Commonwealth of Australia

Convention on Nuclear Safety

Australian National Report

September 2004

Australian Government

Australian Radiation Protection and Nuclear Safety Agency

Table of Contents

Introduction

National nuclear programs

1. Australia ratified the Convention on Nuclear Safety in December 1996. Australia does not have any “nuclear installations” as defined in the Convention, and none are planned. Federal, State and Territory legislation in fact prohibits the 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 a nuclear fuel fabrication plant, a nuclear power plant, an enrichment plant or a reprocessing plant.
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 owned or planned by ANSTO at the Lucas Heights Science and Technology Centre in Sydney’s south in the State of New South Wales.
3. The only nuclear research reactor that ANSTO currently operates is HIFAR. HIFAR is 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. Another reactor, Moata, is a small Argonaut type reactor that was used for materials and physics research and is in the second stage of decommissioning.
4. Other 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.
5. A replacement research reactor (RRR) is being constructed for ANSTO. If it comes into operation in 2005 as planned, will replace HIFAR. The RRR will be a 20 MW pool-type facility with a higher neutron flux than HIFAR and superior neutron beam capability. To meet obligations in relation to non-proliferation, the reactor will use low-enriched uranium fuel.
6. The RRR will be housed in a containment building, which also includes the primary cooling circuit and most of the auxiliary plant. The stainless steel reactor pool will be 12.6 metres deep and surrounded by thick-walled reinforced concrete construction. The reactor core will sit towards the bottom of the pool. A service pool, contiguous with the reactor pool, will handle irradiated materials and provide for the interim storage of spent fuel. A neutron guide hall has been constructed adjacent to the reactor building. This will contain experimental stations and instrumentation for neutron beam research purposes.
7. A Facility Licence authorising the construction of the RRR was issued by ARPANSA, as described under Article 14 below.

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 license conditions to the HIFAR operating licence issued by ARPANSA in June 2001. Specific tasks were identified in the following areas:

   (a) Update documentation to reflect the existence of a formal operating licence and of specific ANSTO Safety Directives;

   (b) Document agreements for provision of health physics, waste management and engineering support services;

   (c) Accredit key maintenance staff;

   (d) Implement outstanding human factor recommendations of the HIFAR Probabilistic Safety Analysis (PSA) (published in 1998);

   (e) Implement outstanding accident management recommendations of the HIFAR PSA;

   (f) Revise and strengthen aspects of the emergency planning arrangements;

   (g) Update the HIFAR Safety Analysis Report to incorporate outcomes of the HIFAR PSA, undertake additional reactivity excursion analyses and confirm Reference Accident consequences;

   (h) Re-examine the seismic hazard to HIFAR in light of the most recent seismic data; and

   (i) Develop and document HIFAR specific procedures related to waste management (separate from existing site wide procedures).

9. The specific activities have been discharged by ANSTO to ARPANSA's satisfaction or, in several cases, agreed modified objectives have been achieved.

Summary of significant matters since the last report

10. Several matters have progressed since the last national report and these are explained in detail in the main body of the report. A summary of the matters follows.

    (a) A shortage of nuclear science and engineering expertise in Australia, available for both operators and regulators.

    (b) Development of a quality system for the ARPANSA's Regulatory Branch is well progressed.

    (c) The CEO of ARPANSA issued ANSTO a facility licence authorising construction of the RRR.

    (d) Conversion from high-enriched uranium (HEU) fuel to Low-enriched (LEU) fuel for HIFAR, in step-wise pattern from October 2004.

The rest of this report

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. ARPANSA has been designated by the Commonwealth 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.

13. 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[1]. 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.

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

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[2].

[2] 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

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

- The HIFAR Research Reactor. This is a 10 MW(t) heavy water, tank type, materials testing reactor, operating since 1958 at Lucas Heights in New South Wales (in Sydney's south) (See **Annex 1** for details).
- The Moata Research Reactor. This 100 kW(t) Argonaut university type research reactor at Lucas Heights was permanently shut down in 1995 and is in the second phase of decommissioning.

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

6.2. The only operational nuclear reactor in Australia is ANSTO's HIFAR research reactor. The decision to build a reactor to replace HIFAR negated the need to plan the refurbishment of HIFAR.

Overview of safety assessments and measures for safety upgrading

HIFAR research reactor

6.3. Although HIFAR would not fully meet modern standards, the ARPANSA review for an operating licence and the HIFAR SAR, updated in 2002, and PSA show that HIFAR is acceptably safe and that there is no evidence of significant ageing effects which would impair safety in the period to its planned shutdown in 2006.

6.4. ARPANSA issued ANSTO with a licence to operate HIFAR (subject to certain licence conditions) in June 2001. In February 2004, that licence was varied so as 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. This would require review of the safety case against modern standards. ANSTO has made no such submission.

Moata

6.5. 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 has been unloaded and is temporarily stored, awaiting return to the United States. In the last Australian National Report in 2001, it was reported that ARPANSA had issued a licence for the care and maintenance of the facility.

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 ARPANS Act was passed by the Commonwealth Parliament in 1998. The Act established the statutory office of the CEO of the ARPANSA. The Act applies to Commonwealth Government entities and their contractors in respect of any activity in relation to controlled material, apparatus and facilities. ARPANSA took over the assets, liabilities, staff and functions of the former Australian Radiation Laboratory and the Nuclear Safety Bureau.

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. Under the *Australian Nuclear Science and Technology Organisation Act 1987* (ANSTO Act), ANSTO is not generally subject to the health and safety laws of the State of New South Wales.

> ***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 Guidelines

7.3. The Australian Radiation Protection and Nuclear Safety Regulations 1999 (the ARPANS Regulations) were made under the ARPANS Act. The Act and the Regulations constitute the first tier documents in the framework under which ARPANSA regulates safety of ANSTO's nuclear plants and reactors.

7.4. The Act and the Regulations enable the CEO to promulgate guidelines and principles for the regulatory functions of ARPANSA. Accordingly, the following documents have been produced.

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

(b) *Review of Plans and Arrangements (August 2003)*;

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

(d) *ARPANSA Regulatory Guideline on Operation Controlled Facilities (1999);*

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

(d) *Regulatory Assessment Criteria for the Design of New Controlled Facilities and Modifications to Existing Facilities, October 2001.*

7.5. The ARPANSA regulatory guidelines, criteria and principles provides the criteria that ARPANSA uses for its assessment of the applicant's plans and arrangements for managing safety in an application for a licence. As well as assisting ARPANSA in its regulatory assessment by decreasing the likelihood of omitting important considerations, the documents are also meant to assist an operating organisation in the preparation of a licence application.

7.6. The Regulatory Assessment Principles supersede and replace the regulatory documents used by ARPANSA’s predecessor organisations. The principles are those criteria on which ARPANSA places the most importance, priority and focus when it performs a regulatory assessment. They draw extensively from international publications and experience, especially the International Nuclear Safety Advisory Group (INSAG) and the IAEA.

7.7. However, the first tier documents for regulatory assessment remain the ARPANS Act and Regulations. The second and third tier documents for regulatory assessment are the Regulatory Assessment Principles (RB-STD-42-00) and the Regulatory Assessment Criteria (RB-STD-43-00) and guideline documents respectively.

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

Licensing

7.8. Part 5 of the ARPANS Act deals with the regulation of controlled material, apparatus and facilities. This Part prohibits the construction, operation 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.

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

Inspection

7.9. Section 35 (3) of the ARPANS Act sets a condition of licence allowing persons authorised by the CEO of ARPANSA to enter and inspect sites and facilities. Part 7 of the Act enables the CEO of ARPANSA to 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.

7.10. In general, inspectors may search premises, inspect, examine, take measurements, take samples or conduct tests. The inspector may also take photographs, record video pictures, take audio recordings or make sketches. Books, records and documents may be inspected and copies may be taken.

7.11. Special powers are also provided for inspectors to deal with hazardous situations or to gather evidential material. In dealing with hazardous situations, the inspector may also give directions for such steps to be taken as the inspector considers necessary.

