 Siting	Detailed site evaluation, including a consideration of the extent to which the site may be affected by natural and man-made events, and environmental impact assessments.
 Construction and operation	Design information, including the OLC within which the reactor must operate, the safety analysis, and detailed plans and arrangements for safety.
 Possession or control	Arrangements for safe storage of radioactive material and maintaining the nuclear reactor.
 Decommissioning and abandoning	Decommissioning plans and results (respectively) and the details of any proposed environmental monitoring program for the site.

OPAL

- 14.4. ARPANSA issued the operating licence to OPAL in 2006 following a detailed assessment of the SAR and the plans and arrangements for managing safety submitted by ANSTO³². Any change to the SAR or the plans and arrangements with significant implications for safety requires approval by ARPANSA under section 63 of the Regulations, before implementation.
- 14.5. ANSTO has a well-developed and sophisticated system for safety assessment and verification, including the requirement for prior review and approvals of modifications to all licensed facilities that have the potential for significant implications for safety. Changes at the OPAL reactor that have any impact on nuclear safety must be reviewed by the Reactor Assessment Committee (RAC).

ii. verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

Safety verification

- 14.6. The Regulations require a licence holder to take all reasonably practicable measures to implement its plans and arrangements for managing safety. The licence holder is also required to review those plans and arrangements at least once every three years. Any change to plans and arrangements that may have significant implications for safety must be approved prior to implementation.
- 14.7. ARPANSA conducts planned inspections to verify the safety of OPAL and HIFAR and other facilities. The inspections aim to assess the safety performance of ANSTO and provide reasonable assurance to the Australian Government and the public that activities involving radiation facilities and sources do not pose a threat to human health or the environment. The inspections focus on compliance with the Act and Regulations. A set of performance objectives and criteria (PO&C)³³ are used by inspectors for a transparent and graded approach to assess licence holders' practices and is consistent with the risk of the facility.
- 14.8. The PO&Cs reflect international best practices and are organised under eight 'baseline modules' and three cross cutting areas. One or more of these modules is used for the inspection of facilities. The eight baseline modules cover:
- performance reporting
 - configuration management
 - inspection, testing and maintenance
 - training
 - event protection
 - security
 - radiological protection

³² See <https://www.arpansa.gov.au/regulation-and-licensing/regulation/about-regulatory-services/who-we-regulate/major-facilities/open-pool-light-water-reactor/operating-licence-application>

³³ See <https://www.arpansa.gov.au/regulation-and-licensing/licensing/information-for-licence-holders/inspections/performance-objectives-and-criteria>

- emergency response and preparedness

- 14.9. The cross cutting areas are safety culture, human performance and performance improvement.
- 14.10. ARPANSA also undertakes routine site visits to OPAL, HIFAR and other facilities. Site visits supplement the inspection program and are regular, frequent and informal visits to the premises of a licence holder for regulatory oversight and discussions.
- 14.11. Requirements for the assessment and reporting of design extension conditions (DEC) for the OPAL reactor were stipulated in the revised OPAL licence issued in May 2019 following submission of detailed plans by ANSTO. This was following a suggestion from the 2018 IRRS mission.

Periodic Safety and Security Review

- 14.12. The OPAL operating licence requires ANSTO to undertake periodic safety and security reviews (PSSR). The first periodic safety review (PSR) report was submitted to ARPANSA in December 2011 and a supplementary PSR report was submitted in June 2013. ARPANSA reviewed and accepted the PSR in October 2014. The first periodic security review was submitted in 2014 and approved by ARPANSA in 2015. The reviews identified a high degree of conformity by ANSTO with the current international safety and security standards and practices. The licensing basis was found to be valid. The new ANM facility also has a licence condition requiring a full PSSR within 5 years.
- 14.13. A licence condition on the OPAL licence requires the next combined periodic safety and security review to be conducted in 2021. A detailed OPAL PSSR plan was submitted to ARPANSA for approval in May 2019.

Summary of how Australia meets the Vienna Declaration on Nuclear Safety

Principle 2

Australia meets the Vienna Declaration Principle 2 in relation to Research Reactors: *Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are implemented in a timely manner.*

This is achieved through:

- Requiring a licence holder to take all reasonably practicable measures to implement its plans and arrangements for managing safety. The licence holder is also required to review those plans and arrangements at least once every three years. Any change to plans and arrangements that may have significant implications for safety must be approved by ARPANSA prior to implementation.
- OPAL is required to undertake periodic safety and security reviews (PSSR).
- From May 2019, OPAL is required to assess and report on applicable design extension conditions.
- The requirement to undertake PSSR and assess and report on the design extension conditions also applies to the ANM Facility which was issued a full operating licence in May 2019.
- Reasonably practicable/achievable safety improvements arising from these reviews are required to be implemented in a timely manner.

