Commonwealth of Australia

Convention on Nuclear Safety

Australian National Report

September 2007

Australian Government

Australian Radiation Protection and Nuclear Safety Agency

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Introduction

National nuclear programs

1. Australia ratified the Convention on Nuclear Safety in December 1996 but does not have any "nuclear installations" as defined in the Convention. Indeed Commonwealth, State and Territory legislation currently prohibits the construction or operation of such installations. For example, Section 10 of the *Australian Radiation Protection and Nuclear Safety Act 1998* (ARPANS Act) prohibits the Chief Executive Officer (CEO) of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) from issuing a licence in respect of the construction or operation of a nuclear fuel fabrication plant, a nuclear power plant, an enrichment plant or a reprocessing plant. The Australian Government is currently considering its policy in this regard, arising from consideration of the findings of key reports into the nuclear fuel cycle, including the Uranium, Mining, Processing and Nuclear Energy Review in 2006[1].

2. The Commonwealth Government's Australian Nuclear Science and Technology Organisation (ANSTO) is the only organisation in Australia that operates nuclear facilities, which include nuclear research reactors. As such, this report only addresses research reactors operated by ANSTO at the Lucas Heights Science and Technology Centre in Sydney's south in the State of New South Wales.

3. The High Flux Australian Reactor (HIFAR) at ANSTO was finally shut down in January 2007 after 49 years of operation. HIFAR was a high flux thermal neutron tank-type reactor, fuelled with enriched uranium/aluminium fuel elements, moderated and cooled by heavy water and having a nominal thermal power output of 10 megawatts. All the fuel and heavy water coolant has been removed from within the reactor building. Another reactor, Moata, is a small Argonaut type reactor that was used for materials and physics research and has been in the second stage of decommissioning since 1996. Detailed specifications of HIFAR were provided as an attachment to the 2005 National Report.

4. The only nuclear research reactor that ANSTO currently operates is the Open Pool Australia Light-water reactor (OPAL). The OPAL reactor is a high flux, thermal, multi-purpose pool type reactor. The CEO of ARPANSA issued a Facility Licence authorising operation in July 2006. The OPAL reactor achieved its full power of 20 megawatts in November 2006. To meet obligations in relation to non-proliferation, the OPAL reactor is fuelled with low enriched uranium (LEU) aluminium clad and uranium silicide fuel elements. It is cooled by light water and has a heavy water reflector system surrounding the core. Detailed specifications of the OPAL reactor can be found at Annexe 1.

5. The OPAL reactor is housed in a containment building, which also includes the primary cooling circuit and most of the auxiliary plant. The stainless steel reactor pool is 12.6 metres deep and surrounded by thick-walled reinforced concrete construction. The OPAL reactor core sits at the bottom of the pool and is surrounded by a zircaloy 4 reflector vessel which houses all the experimental irradiation rig and beam tube assemblies. A service pool, contiguous with the

[1] See http://www.dpmc.gov.au/umpner

reactor pool, stores the irradiated materials and provide for the interim storage of spent fuel. A neutron guide hall has been constructed adjacent to the reactor building and contains experimental stations and instrumentation for neutron beam research purposes.

6. A Facility Licence authorising the siting of the OPAL reactor was issued by the CEO of ARPANSA in September 1999 (see Article 17). A Facility Licence authorising construction of the OPAL reactor was issued by ARPANSA in April 2002 (see Article 18). Finally, a Facility Licence authorising Operation of the OPAL reactor was issued by the CEO of ARPANSA in July 2006 (see Article 19).

7. 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, industry and research within Australia and overseas. All these activities will continue in parallel with the operation of OPAL.

Safety issues arising from the last report

8. A number of planned activities by ANSTO to improve safety were identified in the Australian National Report (October 2001) to the Second Review Meeting. These activities arose from special licence conditions imposed on Facility Licence authorising the operation of the HIFAR issued by the CEO of ARPANSA in June 2001. These activities, which covered a range of documentation, operational and safety analysis tasks, were identified in the Australian National Report (September 2004) as items (a) to (i). All of the associated special licence conditions have been complied with by ANSTO. The CEO of ARPANSA accordingly amended the licence and removed all the relevant special licence conditions in 2006.

Summary of significant matters since the last report

9. Several events have occurred since the last national report, which are explained in detail in the main body of the report. These matters are:

   (a) The Cold Commissioning of the OPAL reactor was completed under the authorisation given by the Facility Licence authorising Construction of the OPAL reactor and a report was provided by ANSTO as part of the Application for a Facility Licence authorising the operation of the OPAL reactor. The CEO of ARPANSA issued ANSTO a facility licence authorising operation of OPAL in July 2006, and the OPAL reactor achieved its full power of 20 megawatts in November 2006. The Hot Commissioning of the OPAL reactor was undertaken under the facility licence authorising operation of the OPAL reactor and was completed in 3 stages, namely: Stage B1 — Fuel Loading and First Criticality; Stage B2 – Low Power tests (up to 400 kilowatts); and Stage C — Power Ascension to 20 megawatts. Further details of the licence are provided at Paragraph 7.9 and under Article 19.

   (b) On 24 July 2007 during the course of routine checks following fuel handling operations within the reactor core prior to start-up, three of the sixteen fuel assemblies in the core were each found to have one of 21 fuel plates partially dislodged. Subsequent checks showed that a further two assemblies had also suffered similar problems. As a result, reactor start-up was postponed for at least eight weeks pending resolution of this issue. There was no damage to any

of the fuel in the dislodged assemblies. Had only a single fuel assembly been dislodged, the event would have been rated as a level 1 incident on the International Nuclear Events Scale (INES). However, because multiple fuel assemblies were affected it was not possible to rule out common cause failure as a factor. Therefore ARPANSA's preliminary report to the IAEA rated the event as INES level 2. ANSTO will be undertaking a series of tests, approved at appropriate stages by ARPANSA, to fully determine the cause of that event and actions required to rectify the situation.

(c) During commissioning of the OPAL reactor, a small amount of light water in the pool surrounding the reactor's reflector vessel was found to be leaking into the reflector vessel's heavy water. Whilst the leakage raised no safety concerns, if left unremedied it would eventually lower the neutron flux and thereby degrade the reactor's performance. This issue should also be resolved during the extended shutdown discussed under (b) above.

(d) Conversion from high-enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel for HIFAR took place in a step-wise pattern from October 2004. The conversion to LEU was complete in May 2006. This project is discussed further in Paragraph 19.4.

(e) On 30 January 2007, HIFAR was shutdown for the last time and fuel was removed permanently to a separately licensed facility shortly afterwards. The CEO of ARPANSA received an Application for facility licence authorising ANSTO to Possession or Control HIFAR in May 2007. If granted, this facility authorise ANSTO activities in relation to HIFAR for approximately 10 years, during which time HIFAR will remain in a state of safe enclosure. If relevant approvals and waste management facilities are in place at the end of that period of safe enclosure, ANSTO will apply for a facility licence authorising it to decommission the facility. Further details are at Paragraph 14.8.

(f) An IAEA International Regulatory Review Service (IRRS) mission was undertaken in June 2007, the outcomes of which are reported on under Articles 7 and 8. The mission made a number of findings of good practice, together with a number of recommendations and suggestions for further improvement to the implementation of the Australian radiation protection and nuclear safety framework. A summary of the mission is provided at Annexe 2 and, once finalised, the full report will be available from the ARPANSA website[2].

(g) In June 2006, the Prime Minister announced the appointment of a task force to undertake an objective, scientific and comprehensive review of uranium mining, value added processing and the contribution of nuclear energy in Australia in the long term. A draft report was issued for comment in November 2006, and a final report *Uranium Mining, Processing and Nuclear Energy – Opportunities for Australia?* was published in December 2006[3]. Further details of this report are available at Annexe 3.

[2] http://www.arpansa.gov.au

[3] See http://www.pmc.gov.au/umpner

(h) A shortage of nuclear science and engineering expertise in Australia, available for both operators and regulators identified in the Australian 2004 CNS report continues, and in the case of ARPANSA very senior nuclear engineers have either retired or are close to retirement. In recognition of this shortage, both ANSTO and ARPANSA have announced graduate recruitment programmes that will provide in-house training to develop the skills of tertiary graduates to address the identified skills shortages. In addition to this, a number of high-profile Australian universities have announced nuclear science programmes commencing in 2008.

The rest of this report

10. ARPANSA has been designated by the Australian Government to take primary responsibility for the implementation of Australia's obligations under the Convention, working in consultation with other agencies. In the interests of similarity of approach and transparency, this document is publicly available.

11. The Convention obliges Contracting Parties to report to periodic Review Meetings on the implementation of their obligations. This Report also provides an opportunity for Australia to:

- evaluate the effectiveness of its regulatory framework by assessing the safety standards of Australia's research reactors, based on practices promoted by the Convention;
- promote and contribute to a similarity of approach to nuclear safety worldwide;
- promote transparency of nuclear operations within Australia and other countries; and
- better understand the Convention obligations and facilitate Australia's review of the National Reports of other Contracting Parties.

12. The rest of this report is a self-evaluation of Australia's compliance with the obligations of the Convention. The reporting format is based on the Articles in the Convention and is in accordance with International Atomic Energy Agency (IAEA) guidelines[4]. The paragraph numbering corresponds to the Article numbers, and the report under each Article of the Convention is, as far as practicable, divided so that Australia's formal compliance with the Article is first reported followed by the factual compliance of the operating organisation, namely ANSTO, with respect to its research reactors.

[4] Including the IAEA Information Circular, INFCIRC/572/Rev.2, published 2 September 2002 and the *Synopsis of the relevant IAEA safety requirement statements reflecting the issues addressed by Articles 16 to 19 of the Convention on Nuclear Safety* published by the IAEA secretariat on 18 May 2006.

Articles 1 to 5

These Articles cover the following:

- Article 1 – Objectives
- Article 2 – Definitions
- Article 3 – Scope of Application
- Article 4 – Implementing Measures
- Article 5 - Reporting

No report is required in respect of these Articles[5].

[5] IAEA Information Circular, INFCIRC/572/Rev.1, 15 October 1999

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.***

List of existing nuclear installations at the time the Convention entered into force for Australia

6.1. The research reactors owned by ANSTO at the time of entry into force of the Convention were:

- The HIFAR Research Reactor. This was a 10 MW(t) heavy water, tank type, materials testing reactor, which operated between 1958 and 2007 at Lucas Heights in New South Wales (in Sydney's south) and is permanently shut down; and
- The Moata Research Reactor. This 100 kW(t) Argonaut university type research reactor at Lucas Heights operated between 1961 and 1995, and is currently in the second phase of decommissioning.

List of existing nuclear installations where significant corrective actions have been found to be necessary

6.2. A review of HIFAR undertaken in the context of the review and assessment of the facility licence authorising the operation of the HIFAR 2001 and the review of the HIFAR Safety Analysis Report (SAR) in 2002 to ensure compliance with a licence condition, demonstrated that HIFAR was safe and that there was no evidence of significant ageing effects which would impair safety in the period prior to its planned shutdown in 2006. However, a number of areas were identified by ARPANSA where HIFAR did not fully meet modern standards and additional licence conditions were imposed to address these matters. Details of those matters can be found in the 2004 Report.

Overview of safety assessments and measures for safety upgrading

HIFAR research reactor

6.3. The CEO of ARPANSA issued ANSTO with a facility licence authorising it to operate HIFAR (subject to certain licence conditions) in June 2001. In February 2004, the conditions of licence were varied to require ANSTO to, as soon as practicable, make a submission to the CEO of ARPANSA seeking the approval of the CEO to operate HIFAR beyond December 2006, should it propose to do so.

ANSTO made such a submission in October 2006, and the CEO of ARPANSA agreed later that month that HIFAR could operate up until the end of February 2007. HIFAR shut down on 30 January 2007.

Moata

6.4. Moata is a training reactor of the 'Argonaut' type. It commenced operation in 1961 and operated at thermal powers up to 100 kilowatts until mid-1995, when it was permanently closed down. The irradiated reactor fuel was returned to the United States in December 2006 with a shipment of spent HIFAR HEU elements. In the Australian National Report in 2001, it was reported that ARPANSA had issued a facility licence to ANSTO authorising it to possess or control and decommission the facility. ANSTO has not yet submitted detailed plans for decommissioning to ARPANSA. Such plans will be subject to a separate review and approval process by ARPANSA before further substantive decommissioning work can proceed.

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

7.1. The Commonwealth Parliament passed the ARPANS Act in 1998. The Act commenced in February 1999. The Act establishes the statutory office of the CEO of the ARPANSA. The Act applies only to *controlled persons* – Commonwealth Government entities and their contractors, or persons in a prescribed Commonwealth place. It provides that, under certain conditions, the CEO may issue licences to controlled persons authorising the licence holder to undertake activities in relation to controlled material, controlled apparatus and controlled facilities such as research reactors.

7.2. Australia is a federation of six States and two self-governing Territories. Constitutional responsibility for radiation health and safety in each State and Territory rests with the respective State/Territory government, unless the activity is being carried on by a Commonwealth Government agency. State and Territory legislation currently prohibits the construction or operation of nuclear installations and research reactors, although the relevant NSW legislation contains an exception in respect of ANSTO's facilities.

7.3. Under the *Australian Nuclear Science and Technology Organisation Act 1987* (ANSTO Act), ANSTO is not subject to State legislation relating to: the use or proposed use of land or premises; radioactive materials or dangerous goods; or licensing. Being a controlled person for the purposes of the ARPANS Act, ANSTO's activities in respect of its research reactors are regulated by the CEO of ARPANSA.

7.4. The ARPANS Act requires the CEO of ARPANSA to take all reasonable steps to avoid any conflict of interest between his/her regulatory functions and any other functions prescribed by the Act.

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 1999 and other Regulatory Guidance documents

7.5. The Australian Radiation Protection and Nuclear Safety Regulations 1999 (the ARPANS Regulations) were made under the ARPANS Act. The Act and the Regulations are the basis upon which the CEO of ARPANSA regulates the safety of ANSTO's nuclear plants and reactors.

7.6. The Act and the Regulations empower the CEO to promulgate guidance documents relating to the exercise of the regulatory function of ARPANSA. Documents produced include:

(a) *Regulatory Assessment Principles for Controlled Facilities (October 2001);*

(b) *ARPANSA Criteria for the Siting of Controlled Facilities (April 1999);*

(c) *Regulatory Guideline on Review of Plans and Arrangements (August 2003)*;

(d) *ARPANSA Regulatory Guideline on Commissioning of Controlled Facilities (August 2004);*

(e) ARPANSA Regulatory Guideline on Operation Controlled Facilities (1999);

(f) Regulatory Assessment Criteria for the Design of New Controlled Facilities and Modifications to Existing Facilities, October 2001; and

(g) Regulatory guideline for the Decommissioning of Controlled Facilities.

Publication of the above guidance documents ensures helps to ensure the transparency (from the point of view of applicants and the general public) and predictability of the licensing process. Generally these documents are available from the ARPANSA website; however some are currently removed pending their review.

ii. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence:

Licensing

7.7. Part 5 of the ARPANS Act deals with the regulation of controlled material, apparatus and facilities. This Part prohibits the siting, construction, operation, possession or control, or decommissioning of nuclear installations or prescribed radiation facilities without a facility licence issued by ARPANSA. This Part also prohibits dealing with controlled material or controlled apparatus without a source licence issued by the CEO of ARPANSA. The CEO of ARPANSA may impose conditions in a facility or source licence and such conditions must be complied with.

7.8. HIFAR operated under a set of 55 Licence Conditions specified in a licence conditions handbook published by ARPANSA to operate a controlled facility such as research reactor. Many of the licence conditions in the ARPANS Regulations were repeated in this document.

7.9. The OPAL operating licence is structured in a manner that refers explicitly to the licence conditions in the Act and Regulations and in addition includes only six other licence conditions imposed by the CEO of ARPANSA at the time the licence was issued These related to:

- Periodic safety review, including revision of the safety analysis report within 2 years of the completion of commissioning and every 10 years thereafter;
- Periodic review of physical protection within 2 years of the completion of commissioning and periodically thereafter;
- Safety culture and safety performance indicators to support continuous improvement;
- Quarterly reporting to the CEO of ARPANSA covering a range of identified areas;
- Compliance with the ANSTO site discharge authorisations; and

- The development and maintenance of an Index of Documents to demonstrate compliance with the OPAL licence conditions.

The shift in licensing style was considered thoroughly to ensure that there was no diminution of the safety outcomes that ANSTO would have to demonstrate. This system of licensing indicates a shift in ARPANSA's licensing style to a more outcomes-focussed approach. It was also felt that this style of licensing emphasises further that the ultimate responsibility for ensuring the safety of the nuclear facility rests with the licensee.