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

Enforcement

7.12. Under Part 5 of the ARPANS Act, 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.

7.13. 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 others, 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.

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. As outlined under the report on Article 7 above, ARPANSA was created in 1998 to be the regulatory body for all Commonwealth Government entities. ANSTO is a Commonwealth Government entity and is the only organisation in Australia that operates nuclear facilities, including research reactors.

8.2. ARPANSA's authority is clearly enunciated in the ARPANS Act. As explained in the report under Article 7, 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.

8.3. The functions of the CEO of ARPANSA include:

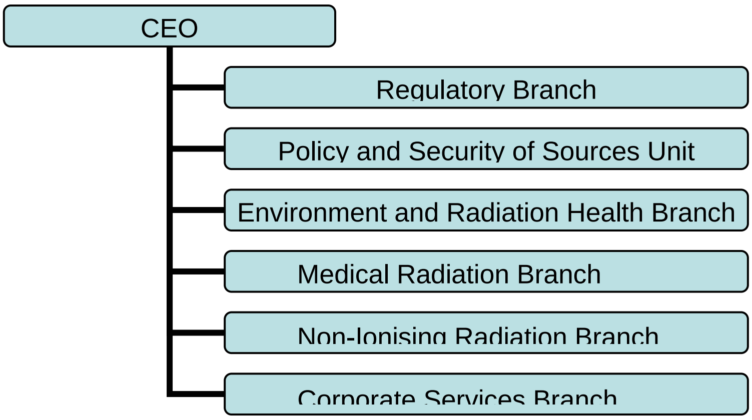
- Promotion of national uniformity of radiation protection and nuclear safety policies and practices across the jurisdictions of the Commonwealth of Australia, the States and Territories;
- Provision of advice on radiation protection and nuclear safety;
- Undertaking research and providing services in 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.

8.4. 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.

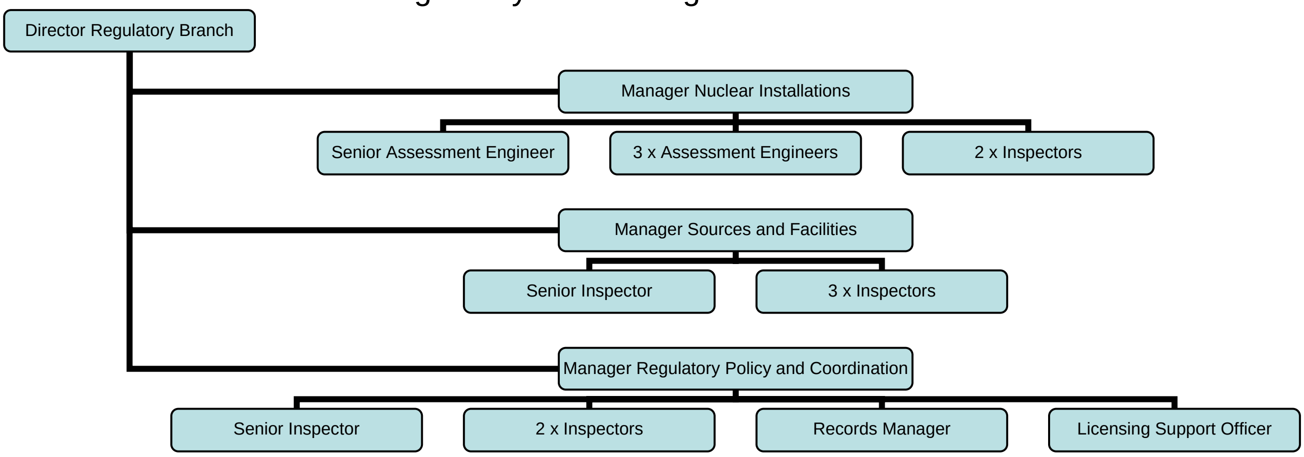
8.5. ARPANSA currently has 124 staff. The staff comprises a mixture of scientists, engineers, lawyers, policy professionals and administrative support personnel. The ARPANSA Regulatory Branch comprises 21 staff. ARPANSA's financial needs are adequately met through budget appropriation and licence fees. Just over half of ARPANSA's annual operating revenue of about A$16 million comes from budget appropriation.

8.6. The Regulatory Branch of ARPANSA has primary responsibility for regulating ANSTO's facilities. The structure and organisation of ARPANSA and its Regulatory Branch are shown below.

ARPANSA Organisational Chart



Regulatory Branch Organisational Chart



8.7. The Regulatory Branch:

- assesses applications for licences against accepted standards for radiation protection and nuclear safety;
- makes recommendations to the CEO on the issuing of licences;
- monitors compliance including undertaking inspections of licensed activities to confirm compliance with legislative requirements;
- investigates incidents; and
- takes any enforcement actions required by the CEO that are necessary to ensure compliance, safety of people and protection of the environment.

8.8. The regulatory framework applies to a very wide range of nuclear and radiation facilities and sources, 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.

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.

8.9. ARPANSA and ANSTO are different legal entities. The entities have separate enabling Acts, operate from separate premises and do not share any management or administrative resources. For example, ARPANSA operates under the ARPANS Act while ANSTO operates under the ANSTO Act.

8.10. The CEO of 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 Minister for Science. The independence of the CEO of ARPANSA is further assured through several mechanisms established under the 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 ensure that there is no conflict of interest between his regulatory role and any other roles as a service provider;

(c) Reporting mechanisms that ensure that the CEO reports 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, 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.

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 ARPANS Act and Regulations require that ANSTO be solely responsible for the safe operation of HIFAR. Any breach of the Act or Regulations or any licence condition is a punishable offence. In addition, the CEO of ARPANSA may also suspend or cancel a licence for the breach of a licence condition.

9.2. Staff from ARPANSA's Regulatory Branch regularly monitor and review the operations of ANSTO to ensure that the organisation meets its responsibility for safety as spelt out in the legislation, ARPANSA's regulatory guidelines and the conditions attached to the HIFAR operating licence and replacement reactor construction licence.

9.3. In addition to formal inspections and assessments, ARPANSA may also act on reports made by ANSTO staff on safety breaches or unsafe practices in ANSTO's nuclear facilities. ANSTO is obliged by the Act and Regulations to report all abnormal occurrences to ARPANSA.

Factual Compliance

9.4. ANSTO's relevant safety directives describe safety management systems that include safety management policies. ANSTO has policy documents that detail its health, safety and environmental policies and associated authorities and responsibilities. The policies set out the delegations for safety management, and list responsibilities of ANSTO's directors for safety, waste, security and safeguards management.

9.5. ANSTO also has a safety directive for safety assessment and approvals systems. This directive governs the functions and responsibilities of review and assessment committees, such as the ANSTO Health, Safety and Environment Committee, the Environmental Monitoring Committee and the Safety Assessment Committee.

9.6. Since ARPANSA was formed, there has been no breach of its legislation by ANSTO. However, on one occasion, the CEO of ARPANSA found a contractor to ANSTO to be in breach of the Act. This was covered in the Quarterly Report of the CEO of ARPANSA for the period 1 October to 31 December 2002.

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. ARPANSA's Regulatory Assessment Principles and Guidelines provide the basis for its assessment of whether ANSTO's nuclear facilities can be licensed in accordance with the requirements of the ARPANS Act and Regulations. This ensures that ANSTO's nuclear facilities are designed to ensure that the operating organisation considers and ensures the safety of its facilities from design through to decommissioning stages. The Principles have been derived from IAEA guidelines and stress the importance that the operating organisation must accord to safety culture, safety analysis and defence in depth measures.

10.2. In particular, Principle 1 states an overarching requirement for the operating organisation to demonstrate 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.

10.3. The licence issued to ANSTO for the operation of the HIFAR reactor was based on a satisfactory demonstration by ANSTO that it has safety policies and strategies in place to achieve ARPANSA's requirements in relation to safety culture, safety analysis and defence in depth.

10.4. The Regulatory Assessment Principles can be obtained on the ARPANSA web site **http:/www.arpansa.gov.au**.

Factual Compliance

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.