Summary of how Australia meets the Vienna Declaration on Nuclear Safety

Principle 3 (see also Articles 7 and 10)

Australia meets the Vienna Declaration Principle 3 in relation to Research Reactors: *taking into account IAEA Safety Standards and other good practises identified in Review Meetings of the CNS in the following ways: (summary from Articles 7,10 and 14)*

- In assessing a licence application, ARPANSA must, under the Act, take into account international best practice in radiation protection and nuclear safety. The relevant international best practice documents (primarily IAEA Safety Standards) are listed on the ARPANSA website.
- Publishing of ARPANSA Regulatory Guide: *Periodic Safety and Security Review for Research Reactors* (based on IAEA SSG-10) in 2016 and Regulatory Guide: *Decommissioning of Controlled Facilities* published in 2018 based on IAEA SSG-47. In addition publishing of Regulatory Guide: *Applying for a licence for radioactive waste storage or disposal facility* based on the IAEA Safety Series including GSG-1 *Classification of Radioactive Waste* and SSR-5 *Disposal of Radioactive Waste*.
- A set of performance objectives and criteria (PO&C) are used by inspectors for a transparent and graded approach to assess licence holders' practices and is consistent with the risk of the facility. The PO&Cs reflect international best practice.
- Hosting of a full scope IRRS mission in 2018 which reviewed Australia's national, legal and governmental framework for nuclear and radiation safety against the IAEA's Safety Standards.
- Imposing a licence condition to require OPAL to assess and report on design extension conditions as per the IAEA SSR-3 *Safety of Research Reactors* Requirement 22.
- Implementing a licence condition on the new ANSTO ANM Facility to produce design extension conditions as related to SSR-3 above.

Article 15 – Radiation Protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

15.1. The Regulations require ARPANSA to be satisfied that licence holders optimise radiation protection. The Regulations also set out statutory effective dose limits, as well as equivalent dose limits for the skin, extremities and eye. The dose limits to the lens of the eye specified in the Regulations implements the most recent recommendations from the International Commission on Radiological Protection. ARPANSA monitors whether ANSTO ensures that radiation doses arising from normal operation and anticipated operational occurrences throughout the life of the reactor are optimised and do not exceed the dose limits.

OPAL Reactor

15.2. ANSTO's plans and arrangements for OPAL include a radiation protection plan, as required by the Regulations and further elaborated in ARPANSA's Regulatory Guide: *Plans and Arrangements for Safety* which covers the following:

- roles and responsibilities for radiation protection
- an evaluation and safety assessment of the main radiological hazards in OPAL
- access control to areas with radiological hazards
- administrative controls for management of radiological hazards
- radiological monitoring programs for plant, individuals and the environment
- transportation of radioactive materials
- training requirements for radiation protection
- arrangements for reviewing the radiation protection plan

15.3. Radiation protection in OPAL is managed with advice from a dedicated radiation protection adviser (RPA). The RPA is supported by a group of radiation protection personnel working in OPAL, including health physics surveyors. The RPA advises on the continuing effectiveness of controls against identified radiological hazards within OPAL and co-ordinates radiation monitoring programs.

15.4. Doses associated with OPAL are typically low, due to design features which limit operational exposure. These features include a reactor pool incorporating a hot water layer which reduces ambient dose-rates associated with activation and contamination products. Other features include dedicated hot cells for handling irradiated materials and the demarcation of areas of restricted access during reactor operation.

15.5. Dose records are submitted quarterly to ARPANSA and recorded in the Australian National Radiation Dose Register maintained by ARPANSA.

15.6. The 2018 IRRS mission made the following recommendation: *ARPANSA should make provision for an independent monitoring programme to confirm the monitoring results submitted by licensees and should consider basing the programme on an assessment of the nuclides that make a major contribution to public dose.* ARPANSA is addressing this recommendation as part of the response to the IRRS mission.