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

Inspection

7.10. Sub-section 35 (3) of the ARPANS Act requires licence holders to allow the CEO or persons authorised by the CEO of ARPANSA to enter and inspect sites and facilities at reasonable times. The CEO of ARPANSA can appoint inspectors and authorise them to undertake searches and exercise a range of powers to establish whether the Act and regulations are being complied with.

7.11. Inspectors are authorised to enter the premises of a nuclear installation and exercise a range of powers, including issuing directions to the licensee, if they have reasonable grounds for suspecting that the Act or the regulations have not been complied with in relation to that nuclear installation *and* it is necessary to exercise those powers to avoid an imminent risk of death, serious illness, serious injury or serious damage to the environment.

7.12. Internal guidance is given to inspectors on exercising their powers, including during planned inspections, unplanned inspections and in the event of an incident. ARPANSA is also developing additional guidance on how the inspections can give regulatory assurance of nuclear safety. These and other inspection-related documents have been removed temporarily from the ARPANSA website pending their review and re-issue.

Assessment

7.13. The primary documents for regulatory assessment are the ARPANS Act and Regulations. In particular the ARPANS Act requires the CEO of ARPANSA to take into account international best practice in radiation protection and nuclear safety when making licence decisions. Consistent with this statutory framework ARPANSA has developed Regulatory Assessment Principles to assist in the assessment of research reactors. These Principles draw extensively from international publications and experience, especially those of the International Nuclear Safety Advisory Group (INSAG) and the IAEA.

7.14. The Principles, together with other guidelines are publicly available documents that state ARPANSA's regulatory expectations in relation to the content of applications for licence. These documents ensure the thoroughness and transparency of the licence assessment process.

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

Enforcement

7.15. Part 5 of the ARPANS Act provides that the CEO of ARPANSA may give written directions requiring the performance of such necessary steps within a certain specified time frame. If the person so directed does not act accordingly, the CEO may arrange for such steps to be taken. The CEO has the power to recover the costs of such steps.

7.16. An injunction may be granted by the Federal Court if a person is engaging or is proposing to engage in any conduct that is or would be an offence against the Act or regulations.

7.17. The CEO may, from time to time, impose additional licence conditions, remove or vary conditions or extend or reduce the authority granted by a licence. The CEO may also suspend or cancel a licence if, among other things, the licensee (or anyone covered by the licence) has breached a condition, committed an offence against the Act or the regulations, or if the licence was obtained improperly.

7.18. Some enforcement and licensing decisions taken by the CEO are subject to the review of the relevant minister (currently the parliamentary secretary to the Minister for Health and Ageing). The minister's decision is, in turn, subject to review by the Administrative Appeals Tribunal. This form of review is referred to as merits review and allows the external review body to affirm, revoke or vary the decision of the CEO of ARPANSA or his delegate.

7.19. All decisions made under the ARPANS Act may also be the subject of an application for judicial review by an "aggrieved person" to the Federal Court of Australia under the *Administrative Decisions (Judicial Review) Act 1977*.

Article 8 – Regulatory Body

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

Australian Radiation Protection and Nuclear Safety Agency

8.1. ARPANSA was created in February 1999, following the commencement of the ARPANS Act, as the regulatory body for all Commonwealth Government entities (paragraphs 7.1 and 7.2 refer). The CEO of ARPANSA's authority is clearly enunciated in the ARPANS Act. The CEO of ARPANSA has the power to issue source and facility licences, impose conditions in the licenses, vary, amend or add conditions, authorise inspections of premises and enforce compliance (paragraphs 7.7 to 7.19 refer).

8.2. The functions of the CEO of ARPANSA[6] include:

- Promotion of national uniformity of radiation protection and nuclear safety policies and practices across the jurisdictions of the Commonwealth of Australia, the States and Territories;
- Provision of advice on radiation protection and nuclear safety;
- Undertaking research and providing services in relation to radiation protection, nuclear safety and medical exposures to radiation; and
- Monitoring the compliance of licensees with the provisions of the ARPANS Act and Regulations and conditions imposed on licensees, and recommending prosecutions for the breach of these requirements.

8.3. The ARPANS Act sets out the offences that may be committed by any action or omission, and the penalties that the offender could be liable for. The Act provides that the Criminal Code applies to all offences against the Act

8.4. ARPANSA currently has 132 staff. The staff comprises a mixture of scientists, engineers, lawyers, policy professionals and administrative support personnel. The ARPANSA Regulatory and Policy Branch comprises 31 staff. ARPANSA's financial needs are adequately met through budget appropriation and licence fees. In 2006/07 approximately 60% of ARPANSA's annual operating revenue of A$22 million came from budget appropriation.

8.5. The Regulatory and Policy Branch of ARPANSA has primary responsibility for providing advice to the CEO of ARPANSA in relation to the regulation of ANSTO's facilities. The structure and organisation of ARPANSA and its Regulatory and Policy Branch are shown below

[6] Prescribed in Section 15 of the ARPANS Act.

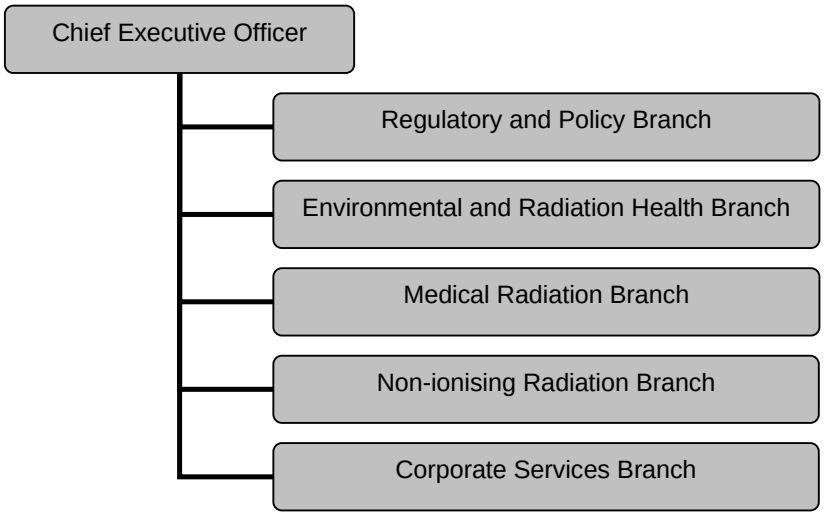

Figure 1: ARPANSA Organisational Chart

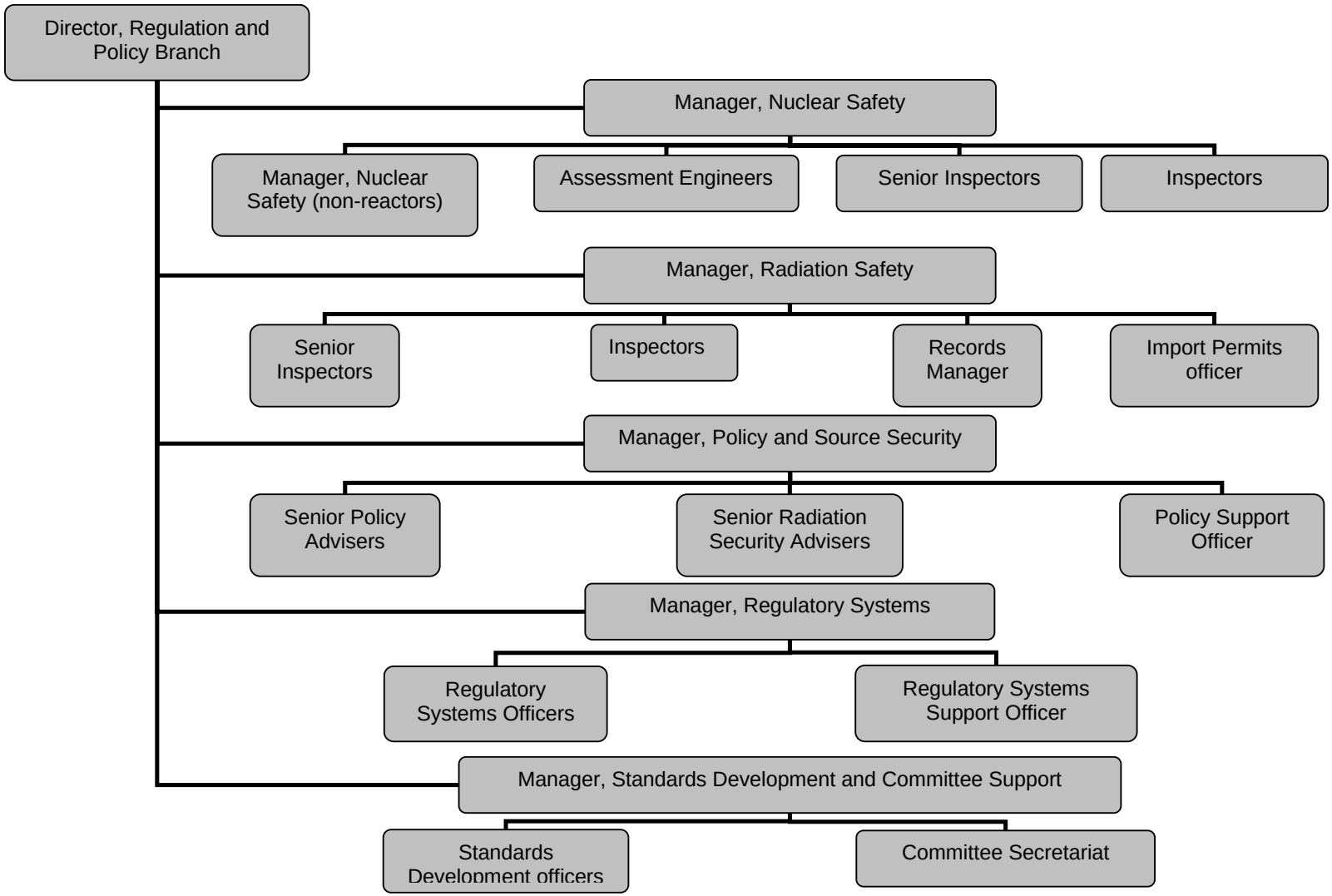

Figure 2: Structure of the Regulatory and Policy Branch of ARPANSA

8.6. The functions of the Regulatory and Policy Branch include:

- assessing applications for licences against accepted standards for radiation protection and nuclear safety;
- making recommendations to the CEO on the issuing of licences;
- monitoring compliance including undertaking inspections of licensed activities to confirm compliance with legislative requirements;
- making decisions in relation to requests by licensees for approval for changes with significant implications for safety under licences
- investigating incidents; and
- taking any enforcement actions required by the CEO that are necessary to ensure compliance, safety of people and protection of the environment;
- Development of national codes and standards to promote national uniformity;
- Management of statutory advisory Council & Committees to the CEO; and
- Formulating regulatory guidance documents for consideration and publishing by the CEO.

8.7. The regulatory framework applies to a very wide range of nuclear and radiation facilities and sources[7] including:

- nuclear facilities such as the nuclear research reactor, large radioisotope production facilities and large radioactive waste facilities operated by ANSTO and the proposed replacement research reactor;
- prescribed radiation facilities, such as particle accelerators and irradiators incorporating large amounts of radioactive material;
- radioactive materials as sealed and unsealed sources;
- ionising radiation apparatus; and
- prescribed non-ionising radiation apparatus such as powerful UV equipment and lasers.

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.

8.8. ARPANSA is created under its principal Act, the ARPANS Act, and the functions and powers of the CEO of ARPANSA are enumerated under that Act. ANSTO is a body corporate created under its principal Act, the ANSTO Act and the powers and functions of the body corporate are set out in that Act. ARPANSA is part of the Commonwealth Government's Health and Ageing portfolio and reports to the Parliamentary Secretary to the Minister for Health and Ageing. ANSTO is part of the Government's Education, Science and Training portfolio and reports to the

[7] For further information see http://www.arpansa.gov.au/Regulation/Applicants/index.cfm

Minister for Education, Science and Training. The independence of the CEO of ARPANSA is further assured through several mechanisms established under the ARPANS Act. These include:

(a) The establishment of the CEO of ARPANSA as a statutory office holder;

(b) A provision in the ARPANS Act that requires the CEO to take all reasonable steps to ensure that there is no conflict of interest between his regulatory role and any other roles as a service provider;

(c) Reporting mechanisms requiring the CEO to report quarterly and annually to the Commonwealth Parliament through the Parliamentary Secretary to the Minister for Health and Ageing;

(d) The CEO may at any time cause a report about matters relating to his or her functions to be tabled in either House of the Parliament. Where a serious accident or malfunction occurs at a nuclear installation[8], the CEO must table a report about the incident in each House no later than three sitting days after the incident;

(e) The requirement for the Parliamentary Secretary to the Minister for Health and Ageing to table in Parliament any direction that he or she makes to the CEO of ARPANSA; and

(f) The establishment of the Radiation Health and Safety Advisory Council, the Nuclear Safety Committee and the Radiation Health Committee, with independent members, to advise the CEO of ARPANSA.

[8] Defined by the ARPANS Act as (a) a nuclear reactor for research or production of materials for industrial or medical use (including critical and subcritical assemblies); (b) a plant for preparing or storing fuel for use in a reactor as described in (a); (c) a nuclear waste storage or disposal facility with an activity greater than that prescribed by the regulations made for the purposes of this definition; and (d) a facility for the production of radioisotopes with an activity greater than that prescribed by the regulations made for the purposes of this definition.

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.

Formal Compliance

9.1. The licence conditions in the ARPANS Act and Regulations ensure that the prime responsibility for the safety of a nuclear installation rests with the licence holder. Inter alia, these conditions require the licence holder to

- prevent breaches of the conditions;
- investigate and rectify any breaches;
- prevent, control and minimise accidents;
- review and update plans and arrangements on an annual basis; and
- comply with their plans for managing safety submitted as part of the licence application.

Any breach of a licence condition may be addressed by appropriate enforcement action.

9.2. In addition to formal inspections and assessments, ARPANSA may also act on reports made by the licence holders' staff on safety breaches or unsafe practices in nuclear facilities. Licence holders are obliged to report all abnormal occurrences to ARPANSA. The regulations require that all accidents be reported to the CEO within 24 hours of their occurrence (Regulation 46). With regard to nuclear installations, guidance published on the ARPANSA website[9] states that any event that is rated at, or has the potential to be rated at, Level 2 or above on the International Nuclear Event Scale[10] (INES) is regarded as an accident for the purposes of the regulations.

9.3. One of the suggestions arising from the recent IRRS mission (Annexe 2 refers) was that consideration should be given to the inclusion of explicit wording in the legislation requiring an operator to have primary responsibility for safety to reflect Principle 1 of the IAEA Fundamental Safety Principles. ARPANSA have agreed to give consideration to this in the next review of their legislation.

Factual Compliance

9.4. Staff from ARPANSA's Regulatory and Policy Branch regularly monitor and review the operations of licence holders' nuclear installations to ensure that the organisation meets its responsibility for safety as required by the legislation, and the conditions attached to the relevant licences.

9.5. ANSTO operates under a documented safety management system, compliant with ISO 9001, which establishes responsibilities for health, safety and environmental

[9] http://www.arpansa.gov.au/regulation/licenceholders/incident.cfm

[10] http://www-ns.iaea.org/tech-areas/emergency/ines.htm

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 operation. The overarching safety body, the Safety Assessment Committee, has external membership in addition to the ANSTO staff membership. ANSTO's safety performance is reviewed regularly by its Executive and Board.

9.6. There have been no findings of breach of licence in relation to the facility licence authorising the operation of HIFAR since the last report.

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.

Formal Compliance

10.1. When undertaking an assessment of an application for a facility licence, ARPANSA's regulatory guidance, in particular the Regulatory Assessment Principles (RAPs) and associated Regulatory Guidelines (Paragraph 7.6 refers), requires an applicant for a licence to demonstrate in their application a commitment to a strong safety culture through the articulation, at the highest level, of a safety policy that stresses the importance of a commitment to safety by the operating organisation (Principle 1). Once a licence is issued, Regulation 49 is a regulatory licence condition that requires the licence holder to comply with plans and arrangements that form part of the application for a licence. Specific regulatory guidance is given in relation to the regulatory expectations for the content of plans and arrangements for:

- Effective Control
- Safety Management
- Radiation protection
- Radioactive waste management
- Ultimate disposal and transport
- Security, and
- Emergency preparedness

The Regulatory Guidelines on Plans and Arrangements, against which licence applications are assessed, state:

> *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.*

Factual Compliance

ARPANSA Reviews of Operating Reactors

10.2. Details of the facility licence authorising operation of HIFAR (shutdown) can be found in Australia's report to the third review meeting[11].