Safety culture and commitments

10.6. ANSTO has stated that its strategy to achieve its policy objectives is by:

(a) Complying with all relevant Commonwealth laws dealing with health, safety and the environment – State laws generally do not apply to ANSTO as a consequence of the ANSTO Act. However, where Commonwealth laws are silent (on matters other than radiation protection and nuclear safety), ANSTO endeavours to comply with relevant State laws;

(b) Taking account of relevant health, safety and environment standards, codes and guidelines, including occupational health and safety principles;

(c) Using radiation and radioactive sources and operating its facilities in compliance with appropriate radiation protection and nuclear safety principles;

(d) Setting and reviewing safety and environmental objectives and targets appropriate to its activities, products and services;

(e) Ensuring that doses are as low as reasonably achievable (ALARA), taking into account economic and social factors;

(f) Providing training to ensure staff understand and implement policy; and

(g) Providing verifiable evidence of the fulfilment of this policy through a program of monitoring and audit, and regular public reporting of results.

10.7. ANSTO has implemented its safety policies and strategies through a set of “Safety Directives” that specify the arrangements of its Safety Management System. These directives inform ANSTO staff of their responsibilities and obligations on health and safety matters. These directives cover 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 to ensure compliance with the organisation’s health, safety and environment policies and strategies.

10.8. ANSTO’s compliance with its policies and strategies is checked and balanced by two committees, which monitor the safety of operations on behalf of ANSTO’s management. These committees and their functions are as follows:

- The ANSTO Health, Safety and Environment Committee monitors ANSTO’s safety and environmental management system, including that of HIFAR. The Committee has a chairperson external to ANSTO, receives reports and advice from various ANSTO safety and technical groups, and provides advice to the Executive Director.
- The Safety Assessment Committee (SAC) assesses the safety of activities at all of ANSTO’s sites that could potentially 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. There is external representation on this committee.

Article 11 – Financial and Human Resources

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

Financial Resources

Formal Compliance

11.1. The ARPANS Regulations require the applicant to have the capacity to comply with the regulations. Under Principle 4(a) of the Regulatory Assessment Principles, ARPANSA must assess ANSTO to be financially viable before ANSTO is issued with an operating licence. ANSTO 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.

Factual Compliance

11.2. The Commonwealth Government's budget appropriation forms the bulk of ANSTO's operating revenue. For the financial year 2002/03, revenues from the Government formed 72% of ANSTO's A$137.5 million operating revenue, with the bulk of the remaining operating revenue coming from the sale of goods and services. 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.

11.3. In addition, ANSTO has 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.***

Human Resources

Formal Compliance

11.4. ARPANSA's Regulatory Assessment Principles 3 to 9 relate specifically to safety culture and the operating organisation. Principles 4(a), 6 and 7 relate to human resources. Compliance with these principles require ANSTO 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).

Factual Compliance

11.5. ANSTO Division Directors – including the Division Director responsible for HIFAR - are responsible for safety within their divisions. The Director, Safety and Radiation Science is responsible for the continual improvement and operation of ANSTO's general safety arrangements. These responsibilities include the continual review and development of Safety Directives as required, operation of the ANSTO safety reporting and safety approval arrangements and keeping other Division Directors informed of changes. The Director, Safety and Radiation Science is also responsible for providing safety advice to the other Division Directors

11.6. 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.

11.7. Most of the safety staff work in ANSTO's Safety and Radiation Science Division. Their activities 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.

11.8. 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.

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. As stated in paragraph 11.4 above, Principles 4(a), 6 and 7 of ARPANSA's Regulatory Assessment principles relate to human resources.

Factual Compliance

12.2. 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 operating organisation, including reactor operators, active handling crew and operations engineers.

12.3. 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.

12.4. 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.

12.5. 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.

12.6. The ANSTO project dedicated to the RRR has been used to involve a range of ANSTO staff in important processes during design and construction of the facility. These include design, safety, and preparation for commissioning and operation.

12.7. A number of introductory RRR systems training courses have been held for relevant staff. Recently, about 20 ANSTO staff commenced a five-month training program for commissioning support and operations of the RRR.

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 Branch is in the process of developing a quality system for regulatory activities.

13.2. ARPANSA's Regulatory Assessment Principles stress the need for 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

13.3. In 1997, ANSTO's HIFAR reactor received formal certification of its Quality Systems as complying with the requirements of AS/NZS ISO 9001. In 1998, ANSTO documented a formal policy for the ongoing maintenance of this quality certification. The policy statement states that ANSTO will undertake its activities in a manner that:

- promotes a quality culture for planning and undertaking research and development, the provision of items and services and the reporting there on,
- is in accordance with national and international quality management standards,
- promotes a culture to achieve its activities in an efficient, effective, safe manner,
- promotes a culture to meet its environmental objectives, and
- meets, at a minimum, customer and stakeholder requirements.

13.4. 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 2002, the HIFAR Quality System certification was reaffirmed, but 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.

13.5. Under the ARPANSA Quality system, the CEO of ARPANSA has promulgated 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 procedures for undertaking these regulatory activities. Requirements have been defined for ARPANSA inspectors, setting out competencies, experience and training standards that must be met through a national accreditation system (Certificate IV in government).

Article 14 – Assessment and Verification of Safety

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

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

Safety Assessments

Formal Compliance

14.1. The ARPANS Act and Regulations require an operating organisation to submit an updated safety case whenever a licence or authorisation is sought during the life of a facility. The safety case must demonstrate that throughout its life a facility complies with the prescribed radiation dose limits, and radiation exposures are kept as low as reasonably achievable (ALARA). 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).

14.2. ARPANSA's Regulatory Assessment Principles 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 a licence or authorisation is sought. The relevant principles are Principles 17 to 38.

14.3. The "preliminary SAR" (PSAR) must be included in an application for a licence to construct a facility. A "final SAR" (SAR Rev. 0) is an updated version of the PSAR and must be submitted when applying for a licence to operate 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.

Factual Compliance

14.5. Prior to the establishment of the ARPANSA nuclear facility licensing system, the safety assessment of HIFAR was contained in the HIFAR Safety Document, first prepared in 1972, supplemented in 1983 and extensively revised in 1996. A Probabilistic Safety Assessment of HIFAR (HIFAR PSA) was also issued in 1998.

14.6. The 1996 Revision of the HIFAR HSD, updated in July 2000, was submitted as the FSAR in ANSTO's application to ARPANSA for a Facility Licence, Authorisation to operate in 1999. The HIFAR PSA was included in the application. The licence that was issued to ANSTO in June 2001 was based on an evaluation of these documents. Overall, the Final Safety Analysis Report was considered by ARPANSA to be acceptable in its depth and treatment of potential HIFAR accidents from internal faults, internal hazards and external hazards.

14.7. In 2002, a revision of the HIFAR SAR was submitted to ARPANSA. It addressed recent plant changes, safety analyses completed since the last revision, results of the PSA and analyses demonstrating the safety of using low-enriched uranium (LEU) fuel in HIFAR. (The LEU fuel was purchased from the RISO national laboratory in Denmark, following the closure of the DIDO class DR3 research reactor.) ARPANSA reviewed the revised HIFAR SAR and concluded that it adequately demonstrated the safety of the operating facility and, in particular, the safety of using LEU fuel in HIFAR. The CEO of ARPANSA subsequently approved the use of LEU fuel.

14.8. The Descriptive and Safety Assessment Manual for MOATA was revised in 2000 to reflect the reactor's status in Phase 2 decommissioning. A Facility Licence for MOATA was issued in May 2001 based on the information in the Manual.

14.9. A Facility Licence, Site Authorisation was issued by ARPANSA for the RRR in September 1999; ANSTO's application included a siting safety assessment which established the suitability of ANSTO's Lucas Heights site for the location of the RRR. A PSAR was submitted in May 2001 with the application for a Facility Licence, Authorisation to Construct. ARPANSA's assessment took account of a Peer Review by an IAEA team and public comment. A facility licence authorising construction of the RRR was issued in April 2002. The PSAR is being developed into the SAR Rev. 0 during the detail engineering, construction and commissioning phases to provide a basis for the final Authorisation to Operate. The SAR Rev. 0 will be submitted in the third quarter of 2004. Further revisions will be submitted following hot commissioning and achievement of full power operation. In addition, and as part of the licence application to operate the reactor facility, ANSTO will submit to ARPANSA documents that address ANSTO's proposals for its local plans and arrangements for safety.