Article 16 – Emergency Preparedness

Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

- 16.1. The Regulations require a licence applicant to include its emergency plans in its submissions that support a licence application. The Regulations also require the plans and arrangements to be reviewed at least once every three years. Under the regulatory guide on review of plans and arrangements, ARPANSA expects emergency plans to be in place for any action that could give rise to a need for urgent protective measures or other actions and be based on an assessment of the consequences of reasonably foreseeable accidents including those with off-site consequences.
- 16.2. Emergency plans must also aim to minimise consequences and ensure protection of on-site personnel, the public and the environment; have comprehensive procedures, and require all external organisations identified in the emergency plan to be prepared for emergencies with adequate and well-maintained facilities and equipment.
- 16.3. The 2018 IRRS mission made the following recommendation which ARPANSA is addressing as part of the response to the IRRS report - *ARPANSA should develop criteria for evaluation of licensee exercises, to include the observation of exercises as part of the inspection process and ensure that licensees exercise all aspects of their emergency plan over an agreed time period and in line with a graded approach.* ARPANSA is addressing this recommendation as part of the response to the IRRS mission.
- 16.4. ARPANSA has published a *Guide for Radiation Protection in Emergency Exposure Situations* (RPS G-3, Parts 1 and 2, 2019). This guide provides the framework in Australia for the protection of emergency workers, helpers, the public and the environment in emergency exposure situations as well as providing guidance for the planning, preparedness, response and transition required to effectively respond to an emergency

OPAL

- 16.5. ANSTO has an emergency response plan for its entire site, which is integrated with the emergency plans of the State of New South Wales. There is a sub-plan covering a major incident at ANSTO which may involve local evacuations. An emergency plan exists for OPAL, with the requirement for a major exercise every two years and more frequent drills on particular aspects of the plan. Major exercises have been held regularly in accordance with the plan. These exercises were witnessed by ARPANSA inspectors. In addition, desktop drills are performed once a week by the duty shift, such that every shift completes a drill once every four to six weeks.
- 16.6. The implementation of these emergency plans for the ANSTO site is regularly discussed with emergency response agencies, local council and others at the ANSTO Local Liaison Working Party, in which ARPANSA is an observer. The plans are also available in local public libraries.
- 16.7. The OPAL reactor conducted three major emergency exercises in the last three years. All exercises involved external organisations and response teams. Two scenarios included evacuation of the reactor building (different triggers) and the treatment of contaminated or injured personnel. The third exercise was a site-wide evacuation that included the OPAL reactor. The exercises targeted effectiveness of the interfaces between ANSTO and external responders, adequacy of the processes at the OPAL reactor and site-wide protocols, and capabilities of personnel and

equipment. The lessons learnt identified improvements in a number of areas, such as communications, coordination of responding teams, personnel decontamination process, and emergency management.

- 16.8. Assessments of the radiological consequences of acts of sabotage and terrorism in relation to OPAL have been undertaken by ANSTO and reviewed by ARPANSA. Both ANSTO and ARPANSA concluded that the current emergency plans and arrangements, including adoption of the World Health Organisation (WHO) guidelines for the dissemination of iodine tablets, provide adequate protection of the public for such events.
- 16.9. A licence condition for moving to routine operations of the new ANM Facility required ANSTO to conduct an emergency response exercise following a scenario agreed by ARPANSA. ARPANSA observed this scenario and were satisfied that the emergency plan had been successfully implemented.

Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

- 16.10. The geographical location of Australia means that an emergency in OPAL is unlikely to result in a transboundary release but could result in a transnational emergency. Australia is a party to the *Convention on the Early Notification of a Nuclear Accident* and the *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency*. ARPANSA is the designated national competent authority for these conventions and the Australian Government Crisis Coordination Centre, operated by Emergency Management Australia a Division of the Department of Home Affairs, is the designated national warning point. ARPANSA maintains capabilities registered in RANET that can be deployed to other countries under the Assistance Convention.
- 16.11. The ARPANSA Emergency Operations Centre can be activated in response to a radiological or nuclear emergency and provides 24 hour access to expert radiation protection and nuclear safety advice. The operations centre maintains communication links with the Australian Government Crisis Coordination Centre ensuring the Australian Government and public are provided with appropriate and timely information during an emergency. This information would also be sent to the IAEA Incident and Emergency Centre as required to inform affected Member States on the situation.

Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

- 16.12. Australia is not geographically close to any State operating a nuclear installation as defined under the CNS. Nevertheless, Australia has appropriate precautions in place in relation to radiation emergencies in other countries, including the provision of information to the public and decision makers and the monitoring of imported foodstuffs. For example, during the Fukushima nuclear emergency, ARPANSA provided continuous technical advice to the Australian Government. Using weather prediction data, ARPANSA modelled the movement of airborne radioactive plumes, both potential and real, on a daily basis to ensure that Australians were given adequate advice while in Japan. ARPANSA also worked with Australia's food standards regulator to assess the available

information on contamination levels in water, milk and foodstuffs in Japan and to screen foodstuffs imported to Australia from Japan and made the information available publicly.