10.3. The facility licence issued by the CEO of ARPANSA to ANSTO authorising operation of the OPAL reactor was based on ARPANSA's review and assessment of ANSTO's safety policies and strategies in relation to safety, safety culture, safety

[11] Available from http://www.arpansa.gov.au/regulation/collaborations/nucsafety.cfm

analysis and defence in depth. During the assessment of the application for a facility licence authorising the operation of the OPAL reactor, an operational readiness review was conducted by ARPANSA to determine whether ANSTO had the capacity to comply with these policies and strategies. This operational readiness review and the separate review of the OPAL safety analysis report were amongst the assessments that informed the CEO of ARPANSA's Statement of Reasons that accompanied the decision to issue a facility licence authorising operation of the OPAL reactor that was made on 14 July 2006[12]. Ongoing review and consideration of operational readiness form part of ARPANSA's planned and unplanned inspection programme.

10.4. The operating licence issued to OPAL requires ANSTO to prepare and implement a program to support continuous improvement in safety culture in relation to the OPAL reactor, including regular independent review of the OPAL operating organisation's safety climate. Licence conditions attached to the facility licence authorising operation also requires ANSTO to propose and maintain a set of safety performance indicators to be agreed with the CEO of ARPANSA.

ANSTO Safety Policies

10.5. ANSTO has a Health, Safety and Environment Policy that provides the framework to manage ANSTO's activities with due regard for health, safety and the environment. The policy states that ANSTO will undertake its activities 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 and prevention of pollution.

ANSTO Safety culture and commitments

10.6. ANSTO has implemented its safety policies and strategies through a Safety Management System which covers radiological, nuclear and occupational health and safety, administration, emergencies, radiological safety and monitoring, engineering, training and safety related instructions. Every member of ANSTO's staff is responsible for ensuring compliance with the organisation's health, safety and environment policies and strategies, and line management is held accountable for safety.

10.7. The ANSTO Health, Safety and Environment Committee (AHSEC) reports to the Executive Director on the performance of the Organisation's safety and environmental management system, including that of HIFAR and OPAL. AHSEC has a chairperson that is external to ANSTO staff and receives reports and advice from various ANSTO safety and technical groups.

10.8. ANSTO's safety record is assured by several mechanisms, including review and approvals by two committees. These committees and their functions are as follows:

[12] http://www.arpansa.gov.au/Regulation/opal/index.cfm

- The Safety Assessment Committee (SAC) assesses the safety of activities at all of ANSTO's sites that have significant potential to harm humans or the environment. Before approving a new proposal (or continuation of an activity), the SAC may recommend changes to monitoring and control systems to ensure high safety standards. One of the members of this committee is from outside of ANSTO
- The OPAL and HIFAR reactors (now Shutdown) have Reactor Assessment Committees which report to the Reactor Management but include members that are ANSTO staff employed outside of the reactors' management structures. In the case of OPAL the RAC has evolved from the OPAL Commissioning Safety Review Committee, which was in place with other OPAL commissioning committees during OPAL commissioning.

Additional assurance of safety is achieved through routine inspections by independent staff and by review of safety performance by senior management and the Board.

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.

Formal Compliance

11.1. The ARPANS regulations require that in making a decision whether to issue a licence the CEO must take into account whether the applicant has shown a capacity to comply with the regulations, and the licence conditions made under the Act and regulations.

Factual Compliance

11.2. In order that ARPANSA can assess the regulatory requirement, one of the Regulatory Assessment Principles (paragraph 7.6(a) refers) states that ARPANSA must assess ANSTO to be financially viable before ANSTO is issued with an operating licence. ANSTO also has to demonstrate that it has detailed plans and periodic reviews with measurable outcomes that demonstrate that it has adequate managerial structure and resources, including financial capability.

11.3. The Commonwealth Government's budget appropriation forms the bulk of ANSTO's operating revenue. For the financial year 2007/08, revenues from the Government are forecast to form 81% of ANSTO's A$227.6 million operating revenue, with the bulk of the remaining operating revenue coming 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 its nuclear facilities, including the research reactors.

11.4. In addition, ANSTO complies with a number of policy documents titled Business Policy, Finance Management Policy, Fraud Control Policy and Risk Management Policy that address prudential requirements for financial management.

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.

Formal Compliance

11.5. ARPANSA's Regulatory Assessment Principles require the applicant to demonstrate:

(a) Adequate managerial structure and resources (Principle 4(a));

(b) That positive safety attitudes are instituted and encouraged by senior management. Clear lines of authority and responsibility are established, procedures developed, sufficient resources provided, and a quality assurance system is implemented (Principle 6); and

(c) That high standards of human performance and competence are expected within the operating organisation. Staff selection and training emphasise inherent abilities, qualification, personal stability, integrity, and a responsible attitude (Principle 7).

11.6. As discussed earlier, the applicant's plans and arrangements to satisfy the principles that form part of the application must be complied with once a licence is issued.

Factual Compliance

11.7. On the job training of ARPANSA regulatory staff in technical areas relevant to each staff member's work area must be completed satisfactorily before being eligible to be appointed as an inspector under the ARPANS Act. Regulatory staff must have a good working knowledge of the ARPANS Act and Regulations.

11.8. In addition, inspector candidates must be able to demonstrate the capabilities required by a national accreditation system (Certificate IV in Government). Key competencies of this programme include the ability to exercise regulatory powers, promote compliance with legislation, assess compliance with legislation, investigate non-compliance with legislation, conduct and record interviews, conduct a search and possible seizure and prepare evidence.

11.9. Overall responsibility for safety at ANSTO rests with the Executive Director; however, day-to-day responsibility is delegated to senior managers. The General Manager, Reactor Operations has responsibility for safe operation of OPAL. The General Manager, Safety and Radiation Services is responsible for operation and continual improvement of ANSTO's general safety arrangements, including the Safety Management System.

11.10. About 10% of ANSTO's 800 staff members are employed in safety-related positions. These staff have expertise in physics, health physics, chemistry, occupational hygiene, engineering, risk assessment, biochemistry, medicine and computer programming, and are supported by appropriate technical and administrative skills.

11.11. Most of the safety staff work in ANSTO's Safety and Radiation Services Division. That division has service level agreements (SLAs) in place with the ANSTO operating and research divisions, including a service level agreement with Reactor Operations. The activities undertaken in that division include health physics monitoring, measurement and management of internal and external ionising radiation doses received by staff. They also work in occupational health and hygiene, ventilation safety, monitoring of radioactive airborne discharges, provision of round-the-clock site emergency services, fire prevention and fire fighting training, safety training, and the safety assessment of work and projects.

11.12. ANSTO has also undertaken internal strategies to ensure that its staff are continuously trained to ensure that the human factor in safety is accorded proper attention. This is covered further under Article 12 below.

HIFAR up until closure in Jan 2007

11.13. The requirements for qualifications and training of personnel are specified in the HIFAR operating procedures. ANSTO's section heads are responsible for the identification of training needs. Arrangements are in place for training and

retraining of all personnel in the HIFAR reactor organisation, including reactor operators, active handling crew and operations engineers.

11.14. There is an extensive training program in place at HIFAR. All HIFAR staff are trained in radiation protection related to HIFAR operations. The training of operators includes theoretical and practical components, and consists of classroom training; practical training; group attachments; and retraining. HIFAR staff and ANSTO staff from other divisions provide training. The effectiveness of the training is assessed in the accreditation and re-accreditation process for HIFAR operators. A procedure covers the maintenance of training records by the HIFAR training officer.

11.15. Arrangements are also in place for the accreditation and re-accreditation of key operating personnel and active handling crew. The accreditation and re-accreditation processes include examinations, practical training and interviews, with the frequency of re-accreditation varying from two years to three years.

11.16. ARPANSA considers that the training and accreditation procedures included in the HIFAR Quality System are extensive. The training is assessed in the accreditation and re-accreditation process, and an ARPANSA inspector usually attends as an observer on the accreditation panel.

OPAL

11.17. The ANSTO project dedicated to the design, construction and commissioning of OPAL was used to involve a range of ANSTO staff in important processes during design, construction and commissioning of the facility. These included design, safety, and preparation for commissioning and operation. The staff included a number of experienced engineering and management staff from HIFAR operations, but very few HIFAR operators, since HIFAR had to remain operational. In addition a number of introductory OPAL systems training courses were held for relevant ANSTO, staff and in 2005 about 20 ANSTO staff undertook a five-month training program for commissioning support and operation of OPAL.

11.18. In practice, ANSTO generally chose not to transfer experienced HIFAR shift operations personnel to OPAL shift operations. Thus, in the early period of normal operation ANSTO is dependent upon shift managers and operators who gained their experience in the construction and commissioning of OPAL and training on the OPAL simulator. The shift manager and reactor operator positions are accredited by ANSTO, and an ARPANSA inspector acts as an observer during the accreditation interviews in a similar manner to HIFAR accreditations. ANSTO has in general recruited graduate engineers to fill the accredited operating roles, although a number of the shift managers were accredited HIFAR Duty Operations Engineers.

11.19. ARPANSA accepted those OPAL shift operations arrangements on the basis that the quality of operating personnel staff derived from their qualifications, their training and their experience of construction and commissioning made them acceptably competent for operation of the OPAL reactor. The experience gained during Hot Commissioning and Normal Operations since the issue of an OPAL operating licence in July 2006 has demonstrated that the conduct of operations has been satisfactory. Following the closure of HIFAR in January 2007, a number of HIFAR accredited operators are being trained as OPAL operators and will be available for shift operations in the future.

11.20. The qualification and training of OPAL staff was summarised in Sections 13.3 and 13.4 of the Safety Analysis Report[13]. The implementation of the training and accreditation process is detailed in various procedures, instructions and manuals that are part of the OPAL ISO 9001 accredited Business Management System. Those documents were provided to ARPANSA as supporting documents to the Application for a Facility Licence, Operating Authorisation for the OPAL reactor.

[13] Further details on the training programme for OPAL operators are found in Sections 13.3 and 13.4 of the OPAL SAR that can be found at http://www.arpansa.gov.au/Regulation/opal/op_applic.cfm.

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.

Formal Compliance

12.1. A number of ARPANSA's Regulatory Assessment Principles (RAPs) relate to human resources. The Regulatory Guideline on the review of plans and arrangement of management systems covers human resources and training as a key attribute of an effective plan for effective control and management of safety under normal operation, incidents and accident conditions.

12.2. ARPANSA's human factors requirements are detailed in the Regulatory Assessment Principles and the Regulatory Assessment Criteria for the Design of New and Modification of Existing Controlled Facilities. Requirements that must be addressed by applications include

- accounting for human factors in any probabilistic safety analysis;
- any action that is required within thirty minutes of an accident occurring should be actuated automatically; and
- that 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.

Factual Compliance

12.3. The Human Factors Program at the OPAL reactor is a dynamic program that has been part of the project from its inception, and will continue on until the plant is de-commissioned. The ANSTO HF program has been developed to ensure the human machine interface is done in the best possible way to avoid operational/maintenance errors and to satisfy ARPANSA's human factors requirements. The human factor design plans for the OPAL reactor, reviewed by ANSTO and then by ARPANSA as part of its assessment function, included a Human Machine Interface Plan. The Human Factors commitments are defined in various sections of the OPAL Safety Analysis Report[14].

12.4. ANSTO's HF independent Design Review Plan was used for the design, manufacture, installation and commissioning stages of the project, then will be revised and included in the plant design modification procedures to ensure that future plant changes have been thoroughly analysed from a HF perspective. This will be a multi-disciplinary review on all design modifications.

12.5. The licence holder (operator) is required by the licence conditions to analyse the causes of incidents (abnormal safety occurrences) and lessons learned, and to report this information to the regulator on a quarterly basis. The regulator reviews and, if serious, investigates the incidents and classifies them as plan or human factor related.

[14] http://www.arpansa.gov.au/Regulation/opal/op_applic.cfm

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.

Formal Compliance

13.1. ARPANSA's Regulatory and Policy Branch is in the process of formalising a quality system for regulatory activities. Documents already completed for this system include policies for the review of licence applications and for preparing, conducting and reporting formal inspections of licence holders for the purpose of monitoring compliance with the ARPANS legislation and licence requirements. These policies are implemented through a set of underlying procedures for undertaking these regulatory activities. ARPANSA are currently considering what certification might be appropriate for their regulatory functions.

13.2. ARPANSA's Regulatory Assessment Principles require an applicant for a licence to demonstrate that adequate steps have been taken for quality assurance of its nuclear facilities. The relevant principles are:

- The operating organisation has a formal QA program in place that is applied at each of the stages in the life of the facility (Principle 13);
- The operating organisation has a recognised quality practices accreditation that is applied to the facility (Principle 14); and
- Design specifications, drawings, test, inspection and maintenance specifications and procedures are current and reflect the status of the facility at all stages in its life (Principle 15).

Factual Compliance

HIFAR up until Closure in January 2007

13.3. A formal HIFAR quality assurance program has existed since May 1997, and certification to AS/NZS ISO 9001-1994 has been given to the HIFAR quality systems. In subsequent years the HIFAR Quality System certification was recertified as compliant to the AS/NZS ISO 9001:2000 standard. This certification covers all the activities associated with the operation, maintenance and modification of the reactor which may have an influence on the safe operation of the reactor.

OPAL

13.4. The administrative control of the OPAL reactor is undertaken in accordance with the OPAL Business Management System (BMS). The system has been developed under the umbrella of the ANSTO Business Management System (ABMS) and encompasses ANSTO policies, overarching processes and supporting guidance. Both systems meet and are certified to the ISO 9001 quality system (BMS was first certified in October 2005 and recertified for three years in July 2007).

13.5. The head document of the BMS is the *OPAL Reactor Operations Business Management System Manual*, and below this lie the range of design manuals, procedures, instructions, and forms for all operations and maintenance activities. The instructions include response to alarms and emergency operating instructions. All the BMS documentation available at the time of the granting of the OPAL operating licence was reviewed by ARPANSA, and an OPAL Operational Readiness Assessment (RB-RAR-43-06) was prepared.

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;

Formal Compliance

14.1. Throughout the lifecycle of a facility, the ARPANS Act and Regulations require an applicant (operating organisation) to submit an updated safety case whenever an application for a facility licence with a new authorisation is submitted. The safety case must demonstrate. *inter alia,* that a facility will comply with the prescribed radiation dose limits, and radiation exposures are kept as low as reasonably achievable (ALARA) throughout its life. In particular the regulations require that:

(a) For siting, the safety case includes a detailed site evaluation, a consideration of the extent to which the site may be affected by natural and man-made events and environmental impact assessments as required by government agencies.

(b) For construction and operation, the safety case includes the design information for the facility, including the operational limits and conditions within which the facility must operate, and a safety analysis that is documented in a safety analysis report (SAR).

(c) For possession or control, the safety case includes the arrangements for safe storage of controlled material and maintaining the controlled facility.

(d) For decommissioning and abandoning a controlled facility, the safety case includes the decommissioning plans and results (respectively) and the details of any environmental monitoring program proposed for the site.

14.2. ARPANSA's Regulatory Assessment Principles (RAPs) list the safety analysis principles which apply to a nuclear installation before its construction and commissioning and during each principal stage in the life of a facility when an application for licence is being assessed. The relevant principles are Principles 17 to 38. Further details on the implementation of the principles are provided in the regulatory guidance documents (RB-STD-43-00 - *Regulatory Assessment Criteria for the Design of New Controlled Facilities and Modifications to Existing Facilities* and RB-STD-15-03 *Regulatory Guideline on Review of Plans and Arrangements*).

14.3. The "preliminary SAR" (PSAR) must be included in an application for a facility licence authorising the construction of a facility. A "final SAR" (SAR Rev. 0) is an updated version of the PSAR and must be submitted when applying for a facility licence authorising operation of a facility. The PSAR and FSAR are thus progressive versions of one SAR. The SAR is a living document that requires updating throughout the life of the facility (including the decommissioning stage) to reflect its current state.

14.4. The SAR must contain a categorisation of all hazards in terms of whether there is potential for significant consequences to occur outside the facility but within the site, or outside the facility and the site. In addition, the SAR must include deterministic safety analyses at several defence-in-depth levels to determine if the safety limits and objectives will be met for design-basis accidents; probabilistic assessment may supplement deterministic assessment of design-basis and beyond-design-basis accidents. The principles require that the operational limits and conditions (OLCs) be determined from the safety analyses (Principle 63).