14.10. The facility licence authorising construction of the RRR was subject to specific licence conditions. Those specific to the assessment and verification of safety addressed the following matters:

- The Licence Holder (ANSTO) must gain the approval of the CEO of ARPANSA prior to commencing construction of any safety category 1 or safety category 2 items. This condition derives from the legislated ARPANS Regulations (Regulation 54). Similar approval is required prior to commissioning of these safety categorised items. Information required in the application for an approval is specified.
- Updating of the Safety Case.
- Review of human factors aspects of design.
- Validation of computer codes.
- Procedures for controlling changes that have significant implications for safety.
- Proposals for staffing structures and arrangements.

- Emergency arrangements.
- Security arrangements and security technology.
- Maintenance of records and reports.

14.11. ARPANSA considers that comprehensive and systematic safety assessments were carried out before the construction of the RRR and are maintained during the current construction and cold commissioning phases.

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

Safety Verification

Formal Compliance

14.12. ARPANSA's Regulatory Assessment Principles provide for periodic reviews 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. The relevant principles are Principles 39 to 41. The operating organisation must address the needs revealed by such reviews, which may include the need for modifications, updating of procedures and training for staff.

Factual Compliance

14.13. ANSTO has demonstrated to ARPANSA's satisfaction that it carries out a program of maintenance, periodic testing and inspection activities to verify that the reactor, including its irradiation rigs and experiments, can be operated safely in accordance with design manuals.

14.14. Functional testing is routinely carried out to ensure that the minimum plant configuration, safety performance requirements, and the safety conditions as specified in the OL&Cs are satisfied. The arrangements for these activities, which are carried out in accordance with written procedures, are presented and results reported for regulatory review. Appropriate modifications are made to incorporate any operational experience.

14.15. The program of maintenance and periodic testing and inspection is reinforced by work undertaken in a major reactor shutdown every four years to undertake tests and inspections that cannot be undertaken during routine refuelling shutdowns. A major shutdown in February 2004 established that the reactor was in a sound condition for continued operation and the CEO of ARPANSA approved the reactor being restarted.

14.16. ARPANSA considers that the arrangements for regular reviews and updates provide an acceptable process for maintaining the safety case.

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 objective 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. ARPANS Regulation 59(1) details quantitative radiation protection requirements drawing on the National Standard for Limiting Occupational Exposure to Ionising Radiation and other recommendations of the National Health and Medical Research Council (based on ICRP 60:1991). The ARPANSA Regulatory Assessment Principles 57 to 62 address the issues taken into account in determining whether ANSTO adheres to the radiation protection requirements and principles.

15.2. Essentially, 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 following effective dose limits (ARPANSA Regulation 59 and Principle 57):

(a) 20 mSv annually, averaged over 5 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.

(b) 1 mSv annually for public exposure (this includes unborn children).

15.3. In addition, under Principle 58, ANSTO has to demonstrate that for each radiation source, the level of radiation protection provided is optimised so that individual and collective doses are kept as low as reasonably achievable (ALARA).

15.4. ANSTO is also given the opportunity to optimise its radiation protection by agreeing to a dose constraint level with ARPANSA, which allows for other occupational or public exposure dose limits at particular facilities that it operates (Principle 59).

Factual Compliance

15.5. ANSTO’s Safety Directive 5.2 (on ALARA), requires an assessment of all operations involving ionizing radiation and describes the procedure for such an assessment. One of these procedures requires radiation exposures at HIFAR to be ALARA. The directive sets objective values for doses below which an assessment of ALARA is not required, namely 2.0 mSv/y for occupationally exposed persons and 0.02 mSv/y for others.

15.6. The following tables show the effective doses received by five HIFAR staff groups over the period 2000/01 to 2003/04.

Effective dose for HIFAR staff groups: 2000-2001

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators	50	3.3	4.5
Reactor Shift Superintendents	55	4.2	6.3
Active Handling Personnel	25	3.6	5.8
All HIFAR personnel	184	1.9	6.3

Effective dose for HIFAR staff groups: 2001-2002

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators	51	2.8	4.9
Reactor Shift Superintendents	56	4.7	6.4
Active Handling Personnel	30	3.0	6.0
All HIFAR personnel	206	2.1	6.4

Effective dose for HIFAR staff groups: 2002-2003

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators	72	3.3	4.7
Reactor Shift Superintendents	29	4.1	6.2
Active Handling Personnel	35	2.7	7.4
All HIFAR personnel	178	1.8	7.4

Effective dose for HIFAR staff groups: 2003-2004

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Reactor Operators	60	3.2	4.7
Reactor Shift Superintendents	27	4.5	5.6
Active Handling Personnel	30	4.3	5.2
All HIFAR personnel	150	1.7	5.6

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

15.8. ANSTO’s Safety Directive 5.2 also sets dose constraints as the upper level of doses that are considered to be acceptable in the ALARA assessments of radiation protection. The constraints are 15 mSv/yr for occupationally exposed persons and 0.3 mSv/y for members of the public. The above tables show that the 15 mSv/y constraint has been met.

15.9. ARPANSA considers that ANSTO’s Safety Directives provide an acceptable policy for requiring that radiation exposures are ALARA. The dose constraint of 0.3 mSv/y for persons other than occupationally exposed persons is acceptable, but the dose constraint of 15 mSv/yr could be reviewed for the operation of HIFAR where actual doses are well below this level.

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

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. The ARPANSA Regulatory Assessment Principles 122 and 123 address the various aspects of the emergency plans, procedures and preparedness to be assessed in reviewing the plans. These cover operating licences for existing installations, as well as siting and construction licences for new installations. The aspects to be assessed 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

16.2. ANSTO has identified a range of potential accidents. The worst case accident consequences have been used as a basis for emergency planning. These arrangements undergo frequent testing in drills and exercises, using severe accidents as the scenario. These arrangements are acceptable to ARPANSA. Assessments of the radiological consequences of acts of sabotage and terrorism have been undertaken by ANSTO and reviewed by ARPANSA. It has been concluded that the current emergency plans and arrangements provide adequate protection of the public for such events.

16.3. Intervention measures in ANSTO's emergency plans follow approved guidelines on evacuation, sheltering and issue of stable iodine. ANSTO has shown that evacuation would not be necessary outside the 1.6 km radius exclusion zone around HIFAR, and that the need for any sheltering would be limited to a small number of people. Intervention measures with respect both to averted dose intervention levels and to policies for evacuation, sheltering and issue of stable iodine are currently under separate review by ARPANSA and NSW Government authorities.

16.4. 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.

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

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

16.7. 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.

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

16.9. 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.***

16.10. 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. Australia has appropriate precautions in place in relation to radiation emergencies in other countries, including the monitoring of imported foodstuffs.

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 Regulations address 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. ARPANSA’s Regulatory Assessment Principles and siting Guideline identify matters it will consider in its assessment of such an application. These are specified at two defence in depth levels. At defence in depth level 1, ANSTO has to 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 (117 to 121) 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 occur 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 PSAR, 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 proposed RRR (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 forbidding Commonwealth agencies 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. The Act lays out principles for the assessment of whether a “nuclear action” should be approved.

Factual Compliance

HIFAR Research Reactor

17.5. The Safe Shutdown Earthquake (SL2) against which HIFAR has been assessed has a peak ground acceleration of 0.23g. The HIFAR Reference Accident is a bounding loss of coolant accident that assumes full core meltdown and severely degraded containment. This could result from an earthquake with peak ground acceleration of 0.38g, much greater than the SL2 level. Recent work using probabilistic seismic hazard analyses has indicated that the Sydney basin has a peak zero period ground acceleration of 0.37g for an earthquake with a return period of 10,000 years. In response to a request from ARPANSA, ANSTO analysed the seismic response of HIFAR for such a hypothetical earthquake and concluded that it would be unlikely to result in a loss of coolant accident.