- 16.13. Whilst not a nuclear installation as defined under the CNS, Australia does receive visits by foreign nuclear powered warships and arrangements have been established including conditions of entry to ensure that the safety of the general public is maintained during visits by such vessels. The Australian Government requires emergency arrangements to be in place at all Australian ports visited by NPW in the unlikely event of a radiological emergency, including a requirement that there be the capability to undertake radiation monitoring of the port environment. The responsibility for the conduct of these procedures is shared between the Australian Government and State/Territory Governments.

Lessons learnt from the Fukushima Daiichi accident

- A preliminary assessment of the implications of the accident for the OPAL reactor identified minor areas for improvement. These were reported after the first periodic safety review between December 2011 and June 2013. An example is the installation of a quick connector to provide emergency water supply to the OPAL reactor.
- ANSTO has since undertaken a formal safety reassessment in accordance with IAEA Safety Report Series No. 80 *Safety Reassessment for Research Reactors* in the light of the accident at the Fukushima Daiichi Nuclear Power Plant. A number of recommendations were made, none of which require immediate corrective action but all of which are opportunities for improvement. Examples include extension of the existing design basis and beyond design basis accident analyses in the SAR to explicitly consider combinations of events and to improve emergency response and management. ANSTO has also reviewed its emergency operating instructions to ensure they cover the additional fault scenarios identified. At the time of writing this report the majority of actions are complete.
- In addition, OPAL and the new ANM facility have been issued licence requirements to assess and report on applicable design extension conditions as result of lessons learnt from the Fukushima Daiichi accident.

Article 17 – Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

- i. for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;*
- ii. for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;*
- iii. for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;*

17.1. In addition to the general requirements for licensing (see Article 7), the Regulations provide that an application for a siting licence must contain:

- A detailed site evaluation establishing the suitability of the site
- The characteristic of the site, including the extent to which the site may be affected by natural and man-made events
- Any environmental impact statement prepared for the site³⁴

17.2. The regulatory guide, *Siting of Controlled Facilities*³⁵ provides detailed guidance on meeting the requirement of the Regulations and relevant IAEA guidelines including the requirement to provide detailed information on:

- The site's seismology, geology, topography, demography, ecology, hydrology, and meteorology
- The effect of nearby facilities and land usage
- The availability and reliability of off-site services such as electricity, water, transportation, and communication systems
- The feasibility of emergency response

OPAL

17.3. The ANSTO site was authorised for the construction of OPAL only after ANSTO demonstrated to ARPANSA's satisfaction that the site is suitable for the construction and operation of a reactor while providing adequate protection of the health and safety of people and the environment. ANSTO demonstrated that:

- the site provides acceptable radiological protection during normal operation and in the event of severe accidents, through the evaluation of a Reference Accident
- the natural characteristics of the site and man-induced phenomena can be accommodated safely in the design bases of the reactor

³⁴ The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* prohibits Commonwealth agencies from undertaking "nuclear actions" which might have a significant impact upon the environment without the consent of the Minister for the Environment, who may require the preparation of an environmental impact statement before approval is granted.

³⁵ See <https://www.arpansa.gov.au/regulation-and-licensing/licensing/information-for-licence-applicants/how-do-i-apply-for-a-licence>

iv. *for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.*

17.4. Due to Australia's geographical location and the low power level of the OPAL reactor its operation has a very low likelihood of affecting any other contracting parties. As stated above, Australia is a party to the *Convention on the Early Notification of a Nuclear Accident* and the *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency*.

17.5. The Lucas Heights site was reassessed in 2013 as part of the OPAL Periodic Safety Review. The site was also reassessed when ANSTO applied for a licence for the Interim Waste Store (IWS) to house reprocessed waste products from HIFAR operations and the ANSTO ANM Facility. The assessment by ARPANSA was conducted against the latest IAEA requirements for siting nuclear installations.