14.5. The ARPANS regulations also require prior approval of the CEO before making a relevant change[15] with significant implications for safety.

Factual Compliance

Moata Reactor

14.6. No further safety analyses for the Moata reactor have been submitted since a facility licence authorising decommissioning was issued by the CEO of ARPANSA in 2001. This licence authorised only a small range of decommissioning activities. Authorisation for further stages of decommissioning will require ANSTO to seek the prior approval the CEO of ARPANSA.

HIFAR reactor

14.7. To comply with a licence condition imposed on the facility licence authorising operation of HIFAR, a revision of the HIFAR SAR was submitted to the CEO of ARPANSA in 2002. It addressed plant changes, safety analyses completed since the last revision, results of the PSA and analyses demonstrating to ARPANSA's satisfaction the safety of using low-enriched uranium (LEU) fuel in HIFAR. Further details of this assessment are available in Australia's report to the third review meeting.

14.8. On 18 May 2007, ARPANSA received an application from the ANSTO for a facility licence under the ARPANS Act 1998 authorising it to possess or control the High Flux Australian Reactor (HIFAR). The application is the first step in the regulatory process leading to the eventual decommissioning of the reactor. As part of the application, ANSTO proposes to measure and map the level of radioactivity in structures, systems and components of the reactor. In the longer term, it is anticipated that the organisation will apply for a further licence to decommission the reactor. Public submissions on the application closed on 3 August 2007 and the application is still being assessed. The complete applications and updates on the process are available on the ARPANSA website[16].

OPAL Reactor

14.9. The PSAR submitted in May 2001 as part of the application for a facility licence authorising construction of the OPAL reactor was revised into the SAR Rev. 0 during the detail engineering, construction and commissioning phases to provide a basis for the facility licence authorising the operation of the OPAL reactor. The

[15] This includes changes to plans and arrangements that form part of the application for a licence.

[16] http://www.arpansa.gov.au/Regulation/hifar/index.cfm

SAR Rev. 0 was submitted in the third quarter of 2004 as part of the application for an Operating Licence. Further revisions of the SAR will be submitted as indicated in paragraph 7.9 above.

14.10. The facility licence authorising construction of the OPAL reactor was subject to additional licence conditions. Those additional licence conditions that related to the assessment and verification of safety were described in the 2004 report. All of these licence conditions were complied with by ANSTO and the outcomes of that compliance was taken into account in the CEO of ARPANSA's decision to issue a facility licence authorising ANSTO to operate the OPAL reactor in July 2006.

14.11. The SAR revision together with the specific Requests for Approval for construction (RFA) under Regulation 54 and Special Licence Condition 4.6 for systems, structures and components important to safety formed the main safety review task of ARPANSA during construction from April 2002 until the issue of the Operating Licence in July 2006. Regulation 54 and Special Licence Condition 4.6 required ANSTO to apply for prior approval to construct an item important for safety that was identified in the SAR as part of the construction of the facility. The term "Items important for safety" was interpreted as systems, structures and components identified in the application as safety category 1 or 2. Construction included the manufacture, installation and cold commissioning of these items. In practice, for any major reactor systems, there were usually a number of related requests for approval for construction and the timing of the submission was determined by the detailed OPAL construction schedule. This was affected by such factors as the lead times for acquisition of materials or components, whether items were to be embedded in the structure and so forth.

14.12. For each OPAL RFA (131 in total over 4 years), ANSTO submitted information in a standard format that addressed the relevant part of the PSAR submitted as part of the facility licence authorising construction of the OPAL reactor and identified any variations from it in terms of materials used, codes and standards, equipment function or other aspects. The approval process also identified relevant recommendations that had been made in the ARPANSA regulatory review report associated with the facility licence authorising construction of the OPAL reactor (RB-ASR-09-02 –April 2002).

14.13. ARPANSA considers that comprehensive and systematic safety assessments were carried out before the construction of the OPAL reactor and were maintained during the construction and commissioning phases.

14.14. The facility licence authorising ANSTO to operate the OPAL reactor imposes a licence condition that requires that periodic safety reviews be conducted. The first such review is to be undertaken within two years of the completion of commissioning and then every ten years thereafter. The licence requires that the first review include a revision of the Safety Analysis Report.

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.

Formal Compliance

14.15. The ARPANS regulations require the licence-holder to ensure that they comply with the plans and arrangements for managing safety that are mentioned in the application. The RAPS and the underlying guidelines used for application assessments require that the application include arrangements for regular inspection and maintenance by the operating organisation.

14.16. ARPANSA conducts regular physical inspections of the nuclear reactors at ANSTO. In addition to physical inspection and verification, these inspections may also include audits of documents that relate to maintenance and testing undertaken by ANSTO.

Factual Compliance

HIFAR before Closure in January 2007

14.17. ANSTO demonstrated to ARPANSA's satisfaction that it carried out a program of maintenance, periodic testing and inspection activities to verify that HIFAR, including its irradiation rigs and experiments, could be operated safely in accordance with design manuals.

14.18. Functional testing of HIFAR was routinely carried out to ensure that the minimum plant configuration, safety performance requirements, and the safety conditions as specified in the OLCs were satisfied. The arrangements for these activities, which were carried out in accordance with written procedures, were presented and results reported for regulatory review. Appropriate modifications were made to incorporate any operational experience.

14.19. The program of HIFAR maintenance and periodic testing and inspection was reinforced by work undertaken in a major reactor shutdown every four years to undertake tests and inspections that could not be undertaken during routine refuelling shutdowns. There was no major shutdown following 2004, as the reactor was shut down for the final time in January 2007.

14.20. ARPANSA considers that the arrangements contained in the HIFAR operating procedures for regular reviews and updates provided an acceptable process for maintaining the safety case.

OPAL Reactor

14.21. A staged approach was adopted for the commissioning of OPAL, commencing with testing each system and component individually (Pre-Commissioning); extending to testing the integration of all systems and components without nuclear fuel in the core (Stage A or cold commissioning) and finally testing with fuel in the core (Stage B and C or hot commissioning.

14.22. During Stage A Commissioning, ARPANSA inspectors witnessed all the Safety Category 1 tests and many Safety Category 2 tests, the nucleonic signals were simulated and dummy fuel assemblies were used. An IAEA peer review of the cold commissioning proposals was undertaken in February 2005 and an ARPANSA report on cold commissioning was prepared (RB-RAR-11-06). This information on cold commissioning and the ANSTO/INVAP Cold Commissioning report (RRRP-7311-EDEIN-004-B) received in May 2006 informed the July 2006 decision of the CEO of ARPANSA to issue an operating licence.

14.23. ARPANSA reviewed the proposals for Hot Commissioning as part of the advice to the CEO ARPANSA on the issue of a facility licence authorising ANSTO to operate the OPAL reactor (RB-RAR-37-06). The ARPANSA reviewers indicated that they were satisfied that the organisational, management and quality arrangements were consistent with IAEA and ARPANSA guidance on commissioning and that it represented best practice for commissioning of research reactors. ARPANSA inspectors witnessed all the Safety Category 1 tests and many Safety Category 2 hot commissioning tests, and were present for all the key hot commissioning milestones such as first criticality, low power operation, and the power ascension stages up to the full power of 20 megawatts.

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.

Formal Compliance

15.1. The object of the ARPANS Act 1998 is to protect the health and safety of people, and to protect the environment from the harmful effects of radiation.

15.2. Division 5.2 of the ARPANS Regulations provides the statutory effective dose limits, based on the National Standard for Limiting Occupational Exposure to Ionising Radiation and other recommendations of the National Health and Medical Research Council (in turn based on ICRP 60:1991), with which all licence holders must comply. These limits are:

- 20 mSv annually, averaged over five consecutive calendar years for occupational exposure. However, the effective dose for an occupationally exposed person must not, in a year, be more than 50 mSv.
- 1 mSv annually for public exposure (this includes unborn children).

15.3. It also mandates that radiation protection and safety be optimised to ensure that:

- the magnitude of individual doses;
- the number of people who are exposed; and
- the likelihood of incurring exposures to radiation

are as low as reasonably achievable, and optimised in accordance with the requirements of the ARPANSA *Recommendations for Limiting Exposure to Ionising Radiation*.

15.4. In addition to the dose limits above, the RAPS provide that the applicant should establish, in agreement with the CEO of ARPANSA a dose constraint for the facility that does not exceed the statutory dose limit. The principles note that optimisation is not required where it can be shown that the annual occupational and public doses from a facility do not exceed 2 mSv and 0.02 mSv respectively.

15.5. The principles also require radiation protection to be considered for occupational and public exposures in the design and operation of the facilities, including in the development of a radiation protection plan.

15.6. The Regulatory Guidelines provide a guide for implementing radiation protection in the facility, including recommendations on the type of equipment to be used to monitor radiation in work areas and recommendations on how to minimise radiation exposure by design.

15.7. ARPANSA monitors whether ANSTO ensures throughout the life of a facility that radiation doses arising from normal operation and anticipated operational occurrences do not exceed the statutory effective dose limits described above in

paragraphs 15.2 and 15.3 and the dose constraints agreed with the CEO as discussed in paragraph 15.4.

Factual Compliance

HIFAR up until Closure in January 2007

15.8. ANSTO operates an ALARA program based on the following principles:

- all radiation exposures to be ALARA;
- all operations involving ionizing radiation doses above 2.0 mSv/y for occupationally exposed persons and 0.02 mSv/y for others shall be assessed to evaluate potential for dose reduction;
- no occupationally exposed person shall receive more than 15 mSv/year; and
- No members of the public shall receive more that 0.3 mSv/y

For ANSTO reactor operations, these dose constraints have been met during the period since the last report.

15.9. The following tables show the effective doses received by five HIFAR staff groups over the period 2004/05 to 2005/06.

Effective dose for HIFAR staff groups: 2004-2005

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators and Shift Superintendents	88	3.3	6.14
Active Handling Personnel	32	4.0	5.41
All HIFAR personnel	157	1.6	6.14

Effective dose for HIFAR staff groups: 2005-2006

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators and Shift Superintendents	109	3.5	6.55
Active Handling Personnel	39	4.9	6.91
All HIFAR personnel	178	1.8	6.91

15.10. The above tables show that a small number of ANSTO staff in HIFAR received doses slightly above the ANSTO objective value of 2 mSv for average effective dose, above which radiation exposures must be demonstrated to be ALARA.

15.11. ARPANSA considers that documented procedures on radiological safety for HIFAR are extensive and a good model for other facilities at ANSTO.

OPAL Reactor

15.12. The OPAL radiation protection programme was included in Part B of the Submission for an Operating Licence. Chapter 12 of the SAR described operational radiological safety. A Radiation Protection Advisor is the leader of a group of radiation protection personnel, including health physics surveyors, working in the OPAL reactor. It is expected that the doses associated with OPAL operations will be lower than those associated with HIFAR, given:

- the shift operating crew are outside the containment; and
- the design provisions of OPAL to limit operational exposure, particularly the cooling with light water rather than heavy water and the associated reduction in airborne tritium.

15.13. OPAL has not had much operating experience to date. The doses reported in quarterly reports to date are shown below, but they represent doses arising predominately from Hot Commissioning operations rather than from normal full power operations.

Effective dose for OPAL staff groups: 2006-2007

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Shift Managers and Reactor Operators	4.97	0.23	0.49
Utilisation Operators	6.05	0.55	1.51
All OPAL personnel	28.71	0.38	1.67

15.14. The doses received by OPAL personnel for the year 2006-2007 are not necessarily indicative of doses during routine OPAL operations. As OPAL moves from Commissioning into full operation, the doses may change significantly in the coming years, due to the change in the nature of the work.

Article 16 – Emergency Preparedness

1. 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.

2. 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.

Formal Compliance

16.1. The ARPANS Regulations prescribe the need for emergency plans to be included as part of an application for licence. The ARPANSA Regulatory Assessment Principles address the various aspects of the emergency plans, procedures and preparedness to be assessed in reviewing the plans and arrangements (Principles 122 and 123). These cover operating licences for existing installations, as well as siting and construction licences for new installations.

16.2. The Regulatory Guideline on the review of plans and arrangement of management systems covers emergency planning as one of the plans for effective control and management of safety under, incidents and accident conditions. The aspects of emergency preparedness covered in this guideline can be summarised as follows:

(a) Detailed emergency plans for any conduct or dealing, which could give rise to a need for emergency intervention. These plans should be based on an assessment of the consequences of reasonably foreseeable accidents, and should aim to minimise the consequences and ensure the protection of on-site personnel, the public and the environment.

(b) Comprehensive emergency procedures are prepared in accordance with the objectives of the emergency plan for any conduct or dealing which could give rise to the need for emergency intervention.

(c) All external organisations identified in the emergency plan are prepared for such emergencies, and adequate facilities and equipment are available and maintained.

Factual Compliance

HIFAR Reactor up until Closure in January 2007

16.3. ANSTO identified a range of potential accidents in the HIFAR Safety Document. The worst case accident consequences were used as a basis for emergency planning. These arrangements underwent frequent testing in drills and exercises, using HIFAR

severe accidents as the scenario. These arrangements were acceptable to ARPANSA.

16.4. ANSTO developed emergency response procedures, which also include HIFAR specific procedures that are part of the HIFAR Quality System. The HIFAR specific procedures covered the range of anticipated events for HIFAR based on accident analysis of specific event sequences. The ANSTO organisational structure for emergency response and organisational arrangements for HIFAR were also clearly set out. The procedures also included training for emergencies. All HIFAR procedures and instructions were presented in a quality assurance format and included special forms, sign off sheets, check sheets, etc.

16.5. ANSTO usually holds major exercises once every two years, and a HIFAR accident scenario was commonly used. HIFAR's emergency procedures were exercised in more frequent drills and training programs. A significant part of the accreditation and re-accreditation of HIFAR operational staff was familiarity with these emergency procedures. The exercises and drills routinely held in HIFAR included the testing of a range of equipment in the HIFAR Emergency Control Room (ECR).

16.6. ARPANSA considered the emergency plans and procedures for HIFAR to be acceptable for the purposes of Article 16 of the Convention.

OPAL Reactor

16.7. ANSTO submitted an OPAL Reactor Emergency Plan as part of the Application for a facility licence authorising it to operate the OPAL reactor. The emergency plan is also covered in Chapter 20 of the OPAL Safety Analysis Report. The plan places responsibility for testing and review of the plan on the OPAL Reactor Manager, and indicates that there would be a major exercise every two years, with emergency drills proposed more frequently.

16.8. The operation of the OPAL Emergency plan was observed by ARPANSA inspectors during Cold Commissioning and the review of OPAL emergency plans, procedure and level of preparedness was an important part of the Opal Research Reactor Operational Readiness assessment (RB-RAR-43-060). The approach used has some differences to that that emerged for HIFAR over the years. In particular, the OPAL emergency guidance procedures have replaced the HIFAR event-based emergency procedures with a symptom-based emergency management system. This is based on the OPAL SAR and the identification of a limited number of common treatable consequences. These consequences form the basis of the OPAL emergency operating instructions (EOIs), which will be implemented following an incident.

16.9. In issuing the facility licence authorising ANTO to operate the OPAL reactor, the CEO of ARPANSA found that the EOIs are sufficient to ensure the safe operation of OPAL. However he noted an expectation of improvement in the EOIs in the light of some operating experience accompanied by a program of tests and drills monitored by ARPANSA inspections.

ANSTO Site as a Whole

16.10. The adequacy of the interfaces with government, local authority, and off-site agencies and public information is routinely discussed with key agencies at the ANSTO Local Liaison Working Party. This involves discussions on exercises,

public information and changes to emergency plans or arrangements. The ANSTO general emergency plans and arrangements are available in the local public libraries.

16.11. ANSTO's emergency plans are part of a Disaster Plan (DISPLAN) of the State of New South Wales. The DISPLAN has been developed and accepted by relevant agencies including the NSW Police, and State Emergency Services. Review of the plans is ongoing and regular meetings of the relevant agencies are held to plan exercises and discuss changes. There is also a specific sub-plan covering an incident at ANSTO, which foresees evacuation of a 3 kilometre radius around the site.

16.12. Assessments of the radiological consequences of acts of sabotage and terrorism in relation to OPAL have been undertaken by ANSTO and reviewed by ARPANSA. It has been concluded that the current emergency plans and arrangements, including adoption of the WHO guidelines for the dissemination of iodine tablets, provide adequate protection of the public for such events.