17.6. ANSTO has described the dispersion of radioactivity released from the HIFAR Reference Accident. The relationship between meteorological data, dispersion of released radioactivity and individual dose estimates to members of the public at and beyond the exclusion zone of 1.6 km is described in the HIFAR SAR.

17.7. ARPANSA considers as acceptable ANSTO's description of the characteristics of the site and the choice of the bounding loss-of-coolant accident (LOCA) as the Reference Accident. ARPANSA considers that the siting of HIFAR complies with its regulatory assessment principles on land use.

17.8. ARPANSA considers that the consequences of the Reference Accident meet the collective effective dose limit of 200 person-sieverts that is specified in its regulatory assessment principles, out to 25 km from HIFAR in the worst downwind direction.

The Replacement Research Reactor

17.9. On 7 April 1999, ANSTO applied to ARPANSA for a facility licence to prepare a site for the RRR. ANTSO proposed to build the RRR at the western end of the Lucas Heights Science and Technology Centre, adjacent to HIFAR. The site is within the existing perimeter fence and covers an area of approximately four hectares. ANSTO intends to maintain the buffer zone of 1.6 km, centred on the existing HIFAR facility, within which land-use restrictions apply and residential development is excluded. The distance from the RRR to the nearest residence (in an easterly direction) is about 1.8 km.

17.10. In its application for a licence to prepare the site for the RRR, ANSTO demonstrated that the site is suitable for the construction and operation of a reactor facility, while providing adequate protection to 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.

17.11. ARPANSA was satisfied with ANSTO's choice of Reference Accident to assess the radiological suitability of the proposed site. This accident was a reactivity induced core melt under water, with 25% instantaneous emission of fission product to atmosphere via a defective containment. In agreeing with this selection, ARPANSA accepted the argument that, in principle, a large loss of coolant accident that could drain the reactor pool can be excluded from consideration on the basis of high quality design of the reactor pool and its penetrations. It should be possible for the reactor to be designed so that even a severe earthquake, which may occur once every 10,000 years or more, would not damage the pool or the adjoining structures to the extent that water could leak away faster than it could be replenished from the supplies available. However, ARPANSA required this to be confirmed in the PSAR at the detailed design stage of the RRR as part of the application for a licence to construct the replacement reactor.

17.12. As for the consequences of the Reference Accident, ANSTO was able to demonstrate that:

- It would be feasible to develop and implement emergency arrangements to adequately protect people and the environment following the Reference Accident;
- The collective effective dose to the most exposed population that could result from the Reference Accident (22.6 man Sv) met the relevant criterion (limit of 200 man Sv), and that the calculated radiological impact of the Reference Accident on the population is acceptable; and
- There would be no long-term disruption to land use following the Reference Accident.

17.13. ARPANSA also considered that ANSTO had provided an acceptable description of the characteristics of the site and the site-related design bases. These design bases are taken into account in the PSAR for the construction of the RRR.

17.14. On 22 September 1999 ARPANSA issued a licence (with certain conditions) to ANSTO to prepare the site for the RRR.

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

17.15. 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.

17.16. The assessment of the proposal to site a RRR at Lucas Heights was undertaken prior to the entry into force of the *Environment Protection and Biodiversity Conservation Act*. Instead, it was undertaken under the *Environment Protection (Impact of Proposals) Act 1974*. Under that Act, a comprehensive environmental impact analysis was undertaken, encompassing the preparation of an environmental impact statement by ANSTO, the consideration of public submissions and an independent assessment by the Department of the Environment, in which international nuclear safety experts from the IAEA and elsewhere were involved. As a result of that analysis, the Minister for the Environment decided that there were "no environmental reasons, including on safety, health, hazard or risk grounds to prevent construction, subject to a number of conditions." Those conditions are being progressively implemented as the RRR project proceeds. ANSTO makes six-monthly reports to the Minister (which are subsequently made public) on the implementation of the conditions.

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 (defense in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

ii. the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

iii. the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

Formal Compliance

18.1. ARPANSA's Regulatory Assessment Principles and its Criteria for the Design of New Facilities are structured in terms of defence in depth.

18.2. The defence in depth principles are set at five levels. 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 envelops the levels below. The levels are successive, that is, 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.

18.3. Principle 2 of the Regulatory Assessment Principles requires 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.

18.5. Principles 48 to 53 of ARPANSA's Regulatory Assessment Principles address 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

18.6. In 2001, ARPANSA reviewed the application by ANSTO, including a Safety Analysis Report, for a licence authorising continued operation of HIFAR. This review considered the design of the operating facility against the Regulatory Assessment Principles. A summary of ARPANSA's findings, documented in a Safety Evaluation Report (SER) under the heading "Conservative Proven Design and Engineering Practice", is at Anne1 1.

18.7. In summary, ARPANSA was satisfied that, although HIFAR does not fully satisfy modern nuclear practice, the Safety Analysis Report demonstrated substantial compliance with Regulatory Assessment Principles for defence-in-depth.

18.8. Additionally, ARPANSA considers that the safe operation of all the DIDO class reactors over the period from the 1950s to the present, taking into account upgrades, is evidence of proven engineering practice in design, manufacture, construction, installation, commissioning, and operation.

Replacement Research Reactor

18.9. The RRR is being 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 2.

18.10. As reported in paragraph 14.8, ARPANSA issued a Facility Licence, Authorisation to Construct in April 2002 after review and assessment of ANSTO's Application for a construction licence and its Preliminary Safety Analysis Report. ARPANSA has closely monitored the construction process, including the fulfilment of Licence Conditions. ANSTO will submit an Application for a licence to operate and the Safety Analysis Report Rev 0 (the “final” SAR) in the third quarter of 2004. It is expected that the process of review and assessment by ARPANSA, issue of an operating licence (if so determined), followed by hot commissioning and achievement of full power licensed operation will extend to mid-2006.

18.11. Of particular note in the regulatory oversight of RRR construction is the requirement for ANSTO to gain the approval of the CEO of ARPANSA prior to commencing construction of safety category 1 and safety category 2 items (Regulation 54 of the ARPANS Regulations) and also gain the CEO’s approval for their commissioning. To date, approval to construct has been given for approximately 120 items.

18.12. A major issue during the construction phase was the discovery of a geological fault during excavation of the RRR sandstone foundations. Extensive scientific analysis by experts in geology and seismicity, retained by ANSTO, established that the fault was at least nine million, plus or minus four million, years old. After receiving independent expert advice that the fault was not “capable” as defined by the IAEA (IAEA Safety Guide 50-SG-S1, 1991) the CEO of ARPANSA determined that the seismic hazard analysis upon which the construction licence approval had been based remained valid. All site construction work was suspended during the four months it took to resolve the issue.

18.13. A final determination of the factual compliance of the RRR design and construction with Article 18 (including reliable, stable and easily manageable operation) can only be made after satisfactory completion of the work that would lead to licensed full power operation of the reactor.

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. The first stage of ARPANSA's licensing process involves a detailed assessment of ANSTO's general plans and arrangements for safety. The second stage of the licensing assessment process is the assessment of the local plans and arrangements for the management of each conduct and dealing at the facility and divisional level.

19.2. The second stage includes a detailed assessment against ARPANSA's Regulatory Assessment Principles and Expectations Guidelines. Further licence applications are required for subsequent stages in the life of a facility, such as decommissioning.

Factual Compliance

19.3. HIFAR started operating before a formal regulatory regime was implemented. Prior to the issue of HIFAR's operating licence by ARPANSA in June 2001, HIFAR operated under an Authorisation from the Board of ANSTO requiring the Executive Director to comply with conditions set by the Nuclear Safety Bureau (which is now ARPANSA's Regulatory Branch).

19.4. The NSB authorisation was based on a thorough deterministic safety analysis that took into account the recommendations of the IAEA and the results of the HIFAR PSA, which analysed accident sequences and demonstrated the robustness of the design. Modifications to the installation over its life have been subjected to regulatory requirements.