See Article 18 for a Summary of how the Vienna Declaration on Nuclear Safety Principle 1 is met

Article 18 – Design and Construction

Each Contracting Party shall take the appropriate steps to ensure that:

- i. the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;*
- ii. the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;*
- iii. the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.*

18.1. ARPANSA's *Regulatory Assessment Criteria for the Design of New Facilities* is structured to reflect internationally accepted principles of defence in depth. The criteria states the need for proven engineering practice and standards in the siting, design, manufacture, construction, installation, and commissioning of a reactor. The OPAL licence application was assessed also against the ARPANSA Regulatory Assessment Principles (now retired and under revision). The criteria and the retired principles set the following expectations for human factors at the design stage:

- facilities are designed with systematic consideration of human factors and ergonomic principles to reduce the potential for human error, facilitate correct actions by operators, and reduce operator stress
- safety systems at nuclear reactors are designed to be automatically initiated and to require no immediate operator action within 30 minutes, while permitting operator initiation or action where necessary to ensure or enhance safety
- control and control room layout provides ergonomic disposition of data and controls for actions important to safety, including accident management
- diagnostic aids are provided to speedily resolve questions important to safety and to monitor the status of the reactor
- maintenance and inspection aspects such as access are considered in the design of equipment and systems
- reliable and redundant communications systems are provided for all operations staff

OPAL

18.2. A significant change to design reported at the 7th CNS Review meeting was the addition of a Heavy Water Upgrade System to remove light water from the heavy water in the reflector vessel. Although the operation of the reactor was adapted to the modification, the safety effect was demonstrated to be minimal and fully within the safety design capabilities.

Summary of how Australia meets the Vienna Declaration on Nuclear Safety Principle (see Article 17 also)

Australia meets the Vienna Declaration Principle 1 in relation to Research Reactors: *New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term off site contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.*

- The siting of OPAL took into account the elements covered by Principle 1 of the Vienna Declaration, namely, the prevention of accidents during the commissioning and operations phase.
- ARPANSA's Regulatory Assessment Criteria for the Design of New Facilities is structured to reflect internationally accepted principles of defence in depth. The criteria state the need for proven engineering practice and standards in the siting, design, manufacture, construction, installation, and commissioning of a reactor.
- ARPANSA's Regulatory Guide: Siting of Controlled Facilities³⁶ sets out international best practice applicable to siting of nuclear installations. The siting of OPAL took into account the elements covered by Principle 1 of the Vienna Declaration, namely, the prevention of accidents during the commissioning and operations phase - ARPANSA's Regulatory Assessment Principles (now retired in anticipation of an updated version) and Regulatory Assessment Criteria for the Design of New Facilities are structured to reflect internationally accepted principles of defence in depth. The criteria state the need for proven engineering practice and standards in the siting, design, manufacture, construction, installation, and commissioning of a reactor.

³⁶ See <https://www.arpansa.gov.au/sites/default/files/legacy/pubs/regulatory/guides/REG-LA-SUP-240L.pdf>

Article 19 – Operation

Each Contracting Party shall take the appropriate steps to ensure that:

- i. the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;*

- 19.1. The ARPANSA licensing process requires the applicant to furnish specific information when applying for a licence to operate a nuclear research reactor. These include:
 - Arrangements for maintaining criticality safety during loading, moving or storing nuclear fuel and other fissile materials.
 - A description of the structures, components, systems and equipment of the reactor as they have been constructed.
 - A final safety analysis report that demonstrates the adequacy of the design, the operating limits and conditions, and arrangements for commissioning and operations.
- 19.2. In assessing a licence application for a nuclear research reactor, ARPANSA must, under the Act, take into account international best practice in radiation protection and nuclear safety. The relevant international best practice documents comprising primarily IAEA Safety Standards are listed on the ARPANSA website.

- ii. operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;*

- 19.3. The Regulations require an applicant for an operating licence to specify the operational limits and conditions (OLC). Failure to comply with an OLC may be a breach of a condition of licence. ARPANSA continues to monitor that OLCs are derived from the SAR. The licence holder may not make any change to the design or operation of the reactor that would invalidate the assumptions and conditions on which the current SAR is based without prior approval from ARPANSA.
- 19.4. Recent amendments to the OPAL OLCs include a change to the allowable deuterium concentration in the heavy water systems and an amendment of the instrumentation OLCs to align with a revised Instrument Calibration Methodology.
- 19.5. The Regulations require licence applications to contain plans and arrangements to ensure the safety of a reactor throughout all stages of its life. Procedures and instructions for operation, maintenance, inspection and testing of the reactor must form part of these plans and arrangements and are reviewed and approved by ARPANSA before a licence is issued. Details of what is expected in the plans and arrangements are provided in regulatory guidelines.
- 19.6. ARPANSA's Regulatory Guide *Plans & Arrangements for managing safety* set expectations on how to demonstrate that procedures for inspection, testing and maintenance are documented and implemented. The licence holder should also demonstrate that inspection, testing and maintenance throughout the life of the facility ensure the availability and reliability of systems at the levels mentioned in the SAR and avoid common cause failures.
- 19.7. Approved procedures for the operation, maintenance, inspection and testing of OPAL is undertaken in accordance with the Nuclear Operations Business Management System (BMS). The head document of the BMS is the *Nuclear Operations Business Management System Manual*, and below this lies the range of manuals, procedures, instructions, and forms for all operations, maintenance, testing and inspection activities.