16.13. The geographical isolation of Australia from neighbouring States precludes any possibility that an emergency in an Australian nuclear installation will impact on the population of neighbouring States. However, 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 competent authority in the event of a nuclear or radiological emergency and, presently, ANSTO is the national warning point. ARPANSA has established an emergency coordination centre at its Melbourne offices. Both ANSTO and ARPANSA would provide resources and expert advice in the event of an emergency. The Australian Bureau of Meteorology provides the Regional Specialised Meteorological Centre for Region V (Australia/South East Asia) in the IAEA/World Meteorological Organisation (WMO) Emergency Notification and Assistance Network.

3. 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.

16.14. The geographical isolation of Australia from neighbouring State currently operating a nuclear installation precludes any possibility that an emergency in such an installation will impact on the population Australia. Nevertheless, 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 and has appropriate precautions in place in relation to radiation emergencies in other countries, including the monitoring of imported foodstuffs[17].

[17] Should an incident occur, the Australian Customs Service has the capability to monitor imported foodstuffs originating from the affected area.

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;

Formal Compliance

17.1. The ARPANS Act and Regulations provide requirements that an application must satisfy before the CEO of ARPANSA will issue a Facility Licence authorising preparation of a site for a nuclear facility, including the requirement to take into account international best practice in radiation protection and nuclear safety. ARPANSA's Regulatory Assessment Principles and Siting Guideline identify matters that should be addressed in such an application. These are specified at two levels of defence in depth. At defence in depth level 1, applicants must take into account site characteristics which may impact on the safety of the installation (Principle 54). These site characteristics are:

(a) The site's seismology, geology, topography, demography (population distribution and existing population centres), ecology, hydrology, and meteorology;

(b) The effect of nearby facilities and land usage;

(c) The availability and reliability of offsite services such as electricity, water, transportation, and communication systems; and

(d) The feasibility of emergency response.

17.2. Siting assessment principles are also provided at defence in depth level 5 to address off-site radiological consequences that might result from the failure of steps taken at defence in depth levels 1 to 4 to protect the public and the environment from a beyond-design basis accident. The principles are as follows:

(a) Siting assessment to be performed early in the planning stages of a proposed facility, so that the selected site provides adequate protection of individuals, society and the environment against hazards arising from potential accidents at the facility (Principle 117);

(b) If a detailed design is not yet established, the siting assessment is to be based on a reference design for the facility, and the assessment determines the consequences of a postulated accident called the Reference Accident, which involves some degradation of the safety systems of the reference design for the proposed facility, and includes conservative assumptions on the release of radioactive materials (Principle 118);

(c) The consequences of the Reference Accident are determined for meteorological conditions which result in the maximum consequences of the accident, but which no less than 10% of the time. For these consequences, it is determined that:

- Emergency intervention would be feasible at any location around the site, at the intervention levels agreed with ARPANSA.
- The maximum collective effective dose would be less than 200 person Sv.
- The long-term use of any land surrounding the site would not be disrupted due to radioactive contamination (Principle 119).

(d) In calculating collective effective doses, no allowance is made for the imposition of short-term emergency interventions. A calculation cut-off may be set so those individual doses representing very low levels of risk are not included in the collective dose (Principle 120); and

(e) Where the siting assessment has been based on a reference design of a proposed facility, the Reference Accident is compared to the analyses of the final design in the SAR, to check the validity of the siting assessment (Principle 121).

17.3. ARPANSA also has a regulatory assessment document (Criteria for the Siting of Controlled Facilities) that is used to assess application for the siting of new nuclear facilities. This document was used to assess the siting of the OPAL reactor - see below). These principles and siting criteria are based on international standards and recommendations, particularly those of the International Atomic Energy Agency (IAEA), and the contemporary practices in the nuclear industries of developed countries.

17.4. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains provisions that prohibit persons from undertaking "nuclear actions" which might have a significant impact upon the environment without the consent of the Minister for the Environment. The definition of "Nuclear actions" includes establishing or significantly modifying a nuclear reactor, such as decommissioning. The Act lays out principles for the assessment of whether a "nuclear action" should be approved.

Factual Compliance

HIFAR Research Reactor up until closure in January 2007

17.5. The HIFAR Safety Document (HSD) and HIFAR Probabilistic Safety Analysis (PSA) considered external events from both natural and human sources related to the Lucas Heights Site. Both the HSD and the PSA identified that the main external hazard was a seismic incident. The previous national report noted that a probabilistic seismic hazard assessment for the HIFAR site had been undertaken and resulting in an upward revision of the seismic criterion (safe shutdown earthquake) for the re-assessment of HIFAR systems, structures and components from 0.2g to 0.37g. .A subsequent re-assessment of HIFAR against the revised seismic level showed that it was unlikely that a loss of coolant accident would result from such a situation. All modifications undertaken on HIFAR subsequent to the last national report were assessed against the new limit of 0.37g.

17.6. The assessment of the proposal to decommission and dismantle HIFAR at Lucas Heights will require an environmental approval under the *Environment Protection and Biodiversity Conservation Act* and a decommissioning licence under the *ARPANS Act*[18]. Those processes will ensure that the re-evaluation of factors required under this Article is undertaken.

OPAL Research Reactor

17.7. In its application for a licence to prepare the site for the OPAL reactor, ANSTO demonstrated to ARPANSA's satisfaction[19] that the Lucas Heights site is suitable for the construction and operation of a reactor facility, while providing adequate protection of the health and safety of people and the environment. ANSTO demonstrated that:

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

17.8. On 22 September 1999 ARPANSA issued a facility licence authorising ANSTO to prepare the site for the OPAL reactor. The Siting Licence was surrendered by ANSTO in July 2003[20].

17.9. The environmental assessment of the proposal to site a replacement research reactor at Lucas Heights was undertaken under the *Environment Protection (Impact of Proposals) Act 1974*[21] and included the preparation of an environmental impact statement, the consideration of public submissions and an independent assessment involving international experts from the IAEA and elsewhere. As a result of that process, the Minister for the Environment approved the proposal, subject to a number of conditions. ANSTO made six-monthly reports to the Minister (which were subsequently made public) on the implementation of the conditions. In mid-2006, the Minister indicated his satisfaction that the conditions had been implemented satisfactorily and removed the requirement for ongoing reporting.

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.

[18] The decommissioning will also require a permit under the *Nuclear Non-proliferation (Safeguards) Act 1987*, but this permit does not relate directly to the radiation protection, nuclear safety or environmental impact aspects of the proposed activity.

[19] See http://www.arpansa.gov.au/Regulation/opal/siting.cfm for an outline of the site licensing process and significant documents.

[20] Further details of the site licensing process, including a the assessment of the reference accidents for the site, are contained in the Australian National Report to the 3rd Review meeting.

[21] The predecessor of the *Environmental Protection and Biodiversity Conservation Act 1999*.

17.10. Due to Australia's geographical isolation and the small power level of the reactors, the operation of the existing and the proposed nuclear facilities in Australia will not affect any other Contracting Parties or other neighbouring countries. However, 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, and would provide appropriate information to neighbouring countries in the event of an accident.

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;

Formal Compliance

18.1. The ARPANS Act and Regulations provide requirements that an application must satisfy before the CEO of ARPANSA will issue a Facility Licence authorising construction of a nuclear facility, including the requirement to take into account international best practice in radiation protection and nuclear safety. ARPANSA's Regulatory Assessment Principles and its Criteria for the Design of New Facilities are structured in terms of defence in depth. In addition there is regulatory guidance document (RB-STD-43-00) on assessment criteria for the design of new controlled facilities and modifications to existing facilities. Much of the design guidance is an extension of the RAPs principles and where criteria are specific to nuclear reactors this is noted in the text.

18.2. There are five levels of defence-in-depth. The first four levels are oriented towards the protection of barriers and mitigation of releases. The last relates to off-site emergency response. Each higher level of defence-in-depth should mitigate the effects of the failure of any lower level of defence-in-depth. The proper functioning of the defence-in-depth concept therefore relies on the physical separation of the structures, systems and components that effect each level of defence. Depending on the hazards identified in the safety analysis for the facility, the number of levels may be less than five. For example, in the case of facilities where there is no significant hazard outside the facility the fifth level of defence in depth would not be required. In the case of both HIFAR and the OPAL reactor, ARPANSA considered the risks of off-site consequences to be sufficient to require the safety management plans for both reactors to consider all five levels of defence-in-depth.

18.3. The Regulatory Assessment Principles (Principle 2) require defence in depth to be implemented at nuclear facilities to provide diverse layers of protection at successive levels, as shown below:

Level	Objective	Means
1	Prevent failures and ensure that anticipated operational occurrences/disturbances are infrequent.	Conservative, high quality, proven design and high quality in construction
2	Maintain the intended operational states and detect failures.	Process control and limiting systems, other surveillance features and procedures.
3	Protect against design-basis accidents.	Safety systems and accident procedures.
4	Limit the progression and mitigate the consequences of beyond-design-basis accidents.	Accident management and mitigation.
5	Mitigate the radiological consequences of beyond-design-basis accidents.	Off-site emergency response.

18.4. The need for proven engineering practice and standards in the siting, design, manufacture, construction, installation, commissioning, inspection, training, operation, testing, maintenance, modification, criticality control, life extension, and decommissioning of a facility is specifically stated as a regulatory assessment principle 46.

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.

18.5. ARPANSA's Regulatory Assessment Principles highlight the need to take into account human factors at the design stage (at defence in depth level 1). These principles are:

- 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 (Principle 48);
- Safety systems at nuclear reactors are designed to be automatically initiated and to require no immediate operator action within thirty minutes, while permitting operator initiation or action where necessary to ensure or enhance safety (Principle 49);
- Control and control room layout provides ergonomic disposition of data and controls for actions important to safety, including accident management (Principle 50);
- Diagnostic aids are provided to speedily resolve questions important to safety and to monitor the status of the facility (Principle 51);
- A reliable and redundant communications system is provided for all operations staff (Principle 52); and
- Maintenance and inspection aspects such as access are considered in the design of equipment and systems (Principle 53).

Factual Compliance

HIFAR Research Reactor up until Closure in January 2007

18.6. The factual compliance of HIFAR with respect Article 18 has been discussed in previous national reports. The most significant change to the HIFAR from the facility that a licence was issued in respect of in 2001 was the move to LEU fuel. The LEU Fuel project concluded in May 2005. This project is summarised in paragraph 19.4.

OPAL Research Reactor

18.7. OPAL was designed and constructed to comply with the ARPANS Act and Regulations, ARPANSA's Regulatory Assessment Principles and Guidelines, IAEA Safety Series Standards and Guides relevant to research reactors and appropriate nuclear and industrial standards. A general description of the design is at Annex 1.

18.8. ARPANSA issued a Facility Licence authorising ANSTO to construct the OPAL reactor in April 2002 after review and assessment of ANSTO's Application for a construction licence, including its Preliminary Safety Analysis Report. ARPANSA closely monitored the construction process, including the fulfilment of Licence Conditions (see Article 14 for a summary of the conditions).

18.9. Assessment of the SAR together with reviewing the specific Requests for Approval (RFA) for construction under regulation 54 and Licence Condition 4.6 for systems, structures and components (SSC) important to safety were the main review tasks for ARPANSA during the period from submission of the last report until the issue of the Operating Licence in July 2006. In practice for any major reactor system there were usually a number of related RFAs, and the timing of the submission was determined by the detailed OPAL construction schedule. This was affected by such factors as the lead times for acquisition of materials or components, and whether items were to be embedded in the structure and so forth.

18.10. For each OPAL RFA for construction (131 in total over 4 years), ANSTO submitted information in a standard format that addressed the relevant part of the PSAR submitted as part of the Construction Licence and identified any variations from it in terms of materials used, codes and standards, equipment function or other aspects. The RFA process also identified relevant recommendations that had been made in the ARPANSA regulatory review report associated with the OPAL Construction Licence (RB-ASR-09-02 –April 2002).

18.11. ARPANSA imposed a number of additional licence conditions during the four year RFA process in areas of construction considered of safety importance. An example was the requirement that all butt welds in the primary coolant system piping and tanks must be subject to 100% Radiograph or Ultrasonic inspection.

18.12. Changes emerged as the OPAL detailed engineering design was finalised and fabrication and installation methods were considered. These changes were captured under the OPAL quality assurance systems of ANSTO and INVAP, and recorded as part of the OPAL reactor "as built" design and plant case history. The most significant approvals for changes were:

- Redesign of the flap valves and siphon effect breakers in the primary and pool services cooling system;

- Change of the control rod material from silver-indium-cadmium to hafnium;
- Deletion of the reactor trip on loss of pneumatic target cooling.
- Revised design of the containment windows, specifically the main control room windows, the meeting room window overlooking the main reactor hall and the windows of the above-pool hot-cell complex; and
- Change of the Final actuation Logics of the Reactor Protection System (RPS) to achieve better physical separation between RPS trains and from the Post Accident Monitoring System to be consistent with defence-in-depth principles.

18.13. The ARPANSA review of OPAL construction is described in report RB-RAR-27-06, and the ARPANSA review of the design as described in the safety analysis report and the various RFAs is described in report RB-RAR-46-06.

18.14. During the period the facility licence authorising construction was in force, ARPANSA inspectors carried out over 230 inspections for the purpose of monitoring compliance with the construction licence. These included inspections of site preparation, civil works, manufacture, assembly and installation of safety category 1 and 2 structures, systems and components, performance of tests and inspections, quality documentation review, and the commissioning of many items and systems. Inspections were also undertaken at witness points for key stages such as concrete pours of the reactor block

18.15. Factual compliance of the OPAL design and construction with Article 18 (including reliable, stable and easily manageable operation) was achieved satisfactorily as indicated in the CEO of ARPANSA's "Statement of Reasons" to issue a facility licence authorising ANSTO to operate the OPAL reactor in July 2006.

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;

Formal Compliance

19.1. As part of its assessment of a facility licence authorising operation, ARPANSA undertakes a detailed assessment of an applicant's general, site-wide, plans and arrangements for safety. The licensing assessment process also includes the assessment of the local plans and arrangements for the management of each conduct and dealings at the facility in question.

19.2. The Act provides that the CEO may at any time require information from the applicant additional to that outlined in the Act and Regulations to facilitate the assessment of a licence application. In a letter of 17 December 2003, the CEO set out his expectations for an application for a facility licence authorising ANSTO to operate OPAL. A listing of relevant ARPANSA and IAEA documents, including ARPANSA guidance on commissioning of reactors, was given and is provided at Annexe 4.

Factual Compliance

HIFAR up until Closure in January 2007

19.3. HIFAR continues to be authorised under its existing facility licence authorising operation. The ongoing maintenance of the ageing HIFAR, the obsolescence of components and the revised criteria including the seismicity discussed in Paragraph 17.5 has resulted in modifications of the reactor systems, structures and components during the past reporting period.

19.4. The most significant request for approval of a modification assessed by ARPANSA during this period was ANSTO's submission covering the conversion of the reactor core from HEU to LEU fuel. The LEU fuel elements used in HIFAR were designed and manufactured to be identical in geometry to their HEU predecessors and have almost identical criticality characteristics. ARPANSA was satisfied with ANSTO's arguments that no changes to the Safety Case were therefore required. Accordingly no structural changes to the core or associated systems, structures or components were required and only minor changes to the OLCs to reference the new fuel type were required. This allowed the change over to LEU fuel to be conducted in a step-wise fashion, with one HEU fuel element being replaced with an LEU element when a fuel change was required. ARPANSA monitored the initial stages of the change over to ensure that the actual results were consistent with those predicted in ANSTO's application for approval. The first LEU element was introduced into the core on 28 October 2004. On 23 May 2005 the 25 element core contained 6 LEU elements, at which stage the results of the evaluation were deemed satisfactory by

both ANSTO and ARPANSA. The number of LEU elements in the HIFAR core continued to be increased such that it operated with a complete core of LEU from May 2006 up until final shutdown.

19.5. Prior regulatory approval was necessary for this and for other Safety Category 1 changes. In many cases, ARPANSA inspectors witnessed the commissioning tests of Safety Category 1 modifications, and were provided with copies of the commissioning reports and test results.

OPAL

19.6. On 13 September 2004, ARPANSA received an application for a facility licence to authorise operation of the OPAL reactor. The application contained general information (Part A), plans and arrangements for managing safety (Part B), the safety analysis report (SAR) with associated safety and licensing documents (Part C), and the plans and arrangements for Hot Commissioning (Part E). The OPAL operational limits and conditions (Part D) were received in October 2004.

19.7. The review process was completed in July 2006, and included an ARPANSA assessment of the entire application. The ARPANSA staff assessment is described in a number of working documents that cover the review of the safety analysis report, the review of OPAL operational readiness as the OPAL BMS documentation became available, the review of OPAL construction (including ARPANSA inspector reports), the review of Cold Commissioning results, and finally the review of the OPAL Hot Commissioning proposals. ARPANSA staff reviews included external expert reviews in selected areas.