19.5. After establishment of the new regulatory regime, ANSTO applied for an operating licence from ARPANSA in August 1999. The licence was granted in June 2001 following an evaluation of the application against the ARPANS Regulations and ARPANSA's Regulatory Assessment Principles and Guidelines. Relevant details of how ANSTO met ARPANSA's requirements and principles for the operating licence have been provided in the earlier sections of this report and are also covered under the relevant headings below.

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

19.6. The ARPANS Regulations (Schedule 3 Part 1) require ANSTO to demonstrate that limits of normal operation and anticipated operational occurrences and safety system settings for HIFAR, including the minimum plant configuration, are determined from safety analysis and that HIFAR operation is constrained within the demonstrated safety envelope (Regulatory Principles 63 and 64 address these requirements).

19.7. 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.

Factual Compliance

19.8. At the request of the NSB in 1992, ANSTO undertook a program for the overall upgrading of the initial authorisation for HIFAR. This was completed in April 1995. The primary objective of the upgrading was to ensure that the safety arrangements in the initial authorisation, addressing the Bureau's conditions, were consistent with international safety standards for research reactors. In 1995, the NSB reviewed in detail the upgraded documentation against its expectations for the initial authorisation and concluded that ANSTO had met the upgrade requirement.

19.9. Regulation 50 of the ARPANS Regulations 1999 obliges ANSTO to review and update at least once every 12 months any plans and arrangements for managing HIFAR. The results of the review must be reported to the CEO of ARPANSA.

19.10. An extensive evaluation by ARPANSA staff of ANSTO's SAR for HIFAR was carried out following ANSTO's application for an operating licence in August 1999. The SAR contained the operating limits and conditions for HIFAR. The HIFAR Safety Evaluation Report prepared by ARPANSA staff contained recommendations for special licence conditions and safety improvements. These outstanding items were included in the HIFAR operating licence issues in June 2001. The outstanding items have been addressed by ANSTO and reported through quarterly and annual reports to ARPANSA.

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

Formal Compliance

19.11. The need to demonstrate the safety of HIFAR throughout all stages of its life is addressed by the Regulations and by Regulatory Assessment Principle 5 (a).

19.12. Principle 65 addresses the need for ANSTO to demonstrate that inspection, testing and maintenance procedures in HIFAR were documented and implemented to confirm and maintain availabilities and reliabilities of systems at the levels used in the safety analysis and to avoid common cause failure. The Principle also addresses the need for appropriate frequencies for inspection, testing and maintenance at HIFAR to avoid degradation of safety.

Factual Compliance

19.13. Before the licence to operate HIFAR was issued to ANSTO in June 2001, ARPANSA assessed that ANSTO had in place plans and arrangements for managing safety in HIFAR, which cover the range of operational activities that ARPANSA's Regulations require ANSTO to cover. These plans and arrangements cover the control of the facility, safety management, radiation protection, radioactive waste management, decommissioning plans, security and emergency planning.

19.14. ANSTO's safety management policies for its Lucas Heights site as a whole are given in the applicable Safety Directives. These directives provide a generic safety management framework and are applicable to HIFAR.

19.15. The arrangements for inspection, testing and maintenance are set out in a HIFAR procedures document that provides for cycled maintenance activities, which include procedures for testing, inspection, checking and adjusting, and overhaul and replacement. Special arrangements are in place for engineered safety provisions, and all maintenance, testing and inspections of engineered safety provisions are the responsibility of a designated officer.

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

Formal Compliance

19.16. ARPANSA assesses whether limits of normal operation and anticipated operational occurrences and safety system settings for HIFAR, including the minimum plant configuration, were determined by ANSTO from safety analysis (Regulatory Assessment Principle 63), and that HIFAR operation was constrained within the safety system settings (Principle 64).

Factual Compliance

19.17. ANSTO's Event Response System, which is documented in a safety directive, 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.

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

Formal Compliance

19.18. ARPANSA's assessment principle is specified in Regulatory Assessment Principle 4(a), which requires ANSTO to demonstrate that it has detailed plans and periodic reviews with measurable outcomes that show that ANSTO has adequate managerial structure and resources.

Factual Compliance

19.19. As mentioned above in the report under Article 11, about 10% of ANSTO's 800 staff members are 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.

19.20. Most of the safety staff work in ANSTO's Safety and Radiation Science Division. Their activities 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.

19.21. ANSTO's Engineering Services Division provides engineering support to all ANSTO Divisions and also undertakes the maintenance of site facilities. Its scope of activities is very wide, ranging from design and manufacture of precision components for the HIFAR reactor to the total project management of multimillion-dollar construction projects. In particular, the Division is able to support ANSTO's Safety Division through its ability to provide comprehensive engineering quality control, inspection, testing and calibration services and facilities. The Division is certified to AS/NZS ISO 9001 quality system standard.

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

Formal Compliance

19.22. 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. 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.

19.23. 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

19.24. Under the HIFAR quality system, ANSTO implements a process for identifying, recording, analysing and reporting to ARPANSA abnormal occurrences and accidents. ANSTO has satisfactorily met its reporting obligations.

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

19.25. ARPANSA’s assessment principles are provided in Regulatory Assessment Principles 8 and 16, which are as follows:

(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:

- Revised safety analyses, design modifications, revised procedures and revised quality assurance systems; and
- Personnel performance assessment and counselling and retraining (Principle 16).

Factual Compliance

19.26. 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 HIFAR.

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

19.27. 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).

Factual Compliance

Management of spent fuel and radioactive waste

19.28. Arrangements for the management of spent fuel and radioactive waste at HIFAR are subject to a certified quality system. Current instructions cover 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.

19.29. HIFAR procedures and instructions for the handling of fuel and radioactive materials and treatment, storage and disposal of radioactive solid, liquid and gaseous wastes have been updated, in compliance with a licence condition imposed in 2001 by the CEO of ARPANSA. The updating addresses arrangements for the minimisation, control and safe acquisition, handling, treatment, transport, storage, transfer, discharge and disposal of all controlled material, including radioactive waste and radiation sources. This includes heavy water, ion exchange column resins, irradiated rigs, materials stored in reactor top plate and No. 1 Storage Block mortuary holes, HEPA filters, radiation sources, radioactive samples, and other contaminated components, and all radioactive waste that may arise from operations at HIFAR.

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

19.30. The ANSTO Radioactive Waste Management Policy is committed to the maintenance of waste from source to disposal. HIFAR arrangements for gaseous and liquid discharges have been established. The basis for calculating off-site doses from HIFAR gaseous discharge and pathways is the code PC CREAM, a computer code developed by the United Kingdom National Radiation Protection Board under a contract for the European Commission. The ANSTO Trade Waste Agreement with Sydney Water, the regional water utility, is the basis for HIFAR liquid discharges.

19.31. ANSTO has set a limit of 30,000 Bq/ml on the tritium allowed in the weekly blowdown to the RCB pit tank. There are no other specific values for the safe amount or concentration for the HIFAR discharge to the HIFAR delay tanks. This is consistent with the ANSTO policy of collecting all site liquid discharges in central treatment tanks before discharge.

19.32. The ANSTO Radioactive Waste Management Policy governs the safe management of radioactive waste from generation to its disposal, including the maintenance of the inventory (ANSTO Safety Directive 5.7).

Packaging and containment of radioactive waste

19.33. 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.

19.34. Since the last National Report, ANSTO has put in place detailed procedures and instructions for radioactive waste minimisation at HIFAR.

Interim storage of spent fuel and radioactive waste

19.35. ANSTO has a Waste Management Section Procedures Manual for the storage of radioactive materials. HIFAR spent fuel is stored immediately in the No. 1 Storage Block, which has mortuary holes that are used for interim storage of radioactive materials, including ‘ragged ends’ of fuel elements that are re-used, as well as waste radioactive material. The storage block is a doubly contained tank and is above groundwater. External hazards (including earthquakes) have been considered in the design of the storage block.