iii. *procedures are established for responding to anticipated operational occurrences and to accidents;*

- 19.8. ARPANSA's *Regulatory Assessment Principles* (now retired in anticipation of an upcoming revision) and the *Regulatory Assessment Criteria for the Design of New Facilities*³⁷ set the expectations on how an applicant should demonstrate that limits of normal operation and anticipated operational occurrences and safety systems settings, including the minimum plant configuration, are derived from safety analyses. The applicant is expected to demonstrate that the operation of the reactor will be constrained by the safety settings.
- 19.9. The applicant must also demonstrate how, at defence in depth level 4, it is possible for operators to diagnose the status of the reactor and to make accident management arrangements. Accident management arrangements may include maintaining or restoring at least one barrier for the confinement of radioactive material and should be based on the outcomes of the safety analysis. The instrumentation important for monitoring the status of the reactor and to undertake effective accident management arrangements is regularly inspected, tested and maintained.
- 19.10. As with other plans and arrangements that form part of the application, the measures relating to the procedures for responding to anticipated operational occurrences and accidents become mandatory upon issue of licence.
- 19.11. The Nuclear Operations BMS has 17 procedures dealing with arrangements for symptom-based incidents/emergencies ranging from minor abnormal occurrences to major events, including reactor transients, water leaks and radiation events such as airborne releases or the failure of fuel cladding. These procedures provide guidance on actions which should be taken within the OPAL operations environment and the circumstances under which a wider ANSTO site response is required.

iv. *necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;*

- 19.12. In determining whether to issue a licence to an applicant, the Regulations require ARPANSA to consider whether the applicant has the capacity to comply with the Regulations and any licence condition. ARPANSA's *Siting of Controlled Facilities* set expectations on what an applicant should consider when developing appropriate managerial structure and resources. The regulatory guideline on *Plans and Arrangements* provides guidance on how to demonstrate effective control and management of safety under normal operation, incidents, and accident conditions. To demonstrate this, the licence holder should show the availability of all necessary engineering and technical support resources in all safety-related fields.
- 19.13. ANSTO has a corporate plan which identifies the development and retention of technical and engineering skills in its human resources, which will support safe operation of all its facilities. There is a human resource plan for Nuclear Operations, which is reviewed annually.

v. *incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;*

- 19.14. The Regulations requires every licence holder to report any accident to ARPANSA within 24 hours of its occurrence. Guidance on reporting accidents is provided in the ARPANSA website³⁸, including

³⁷ See <https://www.arpansa.gov.au/sites/default/files/legacy/pubs/regulatory/guides/REG-LA-SUP-240L.pdf>

³⁸ See <https://www.arpansa.gov.au/regulation-and-licensing/licensing/information-for-licence-holders/reporting-an-accident>

what constitutes a reportable accident. In addition, a licence holder is required to report the breach of any licence condition to ARPANSA within a reasonable time after the breach is first discovered.

19.15. Under the Nuclear Operations BMS, ANSTO implements a process for identifying, recording, analysing and reporting abnormal occurrences and accidents to ARPANSA within appropriate timeframes.

vi. programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

19.16. ARPANSA's Regulatory Guide *Plans & Arrangements for managing safety* set expectations for an operating organisation to have mechanisms :

- for assessment, verification and feedback, including through utilisation of independent reviews
- to review and audit all activities important to safety and establish an ongoing safety assessment program
- to learn lessons from operating experience and safety research from within the organisation and internationally
- to analyse abnormal occurrences, incidents and safety performance of similar reactors worldwide
- to ensure that results of periodic testing, maintenance and modifications, and emergency preparedness exercises are fed back into safety analyses, design modifications, procedures and quality assurance systems

19.17. ANSTO uses a Governance Risk and Compliance (GRC) system for incident management. The system is used to manage and record all incidents, including abnormal occurrences, accidents and near misses. The system is also used to detail the investigations and analyses related to those events. ANSTO is required to report to ARPANSA within 24 hours all events at (or potentially at) INES Level 2 and above. However, ANSTO also voluntarily sends quarterly reports to ARPANSA on all nuclear safety-related events at INES level 1. Australia supports the IAEA Incident Reporting System for Research Reactors (IRSRR). Programs for corrective actions and learning lessons from incidents are integral to ANSTO's Event Management System.