19.8. ARPANSA's Nuclear Safety Committee (NSC) is a statutory body established by the ARPANS Act. Consistent with the Committee's role, in November 2004 the CEO requested it review and advise upon aspects of the application, in relation to

- the plan for maintaining effective control of the facility in Part B of the Application and the conduct of operations in Chapter 13 of the Safety Analysis Report addressing:
    - organisational structure; safety management systems; lines of communication; delegations; accountabilities; resource requirements
    - roles, responsibilities and authorities, and associated competency requirements; and qualifications, training and accreditation processes for personnel.
- the management of spent fuel and radioactive wastes in relation to:
    - the advice and recommendations provided by the Committee in its report of February 2002; and
    - the adequacy of the Radioactive Waste Management Plan and the Ultimate Disposal or Transfer Plan.

19.9. The NSC established two working groups to deal with:

- conduct of operations and
- management of spent fuel and radioactive wastes.

19.10. The working groups met on a continuing basis from November 2004 to July 2005. A draft report from each working group was considered at a meeting of the full NSC in

23 July 2005. The final report to the CEO, dated 27 September 2005 consists of the completed reports of the two working groups and was endorsed by the whole NSC.

19.11. The report was forwarded to ANSTO for comment on 1 November 2005 and received a response on 5 December 2005. The NSC report is available on the ARPANSA website[22]. The NSC considered the ANSTO response at its meeting in February 2006. The members felt that the response from ANSTO had justified the value of the report. They sought one matter to be followed up concerning the relationship shown between the ANSTO safety committees. This matter was concluded at the NSC's meeting on 16 June 2006.

19.12. In addition to the detailed technical assessments described above, there was, consistent with the ARPANS Regulations, a public submission process which was completed in March 2006 and a public forum in December 2005 involving national and international nuclear safety experts. An IAEA peer review of the OPAL operating procedures was undertaken in March 2005 November-December 2005. The reports from these processes were published in May 2005 and February 2006 respectively and are available on the ARPANSA website[22]. An assessment of the OPAL application against the IAEA *Code of Conduct on the Safety of Research Reactors (2004)* and is included in the CEO's statement of reasons for his decision on the OPAL operating licence.

19.13. By taking into account all the considerations outlined above, the CEO's decision to issue an Operating Licence in July 2006 took into account all of the aspects required by legislation. The reasons for the 18 month period taken to authorise operation were that many construction activities (see Article 18) continued up to June 2006, and the official Cold Commissioning results and report, required by ARPANSA before the approval of an OPAL Operating Licence, were not received until May 2006. ARPANSA inspectors however had closely monitored the Cold Commissioning, which began in February 2006, and were able to keep the CEO informed of the results as they occurred via a separate internal reporting process.

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;

Formal Compliance

19.14. The ARPANS Regulations (Schedule 3 Part 1) require an applicant to provide the operational limits and conditions (OLCs) for the facility mentioned in the application. The Principles emphasise that the OLCs must be determined from the safety analyses (Principle 63). Further guidance on the bases for and the details to be provided in OLCs is provided in the principles and guidelines. The operational limits and conditions that form part of an application for an operating licence, through Regulation 49, become mandatory limits for the operation of the reactor upon issuance of the licence. The ARPANS Regulations oblige the licence holder to review and update any plans and arrangements for managing safety at least once every 12 months (Regulation 50) and provide information on the review to the CEO.

[22] http://www.arpansa.gov.au/Regulation/opal/operating.cfm.

19.15. In addition, under Principle 39, periodic reviews are undertaken to confirm that any changes to the design or operation of the facility do not invalidate the assumptions and conditions on which the safety analyses are based. Any change to the details in the application for a licence or a modification to the facility mentioned in the licence is considered a 'relevant change'. The regulations require a licensee to seek prior approval from ARPANSA prior to making a relevant change with significant implications for safety. Changing an OLC is one such change. The CEO must be informed of all other relevant changes at least every quarter-year.

Factual Compliance

HIFAR up until Closure in January 2007

19.16. There were no compliance issues relating to the HIFAR OLCs during the past reporting period.

OPAL Reactor

19.17. Part D of the Submission for an OPAL Operating Licence consisted of the OPAL Operational Limits and Conditions (OLC). This was a self-standing document and expanded on the OLC description in Chapter 17 of the Safety Analysis Report. Part D also included a separate document that gave the bases for the OPAL OLC. These limits and conditions became mandatory upon the issuing of the operating licence on 14 July 2006 (Paragraph 19.14 refers).

19.18. ARPANSA consider the OLCs to be fundamental to the safe operation of the OPAL reactor, and they were given close attention by the ARPANSA staff reviewers during the assessment process. . The IAEA peer review (see paragraph 19.9 above) noted that the surveillance requirements contained in an earlier draft of the OLC were generally longer than surveillance intervals in other similar research reactors. As a result of the review process, a small number of amendments were made to the OLCs prior to the issue of an operating licence.

iii. operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

Formal Compliance

19.19. The regulations require applications to contain plans and arrangements to ensure the safety of a reactor throughout all stages of its life (Paragraph 14.1 refers). As discussed above, the measures in these plans and arrangements become mandatory once a licence is issued in respect of a particular application. Further details of what are required with respect to safety in the plans and arrangements for operation, maintenance and inspection are provided in the regulatory assessment principles and guidelines.

19.20. In particular the principles address the need for an applicant to demonstrate that inspection, testing and maintenance procedures are documented and implemented; and that such undertakings will ensure the availability and reliability of systems at the levels used in the safety analysis and avoid common cause failure (Principle 65). This Principle necessarily addresses the need for appropriate frequencies of inspection, testing and maintenance tasks, to avoid degradation of safety.

Factual Compliance

HIFAR up until Closure in January 2007

19.21. Before the licence to operate HIFAR was issued in June 2001, ARPANSA assessed that ANSTO had in place adequate plans and arrangements for managing the safety of the operational activities in HIFAR.

OPAL

19.22. The administrative control of the OPAL reactor is undertaken in accordance with the OPAL Business Management System (BMS). The head document of the BMS is the *OPAL Reactor Operations Business Management System Manual*, and below this lies the range of design manuals, procedures, instructions, and forms for all operations and maintenance activities. All the BMS documentation available at the time of the granting of the OPAL operating licence was reviewed by ARPANSA and an OPAL Operational Readiness Assessment was prepared. There were some gaps in maintenance instructions for some systems, and this is being addressed following the issue of the OPAL Operating Licence, with progress being reported to ARPANSA in the quarterly reports submitted in accordance with the conditions of the operating licence.

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

Formal Compliance

19.23. The ARPANSA regulations require the applicant to provide a safety management plan and an emergency management plan, both of which form part of demonstrating formal compliance with this sub-article. Defence-in-depth principles (against which all applications are assessed – Paragraph 18.3 refers) for levels 3 to 5 require the safety management plan to protect against design-basis accidents, limit the progression and mitigate the consequences of beyond-design-basis accidents and mitigate the radiological consequences of beyond-design-basis accidents.

19.24. Applications must demonstrate that limits of normal operation and anticipated operational occurrences, and safety system settings including the minimum plant configuration[23], are determined from safety analyses (Principle 63) and that the operation of the facility will be constrained within the settings of the safety sittings or otherwise shutdown (Principle 64).

19.25. The principles emphasise that at defence in depth level 4 applicants should demonstrate how, to an extent that depends on the conditions and with assistance from equipment, it is possible for operators to diagnose the status of the facility and to make management arrangements. Accident management arrangements may include maintaining or restoring at least one barrier for the confinement of radioactive material. The principles note that accident management arrangements should be based on the outcomes of the safety analysis (Principle 113) and that

[23] Minimum plant configuration: the minimum summary set of reactor systems important to safety (including Engineered Safety Provisions, the Reactor Protection system and the Instrumentation Power Supply System etc) that must be operable during specified reactor states. The Minimum Plant Configuration also defines the maximum allowable time for at each system may be inoperable during any yearly period.

instrumentation important for monitoring the status of the facility and to undertake effective accident management arrangements is regularly inspected, tested and maintained.

19.26. The ARPANSA regulatory guidance document on the review of safety plans and arrangements provides further details on the requirement for emergency preparedness procedures at both the reactor and site level. With regard to accidents with anticipated off-site consequences, the applicant is required to demonstrate their plans are equivalent to emergency plans that

- Are prepared in consultation with public authorities that act on the advice of the operating organisation and ARPANSA;
- Are based on the consequences of accidents considered in the safety analysis report for the facility, which may be complemented by a probabilistic safety analysis;
- consider a range of intervention arrangements; and
- comply with relevant legislation and national and international agreements.

The applicant should also demonstrate that emergency exercises are conducted to test selectively various parts of the response.

19.27. 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.

Factual Compliance

HIFAR up until Closure in January 2007

19.28. ANSTO's documented Event Response System, which is tested regularly, provides response procedures to cover any event involving, or with the potential to involve, radiation exposure or contamination. An "event" includes abnormal occurrence, dangerous occurrence, significant event, site incident, accident, reportable event or a near miss.

19.29. HIFAR had a set of emergency procedures which were based on the set of initiating events, design basis accidents and severe accidents described in the HIFAR Safety Document. The procedures were event based and associated with the indicators and accident response measures to accidents such as a loss of coolant accident (paragraphs 16.3 to 16.6 refer).

OPAL

19.30. ANSTO submitted an OPAL Reactor Emergency Plan as part of the Application for a facility licence authorising operation of the OPAL reactor. The emergency plan is also covered in Chapter 20 of the OPAL Safety Analysis Report. The approach used has some differences to that used for HIFAR. In particular the OPAL emergency guidance procedures have replaced the HIFAR event based emergency procedures with a symptom based emergency management system. This is based on the OPAL SAR and the identification of a limited number of common treatable consequences. These consequences form the basis of the OPAL emergency operating instructions (EOIs), which will be implemented following an incident.

19.31. Within the BMS ANSTO have prepared sixteen procedures dealing with arrangements for specified 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 documents 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. Guidance provided in these documents is very general and relies on the knowledge and judgement of the shift manager. Nevertheless, these arrangements were considered satisfactory for responding to minor deviations that do not fall outside operational limits and conditions.

19.32. Paragraphs 16.7–16.11 provide details about the emergency response arrangements for OPAL and the associated ANSTO site.

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

Formal Compliance

19.33. The regulations require the CEO, in determining whether to issue a licence to an applicant, to consider whether the applicant has shown capacity for complying with the regulations and licence conditions imposed under the Act. As discussed above (paragraph 19.14 refers), compliance with the plans and arrangements that form part of the operating licence application is a licence condition upon the issue of an operating licence. Part of demonstrating ability to comply with the plans and arrangements is demonstrating the availability of the necessary engineering and technical support resources in all safety-related fields.

19.34. ARPANSA's Regulatory Assessment Principles, which require the applicant to demonstrate that it has detailed plans and periodic reviews with measurable outcomes that show that it has adequate managerial structure and resources.

19.35. The Regulatory Guideline on the review of plans and arrangement of management systems covers effective control and management of safety under normal operation, incidents and accident conditions (Paragraph 10.1 refers).

Factual compliance

19.36. Paragraphs 11.9 to 11.12 above detail the technical and engineering skills retained by ANSTO together with the organisation's strategy for ensuring the availability of this expertise to the reactor organisations including through service level agreements (SLAs).

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

Formal Compliance

19.37. Regulation 46(2)(c) of the ARPANS Regulations obliges every licence holder to report any accident to the CEO of ARPANSA within 24 hours of its occurrence. Any event that is rated at, or has the potential to be rated at, Level 2 or above on the International Nuclear Event Scale 2(INES) is regarded as an accident for the

purposes of regulation 46. In addition, guidelines published by the CEO of ARPANSA state the following:

(a) The licensee must record, investigate and report to the CEO of ARPANSA within a maximum of 24 hours, any incident or accident involving controlled materials, controlled apparatus and/or a controlled facility which contravene the operational limits, or where there is a serious threat to the environment or human safety.

(b) In addition, immediate notice should be given to the CEO of ARPANSA or his agent of any incident or emergency and this notice should be confirmed by facsimile transmission at the first practicable opportunity.

(c) For less serious accidents or incidents or minor breaches of licence conditions or operation limits, the CEO of ARPANSA must be given a written report about the accident or incident within 14 days of the event happening. Telephone and/or facsimile notice should also be given to the CEO of ARPANSA, as provided in the Regulation 63(1)(b) Guideline.

19.38. In addition, a licensee is required to report the breach of any licence condition to the CEO of ARPANSA within a reasonable time after the breach is first discovered.

Factual Compliance

19.39. Under the OPAL and HIFAR quality systems, ANSTO implements a process for identifying, recording, analysing and reporting abnormal occurrences and accidents to ARPANSA within appropriate timeframes. A recent example of the conformance to these reporting arrangements involves the fuel-plate dislodgement incident discussed in Paragraph 9 on page 7.

vii. 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;

Formal Compliance

19.40. Such programmes form part of the safety management plan required by the regulations in an application for an operating licence. ARPANSA's principles for assessing the application in this regard are:

(a) Assessment, verification and feedback activities are implemented, including independent reviews. Reviews and audits are conducted for all activities important to safety and an ongoing safety assessment program is established. Lessons are learned from operating experience and safety research, both within the organisation and internationally, and are acted on (Principle 8);

(b) Abnormal occurrences, the analysis of incidents and safety performance of similar facilities worldwide, the results of periodic testing, safety system performance testing, maintenance and modifications, and emergency preparedness exercises, are reviewed and fed back as appropriate into:

i. Revised safety analyses, design modifications, revised procedures and revised quality assurance systems; and

ii. Personnel performance assessment and counselling and retraining (Principle 16).

Factual Compliance

19.41. A safety assessment program is in place under ANSTO's QA system for ongoing review and upgrading, and identifying, recording, analysing and reporting abnormal occurrences and incidents. This requires ANSTO to review and report on its findings. In addition, ANSTO is also required to report annually to ARPANSA on the review of its general plans and arrangements for the safety of OPAL and HIFAR. Australia supports the IAEA research reactor incident reporting system and reported one HIFAR event of interest during the last reporting period. Programmes for corrective actions and learning lessons from incidents are integral to ANSTO's incident reporting system.

viii. 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.

Formal Compliance

19.42. The regulations require the dealings with waste produced in association with the facility to be in accordance with the Code of Practice for the Disposal of Radioactive Waste by the User and the Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia . The principles of waste minimisation are consistent with the Regulations' requirements relating to the ALARA principle. The amount of radioactive waste produced contributes to the consideration of whether there is a net benefit from carrying out the conduct in relation to the controlled facility.

19.43. ARPANSA's assessment principles for the handling, storage, transport, discharge and disposal of any radioactive waste attributable to a facility are provided in Regulatory Assessment Principles 73 to 77. The requirements are as follows:

(a) Suitable provisions, including waste management facilities, exist for the safe handling, storage, transport, discharge and disposal of any radioactive waste arising from operations at the facility (Principle 73);

(b) Where radioactive waste is stored prior to being discharged or disposed of, there are suitable provisions for its interim containment (Principle 74);

(c) Handling facilities for radioactive waste are sufficiently flexible to cope with faulty containers, and radioactive waste of non-standard physical or chemical composition (Principle 75);

(d) The form, locations and quantities of any radioactive waste or discharges, are specified, monitored and recorded (Principle 76); and

(e) Where relevant, the safety analysis includes consideration of radioactive waste and confirms compliance with the radiation dose limits specified in the 'Radiation Protection' section and Table 2 of this document (Principle 77).

19.44. The Regulatory Guideline on the review of plans and arrangement of management systems covers radiation protection, radioactive waste management and ultimate disposal. Guidance is given on a range of radioactive waste and disposal matters, drawing on the IAEA guidance. It includes a requirement for the applicant to provide documentation detailing procedures for the minimisation of the generation of radioactive waste and provides recommendations for implementing the principles described above. Compliance with plans and arrangements assessed to adequately meet these guidelines becomes mandatory upon issue of the licence (paragraph 19.14 refers).

Factual Compliance

The subsections below outline the factual compliance of ANSTO in relation to the various aspects of radioactive waste management.

Management of spent fuel and radioactive waste

19.45. Arrangements for the management of spent fuel and radioactive waste at HIFAR are subject to a certified quality system. Instructions covered operation of the heavy water circuit, and handling of controlled material such as heavy water, ion exchange column resins, and irradiated or contaminated components such as valves, pumps, and pipe work.