19.36. The reactor top plate mortuary holes are used to store miscellaneous radioactive waste items (for example, flux scan wires). Other than storage for spent fuel and storage in the reactor top plate mortuary holes and No. 1 Storage Block mortuary holes, there is no interim store for radioactive waste at HIFAR. There is also storage of some low-level solid waste for short periods.

19.37. ARPANSA considers that the interim storage within HIFAR of radioactive waste is acceptable.

Documentation of radioactive waste

19.38. A quarterly report on waste discharges from HIFAR is submitted to ARPANSA as required by the HIFAR license conditions.

19.39. The liquid waste discharge from HIFAR is to on-site storage and ultimately to the Sydney Water sewer as part of the site general discharges. 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 derived concentration limits for drinking water. HIFAR liquid discharges are part of the site general discharges.

19.40. ARPANSA considers that routine discharge from HIFAR 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. However, ARPANSA considers that, in order to meet international best practice, the levels and concentrations of the various radioactive nuclides in the liquid waste should be measured at discharge from HIFAR.

Routine discharge of radioactive waste to the atmosphere

19.41. The document, HIFAR Operational Limits and Conditions, covers airborne discharges from HIFAR and gives notification and correction levels for four-weekly, quarterly and annual sampling periods. These have been agreed with ARPANSA. Any discharge beyond limits would be reported, as a violation of the OLC, as an abnormal occurrence. The correction levels are a factor of five greater than the notification levels and are based on the dose constraint of 0.1 mSv/y set for the public dose from HIFAR discharges. ARPANSA is informed monthly on gaseous and liquid discharges.

19.42. 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 airborne discharges, the Notification Levels and Correction Levels specified by ARPANSA and the actual values for the last four years from ARPANSA Annual Reports.

Annual Notification Levels and actual levels for 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 2000-01	147	6.7	2.4	
Actual 2001-02	143	5.2	1.9	
Actual 2002-03	107	4.9	2.9	
Actual 2003-04	121	8.5		3.1

Note 1: MSD means during major shutdowns.

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

Routine discharge of solid radioactive waste to the municipal tip

19.43. Routine discharge in this manner does not occur.

Routine discharge of radioactive waste by incineration.

19.44. Routine discharge in this manner does not occur.

Management of ultimate disposal or transfer of radioactive wastes.

19.45. 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 are covered by the ANSTO licence for Waste Operations.

Spent fuel management strategy

19.46. The Commonwealth Government decided in 1997 that part of an appropriate management strategy for the 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.

19.47. 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 will include the spent fuel plates from Moata.

(b) 114 fuel rods have been sent to the UK and the long lived intermediate level waste (LLILW) is expected to return around 2020.

(c) The balance of HIFAR fuel rods of non-US origin are being 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.

To date, over half of the life-time arisings of spent fuel from HIFAR have been sent overseas under the above arrangements.

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 the replacement reactor.

Article 11 – Financial and Human Resources

1. It is anticipated that HIFAR will be permanently shut down during 2006, following successful commissioning of the RRR. It is important that during this period of the remaining life of HIFAR and parallel commissioning and operation of the replacement reactor that the licence holder maintains adequate human and financial resources for both reactors. Particular attention is required to maintain the morale of HIFAR operators and safety culture of the HIFAR operating organisation. ARPANSA will continue regulatory monitoring of these matters. This could include a repeat of a safety culture audit of HIFAR conducted in 1999.

Article 14 – Assessment and Verification of Safety

2. ARPANSA will continue to monitor construction and cold commissioning of the RRR for compliance with the licence authorising construction.

3. During the third quarter of 2004, it is anticipated that ANSTO will apply for a licence authorising operation of the RRR. ARPANSA will assess the application against the matters set out in the ARPANS Act and Regulations and regulatory guidance documents. These matters include ‘international best practice in radiation protection and nuclear safety’, ‘undue risk’ to people and the environment, application of defence in depth and safety culture principles.

Annex 1 – HIFAR Reactor

1. The report below is a summary of ARPANSA's findings in its Safety Evaluation Report (SER) for HIFAR under the heading "Conservative Proven Design and Engineering Practice". The SER was the basis on which HIFAR was issued a licence to operate in June 2001.

General Design

2. HIFAR is one of six DIDO-type reactors first operated in the late 1950s. The design of HIFAR is essentially the same as the DIDO reactor that was built at Harwell in England in 1955/56. The DIDO-type reactors have operated safely with a high availability for the past 40 years, although only two are now operating, namely HIFAR in Australia and FRJ-2 in Germany. The British and Danish DIDO-type reactors have all been shut down, for policy rather than safety reasons.
3. There are differences in power, type of fuel and system and detailed design between the DIDO class reactors. However, all the reactors are the same in design principle, namely: the reactor comprises a small core of highly enriched fuel, moderated, reflected and cooled by heavy water, contained in an aluminium tank and surrounded by a further reflector of graphite. These are contained in and supported by a steel tank, which in turn is surrounded by thermal and biological shields. The reactors are supported at first floor level, inside the reactor containment building over a plant room containing the primary pipe work. The use of enriched fuel, heavy water moderator and reflector, and aluminium as the reactor structural material, has resulted in high neutron flux for a small investment in fuel and a modest reactor power.
4. The construction of HIFAR was supervised by the Australian Atomic Energy Commission, working with the Australian and British contractors during the erection, testing, and commissioning phases.
5. Criticality at HIFAR was first achieved in January 1958, and routine full-power operation commenced two years later. Since coming to power in January 1960, HIFAR has operated safely and with a high availability, and has proved under operational conditions to be a most reliable and flexible reactor for in-pile experiments, beam experiments, and the production of radioisotopes.

Reactor protection system

6. The HIFAR SAR describes the reactor protection system (RPS), namely the combined assembly of instrumentation and neutron absorber systems which automatically causes the reactor to be shut down in response to certain operating limits being exceeded. It consists of: a complete shutdown system (CSS), which makes the reactor sub-critical by dropping the coarse control arms and the safety rods; the restricted trip system (RTS), which shuts down the operating reactor by dropping the coarse control arms (CCA); and the control reversal system (CRS) which automatically reduces power by driving the CCA into the reactor core.
7. The design of the RPS reflects the British approach to nuclear safety in the 1960s, and involves conservative rating, considerable levels of redundancy and trip parameter diversity.
8. The HIFAR CCAs are included in the safety shutdown system (SSS), and are thus part of the reactor protection system (RPS). The CCAs are also part of the process

control system to control the neutron flux in the reactor by absorbing excess neutrons. Extensive use is made of interlocks in the HIFAR control circuits to restrict the conditions under which an operator can raise the CCAs. In the case of a complete trip, both the CCAs and safety rods (SRs) are inserted, while in a restricted trip only the CCAs are inserted. The SRs are not used for process control purposes, they are strictly for safety, but they control significantly less reactivity than the CCAs. Like the CCAs, the SRs are dependent on gravity, which limits their drop time to about 1 second.

Emergency core cooling system

9. The HIFAR emergency core cooling system (ECCS) has been designed to protect the reactor core from damage during a loss-of-coolant accident (LOCA), by maintaining a flow of coolant through the fuel element channels. Since the primary cooling water system pipe work is in a plant room directly below the reactor tank, any leak has the potential to drain the reactor aluminium tank (RAT).

10. The ECCS system is redundant and consists of two independent scavenge pump systems, activated automatically by instrumentation which senses the level of heavy water in the RAT. Since it is an active system, and relies on electrical power, the redundant ECCS pumps are fed from separate power supplies, each with a stand-by supply from a diesel.

11. The emergency cooling arrangements and residual (or decay) heat removal system are part of the redundant ECCS. The ECCS provides emergency make up of water on a loss-of-coolant accident by means of two scavenge pumps which return water spilt onto the heavy water plant room floor back into the RAT. In normal operation the RAT level is maintained by liquid level pumps which continuously draw water from a storage vessel and deliver it to the RAT through ion exchange columns.