19.18. ANSTO has, since 2006, taken part in a collaboration agreement with operators of the SAFARI-1 reactor (South Africa) and High Flux Reactor (HFR - The Netherlands). The aim of the agreement is to work together to increase safety and reliability through cooperation as OPAL, SAFARI-1 and HFR are similar reactors. Meetings are held every 12 to 18 months to exchange ideas, experiences and good practices.

vii. the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

19.19. In relation to the handling, storage, transport, discharge and disposal of any radioactive waste attributable to a nuclear reactor, ARPANSA's guidelines set expectations that:

- suitable provisions, including waste management facilities, must exist for radioactive waste arising from operations

- where radioactive waste is stored prior to being discharged or disposed of, there are to be suitable provisions for its interim containment
- handling facilities for radioactive waste are to be sufficiently flexible to cope with faulty containers, and radioactive waste of non-standard physical or chemical composition
- the form, locations and quantities of any radioactive waste or discharges, are to be specified, monitored and recorded
- where relevant, the safety analysis is to include consideration of radioactive waste and to confirm compliance with the radiation dose limits

19.20. ARPANSA provides guidance on a range of radioactive waste and disposal matters, drawing on IAEA guidance. It includes a requirement for the applicant to provide documentation detailing procedures for the minimisation of the generation of radioactive waste.

Management of spent fuel and radioactive waste

- 19.21. Detailed procedures for waste management at OPAL are included in the Nuclear Operations BMS. Solid and liquid radioactive wastes are managed across the whole of the ANSTO site by ANSTO's Waste Management Services within Nuclear Services Group of the Nuclear Operations Division.
- 19.22. OPAL's radioactive waste management plan addresses waste minimisation, segregation and classification of the different waste types and waste streams. Intermediate level solid waste is stored in the OPAL service pool and then transported to France for reprocessing.
- 19.23. The low-level liquid waste is managed under the existing Waste Management Services arrangements for discharge to the sewer under the trade waste agreement (TWA) with Sydney Water as approved by ARPANSA. The TWA requires that, by the time discharges from Lucas Heights reach the sewage treatment plant, the levels of radioactivity comply with the WHO derived concentration limits for drinking water. OPAL liquid discharges are part of the site general discharges.

Limiting exposure during handling, treatment, transport, storage and transfer or ultimate disposal of spent fuel and radioactive waste

- 19.24. Limitation of exposure is implemented by ANSTO through guidance documents and work instructions in the WHS management system and the Nuclear Operations BMS. The guidance and instructions comply with all applicable ARPANSA and international codes and standards.

Packaging and containment of radioactive waste

- 19.25. All solid waste is stored on-site in approved packaging in facilities specifically designed and licensed for this purpose. Prior to discharge, all radioactive liquid waste is stored in appropriate containment vessels and subject to appropriate treatment methods.
- 19.26. A program is also in place for the solidification of intermediate level radioactive liquid wastes from molybdenum-99 production using ANSTO's patented SYNROC process at the proposed ANSTO SyMo Facility. A siting and construction licence for this facility was issued in 2014. The plant is currently under construction as of the time of writing this report. The waste from the ANSTO SyMo facility will primarily be from the ANM Facility which was licensed for operations in May 2019.

Discharge reports

- 19.27. The OPAL operating licence has conditions requiring quarterly and annual reports to ARPANSA on airborne radioactive discharges arising from all of ANSTO's activities. The existing stack monitoring

equipment continuously sample gaseous discharges using TC45 cartridges. The filters are measured weekly by ANSTO's Nuclear Assurance Group to provide information on gaseous discharges. Notification and correction levels are set by ARPANSA. Currently, discharges are well within the notification levels set by ARPANSA in the licence.

Management of ultimate disposal or transfer of radioactive wastes

- 19.28. In accordance with its Radioactive Waste Management Policy, ANSTO stores its radioactive wastes on site until suitable disposal routes are available. There is currently no disposal route for radioactive waste within Australia and this limits the options to on-site storage or return to manufacturer. See Introduction section for more information on the NRWMF.