19.46. Following the closure of HIFAR in January 2007, the spent fuel and heavy water inventory were removed from the reactor building. Other active components of the facility will be dismantled at a future time under a Decommissioning Licence (see, for example, paragraph 9(e) in the introduction).

19.47. Part B of the Submission for an OPAL Operating Licence included a plan for the management of radioactive waste, and detailed procedures were included in the OPAL Business Management System (BMS). Under these arrangements, the management of solid and liquid radioactive waste is transferred to ANSTO's Waste Operations and Technology Development (WOTD) section (which holds a separate facility licence).

19.48. The OPAL reactor radioactive waste management plans explicitly address waste minimisation, segregation and classification of the different waste types and waste streams. Intermediate level solid waste is stored in the OPAL service pool, where a shearing facility is available. The liquid waste is managed under the existing WOTD arrangements for discharge to the sewer under the trade waste agreement with Sydney Water.

19.49. The ANSTO general plans and arrangements include liquid waste discharge to the Sydney Water sewer, under a site Trade Waste Agreement. That Trade Waste agreement requires that, by the time discharges from Lucas Heights reach the sewage treatment plant, the levels of radioactivity comply with the World Health Organisation's (WHO) derived concentration limits for drinking water. HIFAR and OPAL liquid discharges are part of the site general discharges. There are currently no plans to increase the limits for liquid discharge above the WHO drinking water limits.

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

19.50. The ANSTO Radioactive Waste Management Policy governs the safe management of radioactive waste from generation to its disposal, including the maintenance of the inventory. The arrangements which were in place for HIFAR remain in place for OPAL operations, but the allowable gaseous discharge from OPAL is lower than that which was in place for HIFAR, due to OPAL's more advanced design.

Packaging and containment of radioactive waste

19.51. All solid waste is stored on-site. There is a program in place for the solidification of radioactive liquids. There are no statutory limits on the quantity of solid waste stored on-site.

19.52. The procedures for the minimisation of radioactive waste production at HIFAR will also apply to its decommissioning.

19.53. For OPAL, see 19.48 above.

Interim storage of spent fuel and radioactive waste

19.54. All the HIFAR fuel has been removed from the HIFAR Containment Building (RCB) and is now part of a separate ANSTO Fuel Operations licence. The tritiated heavy water has been drained and removed to a building outside the RCB, and its inventory is part of a separate licence.

19.55. With the closure of HIFAR and the ceasing of shift operations from June 2007, the interim storage of solid waste not tied up in structural components and liquid waste has ceased.

19.56. Storage, transfer and ultimate disposal of OPAL spent fuel is addressed in the ultimate disposal or transfer plan submitted as part of the licence application. After removal from the OPAL reactor, the fuel elements are transferred to the service pool, which has a capacity to store spent fuel arising from nine years of reactor operation. The ultimate disposal is for the OPAL spent fuel to be shipped overseas for storage and disposal (in the USA), or for reprocessing in France (or elsewhere).

19.57. An Act for a Commonwealth Radioactive Waste Management Repository and Store was passed in December 2005. The Act provides for the investigation, siting, design and operation of such a combined facility, with operation foreseen as starting in about 2011. This facility is anticipated to provide for safe and secure long-term management of radioactive waste produced by Commonwealth agencies.

Discharge reports

19.58. A quarterly report on waste discharges from HIFAR and OPAL is submitted to ARPANSA as required by the regulations and reactor license conditions.

19.59. The low-level liquid waste discharged from HIFAR and OPAL is subject to interim storage at the reactor, then on site storage and ultimately discharge to the Sydney Water sewer as part of the site general discharges (see 19.46 above).

19.60. ARPANSA continues to consider that routine discharge from HIFAR and OPAL to the sewer, via the site-wide liquid waste system, is acceptable. Site-wide liquid discharges to the sewer are characterised and measured, in accordance with a Trade Waste Agreement with the water utility and agreed with ARPANSA. HIFAR has

now been closed and routine liquid discharges have ceased with the removal of the coolant from the reactor building. In the case of OPAL, and unlike the previous HIFAR practice, the concentrations of various radioactive nuclides in the liquid waste are measured at discharge from OPAL.

19.61. The existing stack monitoring equipment continuously samples gaseous discharges using MayPack filters. The filters are measured weekly to provide information on gaseous discharges. The following table shows, for HIFAR the airborne discharges, the Notification Levels and Correction Levels specified by ARPANSA and the actual values for the last two years from ARPANSA Annual Reports. The values for the first few months of OPAL operation are also shown.

Annual Notification Levels and actual levels for HIFAR airborne discharges

Notification Level	Ar-41 (TBq)	I-131 (MBq)	Tritium (TBq)	
			Normal	MSD See note 1
Notification Level	180	40	10	25
Correction Level	900	200	50	125
Actual 2004-05	144	10.3	2.38	n/a
Actual 2005-06	137	15	2.85	n/a

Note 1: MSD means during major shutdowns.

The above table shows that the airborne radioactive discharges from HIFAR were well within the limits for Notification Levels.

Annual Notification Levels and actual levels for OPAL airborne discharges

Notification Level	Ar-41 (TBq)	I-131 (MBq)	Tritium (TBq)
Notification Level	45	3.5	155
Correction Level	225	17.5	775
Actual 2006-07	0.29	0	8.0

Routine discharge of solid radioactive waste to the municipal tip

19.62. Routine discharge in this manner does not occur. Some matter discharged to the municipal tip is matter that is originally classified as municipal waste but reclassified as non-radioactive following appropriate radioactive decay.

Routine discharge of radioactive waste by incineration

19.63. Routine discharge in this manner does not occur.

Management of ultimate disposal or transfer of radioactive wastes

19.64. ANSTO's Radioactive Waste Management Policy states that radioactive waste will be disposed of when appropriate disposal routes are available. Arrangements for the ultimate disposal of radioactive waste from HIFAR and OPAL are described in paragraph 19.59 above.

Spent fuel management strategy

19.65. The Commonwealth Government decided in 1997 that part of an appropriate management strategy for HIFAR spent fuel involved shipping it overseas and storing any resulting long-lived intermediate level reprocessing wastes in Australia in a form suitable for acceptance into a national storage facility. A budget was allocated for this purpose.

19.66. Storage, transfer and ultimate disposal of OPAL spent fuel is addressed in paragraph 19.58 above

19.67. Present arrangements for HIFAR and Moata spent fuel are as follows:

(a) US-origin spent fuel is being repatriated to the US (no waste will be returned to Australia). This spent fuel includes the spent fuel plates from Moata. The most recent shipment of spent fuel to the USA took place in December 2006.

(b) 114 fuel rods have been sent to the UK and the long lived intermediate level waste (LLILW) is expected to return around 2015.

(c) The balance of HIFAR fuel rods of non-US origin has been sent to France (COGEMA, La Hague) for reprocessing, and the resulting waste will return as LLILW. The waste is expected to return to Australia around 2015. These activities are covered under a contract with COGEMA.

Articles 20 to 35

These Articles cover the following areas:

- Article 20 - Review Meetings
- Article 21 - Timetable
- Article 22 - Procedural Arrangements
- Article 23 – Extraordinary Meetings
- Article 24 – Attendance
- Article 25 – Summary Reports
- Article 26 – Languages
- Article 27 – Confidentiality
- Article 28 – Secretariat
- Article 29 – Resolution of Agreements
- Article 30 – Signature, Ratification, Acceptance, Approval, Accession
- Article 31 – Entry in Force
- Article 32 – Amendments to the Convention
- Article 33 – Denunciation
- Article 34 – Depositary
- Article 35 – Authentic Texts

No report is required in respect of these Articles.

Planned Activities Related to Safety

The report in this section is based on requirements communicated to ANSTO for the HIFAR and OPAL reactors.

Article 14—Assessment and Verification of Safety

1. HIFAR was permanently shut down during in January 2007. In May 2007, ARPANSA received an application for licence authorising possession or control of HIFAR. Safety and organisational arrangements will be reviewed before a facility licence authorising possession or control is issued.

2. Prior to the next review meeting it is anticipated that ANSTO will have submitted a periodic safety review and a review of the physical security systems of the OPAL reactor, as required by the operating licence for that reactor.

Annexe 1 The OPAL Reactor

1. OPAL is a multipurpose, open pool reactor cooled and moderated by light water and reflected by heavy water. Its design is based on widely applied and well proven technology. The designer and prime contractor was the Argentine company INVAP SE, in contract with Australian construction and engineering companies. The reactor achieved full power in November 2006, four months after the operating licence was approved.
2. The reactor core thermal power is 20 MW, and it is designed to achieve high performance in the production of neutrons and to underpin Australia's nuclear expertise with modern technology. The need for high neutron fluxes arises from the main uses of the neutrons for the production of radioisotopes and other radiation services, and the conduct of neutron beam research.
3. The Reactor Facility design meets ANSTO's requirements, including compliance with demanding safety regulations. The fundamental safety objective in the design of the Reactor Facility is the protection of the public, the facility personnel and the environment from exposure to radiation due to the operation of the facility. A "defence-in-depth" approach is applied throughout the facility, providing multiple levels of protection against the accidental release of radioactive materials. All systems and structures are designed with adequate safety margins to ensure they will behave in a known manner under all anticipated operational occurrences.
4. A notable feature of the reactor is its compact core, which maximises the flux of neutrons available for radioisotope production, irradiation services and research. Heavy water, contained in the Reflector Vessel surrounding the core, is used as the reflector to sustain the nuclear reaction. This vessel also provides a large volume of high thermal neutron flux in which to locate irradiation facilities and supply neutron beams. The core consists of 16 Fuel Assemblies of square shape initially having low-enriched uranium silicide fuel plates with aluminium cladding. Heat generated by the nuclear reaction is removed by water circulating upward through coolant channels between the fuel plates. The power of the reactor is controlled by five control plates, four of which have neutron-absorber plates inserted into the core in a cross-shaped array and the fifth with a central cruciform shaped absorber plate.
5. The core and the Reflector Vessel are positioned close to the bottom of the 12.8 m deep Reactor Pool. The Reactor Pool is connected to the Service Pool by means of a Transfer Canal. The Service Pool provides a working area and enough space to store the spent fuel generated during ten years of reactor operation.
6. The Primary Cooling System removes the heat from the core by forced upward circulation of water and transfers the heat to the Secondary Cooling System. A Core Chimney above the Reflector Vessel contains the core coolant before it enters the pump suction line of the primary system piping, and provides an additional enclosure for water that protects the core in the unlikely event of a loss of coolant accident.
7. The Reactor Pool is cooled by a separate system whose main function is cooling of irradiation rigs. This system also provides long-term pool cooling to the Reactor and Service Pools to extract decay heat.
8. Engineered safety features are provided which are capable of maintaining the reactor in a safe condition under all anticipated operational conditions. They constitute the

third level of "defence-in-depth" and are designed to prevent incidents from developing into accidents. They comply with fail-safe and reliability safety criteria and are qualified to withstand the environmental conditions arising from all operational states and all accident conditions for which they are required to function.

9. The engineered safety features are:

   First and Second Reactor Protection Systems
   First and Second Shutdown Systems
   Reactor Pool Coolant Boundary
   Shutdown Core Cooling by Natural Circulation
   Shutdown Rig Cooling by Natural Circulation
   Reactor Containment and Energy Removal Systems
   Post Accident Monitoring System
   Standby Power System
   Emergency Control Centre Ventilation and Pressurisation System

10. The function of the Reactor Protection Systems, which operate under all normal and abnormal operating conditions, is to monitor safety variables so that protective actions are triggered either when the trip set points are reached, or under operator initiation.

11. The First Shutdown System inserts the five control plates into the core when requested by the First Reactor Protection System. During normal operation the central control plate is used for fine power regulation and the other four are used for coarse reactivity compensation; all being controlled by the Reactor Control and Monitoring System.

12. The Second Shutdown System provides an alternate means of fast reactor shutdown that uses different technology from, and is independent of, the First Shutdown System. The Second Shutdown System partially empties the heavy water from the Reflector Vessel into a storage tank beneath the core on command from the Second Reactor Protection System.

13. The Reactor Pool Coolant Boundary (also called the pool liner) ensures that the core is covered by water for cooling during all foreseeable accidents.

14. If normal electric power is lost, the reactor core and the irradiation rigs are cooled by transfer of heat to the pool water by natural circulation. This is initiated about 100 seconds after the loss of primary circulation by the opening of flap valves in the inlet primary cooling piping within the pool. The coast down of the main pumps is slowed down by flywheels. The pool has a sufficiently large volume of water to provide long-term cooling without reliance on external systems or sources of power.

15. The Reactor Containment System encloses the Reactor and Service Pools, Reactor Hall, and areas below the Reactor Pool that house Reactor Pool water systems and Reflector Vessel heavy water systems. This system is designed to prevent or mitigate the uncontrolled release of radioactive materials to the environment in the unlikely event of an accident.

16. The Post Accident Monitoring System provides information to the operators in the Main Control Room or the Emergency Control Centre in the event of an accident. Information supplied includes data on reactor condition and Engineered Safety Feature performance. It also monitors the status of the barriers to fission product release.

17. A (redundant-two train) Standby Power System ensures that safety systems are supplied with the required power to enable them to perform their safety functions in the case of loss of the normal electric supply.
18. The Emergency Control Centre Ventilation and Pressurisation System ensure the continued habitability of the emergency control centre in case the Main Control Room requires evacuation.
19. After completion of construction, an extensive Cold Commissioning Program took place between February and June 2006. An Operations licence was issued in July 2006, and over the next 4 months Stage B commissioning was completed, with full power achieved in November 2006. As with all commissioning programs, there were a number of non conformances but none were safety significant and the formal opening of OPAL occurred in April 2007.
20. Table 1 presents the main reactor characteristics and core parameters.

GENERAL DATA	
Type of reactor	Open pool
Core thermal power	20 MW
Power removed by primary circuit	18.8 MW (94%)
Power removed by reflector circuit	1.2 MW (6.0 %)

NUCLEONIC	
CORE	
Number of fuel assemblies in equilibrium core array	16 in 4 x 4 square grid
Core dimension	35 x 35 x 61.5 cm
Number of control plates	5
Absorbing material	Hafnium
Core fuel load (average Beginning of Cycle BOC)	6.25 kg uranium-235
Average at power operation cycle length, reference core	29 full power days
Average cycle length, reference core	31 days
Maximum peaking factor, reference core / design limit	2.1 / 3.0

NEUTRONIC DATA		
Average core thermal flux (BOC)		1.05×10^{14} n cm^{-2} s^{-1}
Average core fast flux (BOC)		1.27×10^{14} n cm^{-2} s^{-1}
Average core thermal flux (End of Cycle – EOC)		1.15×10^{14} n cm^{-2} s^{-1}
Average core fast flux (EOC)		1.31×10^{14} n cm^{-2} s^{-1}
Prompt neutron life-time		
	BOC, hot/cold	176/180 μsec
	EOC, hot/cold	181/186 μsec
Effective delayed neutron fraction (β effective)		

	BOC, hot/cold	730/731 pcm
	EOC, hot/cold	718/719 pcm
Total reactivity worth (control plates) , cold/hot		16990/17220 pcm

NUCLEAR FUEL	
Fuel Type	19.70% U_{235}, U_3Si_2-Al dispersion
OPERATIONAL DATA	
Full assembly residence time	About 190 full power days
Maximum discharge burn-up per fuel assembly	96500 MWd/Te U (58%)
Average discharge burn-up	78700 MWd/Te U (46.3%)
Maximum cladding surface temperature	97°C (in the hot channel)
FUEL ASSEMBLY	
Fuel element type	Plate
Number of fuel elements per fuel assembly	21
Active length	615 mm
Active width	65 mm
Plate thickness	1.35 mm (inner thickness) 1.5 mm (outer thickness)
Coolant channel dimensions	2.45 mm x 70.5 mm

THERMAL-HYDRAULICS	
CORE THERMAL DATA	
Inlet temperature	Nominal value 38°C
Outlet temperature (1900 m^3/h through the core)	Nominal value 47°C
Core power density	280 kW/L
CORE HYDRAULIC DATA	
Effective coolant flow, minimum	1900 m^3/h
Coolant velocity in core coolant channel (internal channel)	8.1 m/s
Core pressure drop	240 kPa

REACTOR POOL DATA	
Internal pool diameter	4.5 m
Internal pool height	14.1 m
Internal pool water depth	12.8 m
Reactor pool water inventory	186 m^3

Annexe 2 Summary of the Integrated Regulatory Review Service Mission to Australia

Introduction

At the request of the CEO of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), an international team of eleven experts in radiation and nuclear safety visited the ARPANSA from 25 June to 6 July 2007 to conduct an Integrated Regulatory Review Service (IRRS) mission.