12. The design of the ECCS reflects the evolving approach to nuclear safety in the 1970s and 1980s. It involves conservative rating, two levels of redundancy, and experimental work on thermal hydraulics specific to the HIFAR and the DIDO design. Since its installation, the ECCS has been extensively tested on a routine basis to confirm continued operability and has undergone several tests under simulated accident conditions. Improvements have been made to the system as a result of these tests. The ECCS is regularly tested, and the HIFAR operational limits and conditions set operating margins and define availability requirements for various modes of reactor operation.

Reactor containment building

13. The reactor containment building (RCB) is the cylindrical steel dome-roofed structure housing the reactor and much of its ancillary plant and experimental equipment. The RCB acts together with the containment isolation system (CIS) and space conditioning system (SCS) to prevent or mitigate the release of fission products to the atmosphere, should fuel damage occur. For each penetration of the RCB, the CIS has redundancy and in some cases diversity. The SCS has three redundant sub-systems.

14. The SCS runs continuously at ‘house load’, but is not tested under emergency loading conditions which involve steam conditions and high heat removal from the RCB. Weekly tests are carried out to check that the containment isolation system (CIS) automatically closes on a radiation level signal.

15. The design of the RCB and its penetrations reflects the conservative design approach for nuclear reactors in the 1950s, with an emphasis on passive containment.

Electrical power supply system

16. The electrical power supply system (EPSS) is an Engineered Safety Provision (ESP) since it provides power to other active ESPs, such as the ECCS pumps and the SCS compressors. The line supply systems and components are designed to Australian standards, but the stand-by supply (or ESP component) uses design guidance from nuclear power standards, such as IEEE-308-1980, IEEE-384 and some German standards.

17. The EPSS was upgraded in the 1980s and is regularly tested, and the HIFAR operational limits and conditions set operating margins and define availability requirements for various modes of reactor operation.

Emergency control room

18. The HIFAR Emergency Control Room (ECR) is an ESP, designed to be occupied if the RCB becomes uninhabitable. Its purpose is to provide information on the course of accidents, to be a control centre for monitoring and controlling the containment, and to be a safe refuge for operating staff. The ECR, which has been upgraded, has passive and active features, with the passive features provided by the shielding, and the active features consisting of a filtered ventilation system. The filtration system has elements of redundancy, with independent fans, charcoal filters and high efficiency particulate absolute filters. Only one fan can be run at a time, but this is sufficient to protect the operators from particulates or iodine fission products sucked into the ECR from the external environment. Due to its proximity to HIFAR, staff change-over during an accident takes into account any significant radiation shine from the RCB.

19. The ECR ventilation system is regularly tested, and drills and exercises are routinely carried out to test the readiness of the ECR. The HIFAR operational limits and conditions set operating margins and define availability requirements for various modes of reactor operation.

20. The reactor is monitored and controlled from the reactor control room (RCR). The Emergency Control Room (ECR) is maintained as habitable during design-basis accidents by the provision of shielding and filtered ventilation. No ergonomic standards are specified for the control room design. It reflects the approach of the 1950s and 1960s. The reactor has been operated within the constraints of this design since 1960, although there have been many modifications to take advantage of new technology, and to reflect changes in the design of engineering safety provisions and process plant.

21. The quality certification of the reactor’s management systems to AS/NZ ISO 9000 in 1997 had a beneficial impact in improving human factors aspects associated with operations, in particular revised procedures and instructions for operations, maintenance and modifications.

22. Section 9 of the HIFAR PSA describes human performance assessment. The plant-operator interface was considered, including: indications from instrumentation; adequacy of time to accomplish the action; preceding and concurrent action; stress on the operator; training and experience; and the availability of procedures and operational aids. The HIFAR PSA includes a Failure Likelihood Index (FLI), which

takes into account the factors above, including man-machine interfaces appropriate for the control room design and general availability of controls within the RCB. Some of the recommendations of the HIFAR PSA reflect the importance of human factors to HIFAR safety.

23. Extensive use is made of interlocks in the HIFAR control circuits to restrict the conditions under which an operator can raise the CCAs.

24. The initiation of all safety systems at HIFAR is automatic, apart from the activation of the active systems in the emergency control room following evacuation of operators from the RCB. The HIFAR PSA recommended the automation of the reactor aluminium tank (RAT) flooding system. However, as with all accident management measures the actions would be under human control, and the automation refers only to remote operation capability.

Owner\Operator		Australian Nuclear Science and Technology Organisation
Location		Lucas Heights, Sydney
Criticality		1958
Reactor type		Tank type research reactor
Fuel	Type	Coaxial tube elements
	Material	Uranium/aluminium alloy, aluminium clad
	Number of elements	25
	Removal rate	Average 3 elements every 35 day operating cycle
	Total weight U-235	2.7 – 3.3 kg
	Enrichment	60%
	Peak neutron flux	1.4×10^{14} n/cm^2/sec
Thermal power		10 MW
Primary coolant		D_2O
	Flow rate	400 kg/sec
	Inlet temperature	44^{o}C
	Outlet temperature	50^{o}C
Secondary coolant		H_2O
	Flow rate	355 kg/sec
Tertiary coolant		Air cooled towers, pond
Moderator		D_2O
Inner reflector		D_2O
Outer reflector		Graphite
Blanket gas		Helium
Control system		6 stainless steel clad signal arm type, cadmium/europium tip 2 safety rods
Experimental facilities		30 horizontal holes 28 vertical holes plus 25 hollow fuel elements
Containment building		Air-tight steel shell 21 m diameter, 21 m high
Operating staff		1 engineer on site 4 shift staff 1 health physics surveyor
Exclusion boundary		1.6 km

ANNEX 2 - Replacement Research Reactor

1. The RRR 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 is the Argentine company INVAP SE in contract with Australian construction and engineering companies.
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 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. 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 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 ensures the continued habitability of the emergency control centre in case the Main Control Room requires evacuation.

19. 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 x 10^{14} n cm^{-2} s^{-1}
Average core fast flux (BOC)		1.27 x 10^{14} n cm^{-2} s^{-1}
Average core thermal flux (End of Cycle – EOC)		1.15 x 10^{14} n cm^{-2} s^{-1}
Average core fast flux (EOC)		1.31 x 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

Annex 3 - Glossary and Acronyms

AHSEC	ANSTO Health Safety and Environment Committee
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)
CCA	Coarse Control Arms
CEO	The Chief Executive Officer of ARPANSA
CIS	Containment Isolation System
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.
CRS	Control Reversal System
CSS	Complete Shutdown System
DIDO	A class of heavy water cooled and moderated tank-type research reactor
DISPLAN	Disaster Plan of the State of New South Wales
ECCS	Emergency Core Cooling System
ECR	Emergency Control Room
EPSS	Electrical Power Supply System
ESP	Engineered Safety Provision
FLI	Failure Likelihood Index
FSAR	Final Safety Analysis Report
HEPA	High Efficiency Particulate Absolute
HIFAR	High Flux Australian Reactor

HSD	HIFAR Safety Document
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IEEE	Institute of Electrical and Electronic Engineers
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 by ARPANSA to perform specified activities related to a controlled facility
LOCA	Loss of coolant accident
mSv	Millisievert
NHMRC	Australian National Health and Medical Research Council
NSB	Nuclear Safety Bureau
NSW	New South Wales – one of the states in Australia and the one in which HIFAR is located
Nuclear installation	Any land-based civil nuclear power plant under the jurisdiction of the Contracting Party including such storage, handling and treatment facilities for radioactive materials as are on the same site and are directly related to the operation of the nuclear power plant. Such a plant ceases to be a nuclear installation when all nuclear fuel elements have been removed permanently from the reactor core and have been stored safely in accordance with approved procedures, and a decommissioning program has been agreed by the regulatory body. Australia has no nuclear power plant, and none are planned. This report addresses Australia's only operating nuclear research reactor.
OL&Cs	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
RAT	Reactor Aluminium Tank
RCB	Reactor Containment Building
RCR	Reactor Control Room
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

RRR	Replacement Research Reactor
RTS	Restricted Trip System
SAC	ANSTO’s Safety Assessment Committee
Safety Directives	ANSTO documents setting organisation-wide safety policies
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

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