Spent fuel management strategy

- 19.29. The Australian Government decided in 1997 that an appropriate management strategy for HIFAR spent fuel was to ship it overseas and store any resulting long-lived intermediate level wastes in Australia in a form suitable for acceptance into a national storage facility. Reprocessed wastes from those shipments were returned to Australia in 2015 to an Interim Waste Store (IWS) at ANSTO's Lucas Heights site to temporarily store these wastes until establishment of a centralised national storage facility. (See Summary section above)
- 19.30. In 2018, the first shipment of spent fuel assemblies from the OPAL reactor were shipped to the AREVA La Hague facility in France for reprocessing in 4 TN-MTR casks (236 spent fuel assemblies). Residual waste from the reprocessing will be returned to Australia in around 2035-2040 as per the waste from HIFAR.
- 19.31. The Australian Government continues to seek an appropriate site for Australia's National Radioactive Waste Management Facility (NRWMF) in order to provide a single purpose built facility to permanently store low level waste and temporarily store intermediate level waste. See Summary of this report for more information.

Action taken from lessons learnt from the Fukushima Daiichi accident

- 19.32. ANSTO undertook self-assessment against the lessons learnt from Fukushima accident. The actions arising from the self-assessment, which coincided with the OPAL PSR, were not significant for safety and did not require immediate action.
- 19.33. The self-assessment was revised in 2014 in line with the IAEA Safety Reports Series No. 80 *Guidance on Safety Reassessment for Research Reactors in the Light of Accident at the Fukushima Daiichi NPP*. This review is complete and it was concluded that the actions were not significant for safety and did not require immediate action. At the time of this report the majority of the actions are completed.

Glossary and acronyms

Term	Definition
ABMS	ANSTO Business Management System
ANM	ANSTO Nuclear Medicine
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BMS	Business Management System
CEO	Chief Executive Officer
CNS	Convention on Nuclear Safety
FSAR	Final Safety Analysis Report
GIF	Generation IV International Forum
GRS	ANSTO's Governance Risk and Compliance system
HF	Human Factors
HIFAR	High Flux Australian Reactor
IAEA	International Atomic Energy Agency
INES	International Nuclear and Radiological Event Scale
IRRS	Integrated Regulatory Review Service
IRSRR	Incident Reporting System for Research Reactors
ISO	International Organization for Standardization
IWS	Interim Waste Store
LEU	Low Enriched Uranium
Licence	A legal authorisation issued to an applicant by ARPANSA to site, construct, operate, decommission, dispose of or abandon a nuclear research reactor or other radiation facilities or sources.
MW	Megawatt
NRWMF	National Radioactive Waste Management Facility
Nuclear installation	<p>'Nuclear installation' is defined in the CNS as any land-based civil nuclear power plant under the jurisdiction of the Contracting Party including such storage, handling and treatment facilities for radioactive materials as are on the same site and are directly related to the operation of the nuclear power plant. Such a plant ceases to be a nuclear installation when all nuclear fuel elements have been removed permanently from the reactor core and have been stored safely in accordance with approved procedures, and a decommissioning program has been agreed by the regulatory body.</p> <p>Australia has no nuclear power plant, and none are planned. This report mainly addresses Australia's only operating nuclear research reactor.</p>
OLC	Operational Limits and Conditions
OPAL	Open Pool Australia Light-water reactor
POC	Performance Objectives and Criteria

PSSR	Periodic Safety Review
PSAR	Preliminary Safety Analysis Report
PSSR	Periodic Safety and Security Review
QA	Quality Assurance
QMS	Quality Management System
RAC	ANSTO's Reactor Assessment Committee
Regulatory body	'Regulatory body' is defined in the CNS as anybody or bodies given the legal authority by the Contracting Party to grant licences and to regulate the siting, design, construction, commissioning, operation or decommissioning of nuclear installations
ROEMS	ANSTO's Reactor Operations Event Management System
RPA	Radiation Protection Adviser
RSB	ARPANSA's Regulatory Services Branch
SAC	ANSTO's Safety Assessment Committee
SAR	Safety Analysis Report
SLA	Service Level Agreement
SPI	Safety Performance Indicator
SYNROC	SYNROC (synthetic-rock) is an ANSTO-developed technology to transform the intermediate level liquid wastes generated from the Mo-99 production process into a stable immobilised glass ceramic form. The technology greatly reduces the waste volume and converts it into a long-term stable form.
SyMo Facility	A facility under construction in ANSTO to apply Synroc technology for immobilisation of waste from ANSTO's Mo-99 production processes
the Act	<i>Australian Radiation Protection and Nuclear Safety Act 1998</i>
the Regulations	Australian Radiation Protection and Nuclear Safety Regulations 2018
TWA	Trade Waste Agreement
US NRC	US Nuclear Regulatory Commission
WHO	World Health Organisation
WHSE	Work Health, Safety and Environment