The purpose of the IRRS mission was to conduct a review of the regulatory framework established by the *Australian Radiation Protection and Nuclear Safety Act 1998* and the Australian Radiation Protection and Nuclear Safety Regulations and to consider the effectiveness of the implementation of that framework. The mission was also designed to ensure the exchange of information and experience between the members of the mission and their counterparts within ARPANSA

The IAEA has conducted a 'full scope' IRRS Mission in France in 2006 and an abbreviated mission in the UK. An IRRS Mission was taking place in Japan at the time of the Australian Mission and future missions are being prepared for Pakistan, Spain and other countries.

The Australian IRRS Mission

The IRRS Review Team consisted of senior regulatory experts from Canada, Denmark, Finland, France, South Africa, Spain, the US; and staff of the IAEA .

The areas of review considered by the team are based on the IAEA Safety Standards and included consideration of:

- legislative and governmental responsibilities, including the authority of the regulatory body
- organization of the regulatory body
- activities of the regulatory body, including the authorization (licensing) process, review and assessment, inspection and enforcement, the development of regulations and guides
    - each area of activity was examined in relation to research reactors, sources and industrial practices, decommissioning, remediation, and radioactive waste management
- safety and security of radioactive sources
- national infrastructure for radioactive waste, decommissioning and remediation
- emergency preparedness
- the regulatory body's management system
- public information and communication.

Prior to the commencement of the Mission a comprehensive self assessment was undertaken by ARPANSA taken from the requirements of IAEA Safety Standards. The ARPANSA self assessment formed the basis for counterpart discussions between the IAEA Team and ARPANSA staff. In addition the IAEA team observed ARPANSA inspections and interactions with licence holders.

During the course of the Mission the IAEA team met with the Parliamentary Secretary to the Minister on Health and Ageing, representatives from the Department of Prime Minister and Cabinet and the Chair of each of the Radiation Health and Safety Advisory Council, the Radiation Health Committee, the Nuclear Safety Committee and the Regulators' Forum.

Outcome of the Mission

In its draft report discussed with ARPANSA at the exit meeting on 6 July, the IRRS Review Team identified a number of Good Practices and made Recommendations and Suggestions that indicate where improvements are necessary or desirable to further continue improving effectiveness of regulatory controls.

The Review Team found that the ARPANSA legislative and statutory framework was consistent with the IAEA Safety Requirements GS-R-1: *Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety*. The Team found the requirement in the ARPANS Act for the CEO to take into account international best practice in radiation protection and nuclear safety to be a Good Practice. It was suggested that when the ARPANS Act is reviewed, consideration be given to stating licence holder responsibility for safety and to more clearly establish ARPANSA's role in regulating the transport of radioactive material. The Act might also be reviewed to provide a better basis for the regulatory oversight of existing exposure situations.

With respect to the responsibilities and functions of ARPANSA, the Review Team found that ARPANSA was provided with appropriate effective independence. The Team supports the approach being taken to deal with the conflict of interest in ARPANSA regulating itself (using the services of the Victorian Regulator). The Team identified the development of the National Directory for Radiation Protection as the instrument for promoting national uniformity as a Good Practice. Indeed, they record that the progress made so far in promoting national uniformity is 'remarkable'.

With regard to the organization of the regulatory body, the Review Team identified ARPANSA's use of peer reviews and services from the IAEA; the plans for Graduate Recruitment; and ARPANSA's involvement in the framework of international cooperation for radiation protection and nuclear safety all as being Good Practices. The Team recommended that ARPANSA establish a more comprehensive training program for regulatory staff and made some suggestions about corporate planning, interaction between the regulatory and scientific areas and workforce planning and development.

Turning to the activities of the regulatory body, the Review Team identified ARPANSA's seeking of feedback at the close of inspections; and its decommissioning guidelines as Good Practices. It recommended that ARPANSA prepare guidance for the forthcoming periodic safety review of the OPAL reactor; should prepare guidelines for the end-point of decommissioning; and in relation to the decommissioning of HIFAR. The Team also recommends that ARPANSA include unannounced inspections in its inspection program. The Team made suggestions with regard to guidance relating to relevant changes with significant implications for safety and a range of other matters affecting regulatory guidance and enforcement.

The Review Team was supportive of ARPANSA's work with regard to the safety and security of radioactive sources. They saw the development of ARPANSA's Code of Practice on the Security of Radioactive Sources and the implementation of the recommendations in the COAG report on radiological materials as serving to meet Australia's commitment to

follow the IAEA Code of Conduct on the Safety and Security of Radioactive Sources. The Team made a small number of suggestions aimed at supporting and improving further ARPANSA efforts in this area.

The Team commented on national infrastructure for radioactive waste management, decommissioning and remediation. It suggested that ARPANSA strongly promote a national system for classification of radioactive waste and develop guidance for the clearance of materials from decommissioning.

On emergency preparedness, the Team commended ARPANSA's health physics arm and emergency operations unit as being Good Practice. The Team recommended that ARPANSA address in-house procedures and policies for managing its role in emergencies arising with licence holders and in the provision of public and governmental information during and after events and accidents.

The Review Team was supportive of ARPANSA's management system commending its 'systematic and professional manner to improve and develop the management system' as being Good Practice, as were ARPANSA's strategic planning framework, the introduction of the Regulatory Management Information System and the role of internal audit. The Team recommends further work on the completeness and consistency of the QA procedures and that ARPANSA should expand its management system to include, promote and support strong safety culture. The Team also makes suggestions about planning, risk management and further development of costing information.

With regard to the transport of radioactive materials, the Review Team recommends that ARPANSA review transport compliance assurance. It also suggests that there might be a review of the current arrangements, whereby there are 11 different 'competent authorities' for transport of radioactive material in Australia.

The Review Team is supportive of ARPANSA's public information activities and suggests that these be developed further and documented.

The Review Team also undertook discussions on a number of policy issues. These discussions will be included in the report but they do not lead to specific recommendations or suggestions. The policy issues covered were:

- enhancing regulatory effectiveness and compliance
- risk-informed and performance-based approach to regulation
- openness and transparency
- human resources and knowledge management
- the promotion of national uniformity in radiation protection
- emergency response
- implementation of measures to improve security of sources
- stakeholder consultation.

ARPANSA Assessment of the Mission

ARPANSA believes that the Mission was very effective and successful. The Review Team were very capable and experienced individuals. One of the principal outcomes was the value of the interaction between the Review Team members and ARPANSA counterparts.

ARPANSA will take up the recommendations and suggestions made by the Review Team as part of its ongoing planning of its regulatory program.

At the time of the submission of this report the Australian Government had not received the final report of the IRRS Mission to Australia.

Annexe 3 Summary of Findings of the Uranium Mining, Processing and Nuclear Energy Report—Opportunities for Australia?

Summary

1. On 6 June 2006, the Australian Prime Minister announced the appointment of a task force to undertake the objective, scientific and comprehensive review of uranium mining, value added processing and the contribution of nuclear energy in Australia in the longer term.
2. A draft report was released for public comment on 21 November 2006 and was also reviewed by an expert panel chaired by the Chief Scientist. The review received over 230 submissions from interested parties and it also conducted a wide range of consultations with organisations and individuals in Australia and overseas. Some specialist studies were commissioned on various aspects of the nuclear industry.
3. Australia is a substantial holder of recoverable reserves of uranium (38 per cent pf known low cost global reserves and 23 percent of current production). There is considered to be an opportunity for Australia to be a participant in the wider nuclear fuel cycle. In addition the review saw nuclear power as a practical option for part of Australia's electricity production.

Key Findings of the Review

1. Consultations revealed support for the expansion of Australian mining and export of uranium. Skill shortages, government policies and legal prohibitions restricting the growth of the industry would need to be urgently addressed.
2. The rationalisation of uranium mining regulation would ensure a consistent approach to environmental and radiation protection, and the maintenance of high standards throughout the industry.
3. Downstream steps of uranium conversion, enrichment and fuel fabrication could add a further $1.8 billion of value annually if all Australian uranium was processed domestically. However, high commercial and technology barriers could make market entry difficult. Current legal and regulatory impediments would need to be removed, but there may be little real opportunity for Australian companies to extend profitably into these areas.
4. Nuclear power is likely to be between 20 and 50 per cent more costly to produce than power from a new coal fired plant at current fossil fuel prices in Australia. This gap may close in the decades ahead, but nuclear power and renewable energy sources are only likely to become competitive in Australia in a system where the costs of green house emissions are explicitly recognised. .Even then, private investment in the first built nuclear reactors may require some form of government support or directive.

5. The earliest that nuclear electricity could be delivered to the grid would be 10 years, with 15 years more probable. At the outset, the establishment of a single national nuclear regulator supported by an organisation with skilled staff would be required..
6. In one scenario, deployment of nuclear power in 2020, could see 25 reactors producing about 1/3 of the nation's electricity by 2050.
7. Since Three /Mile Island in 1979 and Chernobyl in 1986, the nuclear industry has developed new reactor designs which are safer and more efficient and produce lower volumes of radioactive waste, and has standardised its operational procedures. The future holds the promise of significant innovation.
8. The challenge to contain and reduce green house emissions would be considerably eased by investment in nuclear plants. Australia's green house challenge requires a full spectrum of initiatives and its goals cannot be met by nuclear power alone. The greenhouse gas emission reductions from nuclear power could reach 8 to 17 percent of national emissions in 2050.
9. Many countries have implemented straight forward solutions for disposal of low level radioactive waste. A national repository involving burial of low level waste from all sources including a future nuclear power industry is logical in Australia.
10. Disposal of high level waste including spent fuel remains an issue in most nuclear power countries. There is consensus that disposal in appropriately engineered deep (500 to 1200 metres underground) repositories is the answer and such facilities are under development in many countries. Australia has areas suitable for such repositories, which would not be needed until around 2050 should nuclear power be introduced.
11. Countries with successful nuclear power generation programs have a strong and transparent regulatory environment. Australia starts from a robust, albeit decentralised framework that would need to be integrated and consolidated into a national structure.
12. While proliferation of nuclear weapons remains a critical global issue, increased Australian involvement in the nuclear fuel cycle would not change the risks, nor would Australia's energy grid become more vulnerable to terrorist attack.

On 28 April 2007 the Prime Minister of Australia, the Hon John Howard MP, announced a new strategy for the future development of uranium mining and nuclear power in Australia[24]. This strategy was in response to three recent reports into the nuclear and uranium industry in Australia:

- The report of the *Uranium mining, processing and nuclear energy review* (UMPNER) (http://www.pmc.gov.au/umpner);
- The House of Representatives standing committee on industry and resources report: *Australia's Uranium – Greenhouse friendly fuel for an energy hungry world* (http://www.aph.gov.au/house/committee/isr/uranium/index.htm); and
- The report of the Uranium Industry Framework (UIF) Steering Group http://www.industry.gov.au/assets/documents/itrinternet/Uranium_report20061120135026.pdf.

[24] http://www.pm.gov.au/media/Release/2007/Media_Release24284.cfm

The aims of implementing the strategy include increasing uranium exports and preparing for a possible expansion of the nuclear industry in Australia. As part of this strategy, he announced four work plans mapping out a way forward for:

(i) an appropriate nuclear energy regulatory regime - including those to govern any future potential nuclear energy facilities in Australia;
(ii) skills and technical training to address any identified gaps and needs to support a possible expanded nuclear energy industry;
(iii) enhanced research and development; and
(iv) communication strategies so that all Australians and other stakeholders can clearly understand what needs to be done and why.

Annexe 4 Documents relevant for an operating licence application for OPAL

On 17 December 2003, the CEO of ARPANSA wrote to ANSTO setting out his expectations for an application for a facility licence authorising ANSTO to operate OPAL. Relying on section 34 of the Act which sets out the requirements for an application for licence, in particular paragraph 34(a), he confirmed that he would require all of the items of information relevant to the operation of a controlled facility referred to in Part 1 of Schedule 3 of the regulations. In addition, he stated:

> *I expect to see information pertaining to international best practice in relation to radiation protection and nuclear safety for each authorisation applied for.*

He also suggested that in determining the content of their application, ANSTO may wish to have regard to:

- Regulatory Assessment Principles for Controlled Facilities RB-STD-44-00;
- ARPANSA Regulatory Guideline on Review of Plans and Arrangements (RB-STD-15-03;.
- A Commissioning Guide being prepared by ARPANSA Regulatory Branch

(subsequently published as *RB-STD-09-04 Rev 0* in September 2004);

- IAEA documents for Nuclear Power Plants and in particular the Operations series;
- Safety Series No 35 –S Code of Safety of Nuclear Research Reactors; Design (IAEA 1992);
- Safety Series No 35-S2 Code of Safety of Nuclear Research Reactors; Operation (IAEA 1992);

(f) Safety No 50 SG-G3 Conduct of Regulatory Assessment during the Licensing Process for Nuclear Power Plants (IAEA 1980);

- Standards Series DS259 Draft 5 Draft Safety Guide Commissioning of Research Reactors (2000)
- Safety Series DS 272 Draft Safety Requirements of Research Reactors (April 2003) (subsequently published as Safety of Research Reactors, Safety Requirements NSR-4, IAEA 2005).

Annexe 5 References[25]

Annual Report for 1999/2000, ANSTO

Australian National Report, Nuclear Safety Bureau, 1998

Australian Radiation Protection and Nuclear Safety Act (Cth) 1998

Australian Radiation Protection and Nuclear Safety Regulations 1999

Criteria for the Siting of Controlled Facilities, ARPANSA, 1999.

Expectation Guideline, ARPANSA, 2000, Version 2

HIFAR Safety Evaluation Report, ARPANSA, 2001

Preliminary Safety Analysis Report for the ANSTO Replacement Research Reactor Facility, ANSTO, 2001

Regulatory Assessment Criteria for the Design of New Controlled Facilities and Modifications to Existing Facilities, ARPANSA, 2000

Regulatory Assessment Principles for Controlled Facilities, ARPANSA 2000.

Review of HIFAR against ARPANSA Expectations, ARPANSA, 2001

Review of HIFAR against Regulatory Assessment Principles for Controlled Facilities, ARPANSA, 2001

Safety Evaluation Report on ANSTO Application for Licence to Prepare a Site for the Replacement Research Reactor, ARPANSA, 1999

[25] ARPANSA legislation and references can be accessed on the ARPANSA web site http://www.arpansa.gov.au

Annexe 6 Glossary and Acronyms

ALARA	As low as reasonably achievable
ANSTO	Australian Nuclear Science and Technology Organisation
ANSTO Act	Australian Nuclear Science and Technology Organisation Act 1987
ARPANS Act	Australian Radiation Protection and Nuclear Safety Act 1998
ARPANS Regulations	Australian Radiation Protection and Nuclear Safety Regulations 1999
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Bq	Becquerel (1 disintegration per second)
CEO	The Chief Executive Officer of ARPANSA
Controlled Apparatus	An apparatus that produces ionizing radiation when energised or that would, if assembled or repaired, be capable of producing ionising radiation when energised, an apparatus that produces ionizing radiation because it contains radioactive material or an apparatus prescribed by the regulation that produces harmful non-ionizing radiation when energised.
Controlled Facility	A nuclear installation or a prescribed radiation facility.
Controlled Material	Any natural or artificial material whether in solid or liquid form or in the form of a gas or vapour, which emits ionizing radiation spontaneously.
DISPLAN	Disaster Plan of the State of New South Wales
ECR	Emergency Control Room
FSAR	Final Safety Analysis Report
HIFAR	High Flux Australian Reactor
HSD	HIFAR Safety Document
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
INSAG	International Nuclear Safety Advisory Group
Instructions	Documentation providing sufficient information to allow work to be performed to a required standard
Licence	A formal, legally prescribed document issued to an applicant for licence by the CEO ARPANSA authorising the applicant to undertake certain activity in relation to a controlled facility
mSv	Millisievert
NSW	New South Wales – one of the states in Australia and the one in which HIFAR and the OPAL reactor are located
OLCs	Operational Limits and Conditions

Procedures	A statement of purpose and scope of a nominated process identifying responsibilities, actions and reasons.
PSA	Probabilistic Safety Analysis
PSAR	Preliminary Safety Analysis Report
QA	Quality Assurance
RCB	Reactor Containment Building
Regulatory Body	Any body 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
RPS	Reactor Protection System
SAC	ANSTO's Safety Assessment Committee
SAR	Safety Analysis Report
SCS	Space Conditioning System
SER	Safety Evaluation Report
SR	Safety rod
Sv	Sievert – unit of radiation dose
WHO	World Health Organisation