AUSTRALIA

Commonwealth of Australia

Convention on Nuclear Safety

Australian National Report

October 2001

AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY ARPANSA

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”, and none is planned. Section 10 of the *Australian Radiation Protection and Nuclear Safety Act 1998* prohibits the Chief Executive Officer (CEO) of the Australian Radiation Protection and Nuclear Safety Agency 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 New South Wales (near Sydney).

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. ANSTO plans to operate a replacement research reactor (RRR), which, if it comes into operation as planned in 2005, will replace HIFAR. The proposed replacement research reactor (RRR) would be a 20 MW pool-type facility with a higher neutron flux than HIFAR and superior neutron beam handling capability. To meet obligations in relation to non-proliferation, the reactor would use low-enriched uranium fuel.

6. The RRR would be housed in a containment building, which would also include the primary cooling circuit and most of the auxiliary plant. The reactor pool would be 12.6 metres deep and of thick-walled reinforced concrete construction. The reactor core would sit towards the bottom of the pool. A service pool, contiguous with the reactor pool, would handle irradiated materials and provide for the interim storage of spent fuel. A neutron guide hall is also proposed for construction adjacent to the reactor building. This would contain experimental stations and instrumentation for neutron beam research purposes.

7. A Facility Licence authorising site preparation for the RRR has been issued by the CEO, ARPANSA as described under Article 17 below. ANSTO has submitted an application for an Authorisation to Construct as described under Article 14 below.

Safety issues arising from the last report

8. Two safety issues were identified in the Australian National Report to the First Review Meeting of the Contracting Parties (12 to 23 April 1999). These were:

(a) The need for a legislative framework that provides for proper licensing of operations and enforcement of safety of Australia's nuclear plants and research reactors.

(b) The need to upgrade the HIFAR research reactor.

9. A new legislative framework that provides for the licensing of design, construction, operation and decommissioning of nuclear facilities, including research reactors, was implemented in 1999. Details of the framework are provided in the text of this report under Article 7. The need to upgrade the HIFAR research reactor has been overtaken by the Commonwealth Government's decision to build the RRR. However, conditions to implement further improvements to the safety of HIFAR have been attached to the Facility Licence, Authorisation to Operate issued by the CEO, ARPANSA as summarised at the end of this report.

Summary of significant changes since the last report

10. Several changes have occurred. These are explained in detail in the main body of the report. In summary, the changes are:

(a) The Australian Radiation Protection and Nuclear Safety Act 1998 was passed.

(b) The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) was established to regulate all Commonwealth entities and Commonwealth contractors, bringing ANSTO under the regulatory oversight of ARPANSA.

(c) The Nuclear Safety Bureau, which previously had oversight over the safety of ANSTO's operations, was reconstituted as ARPANSA's Regulatory Branch.

(d) The Government made a decision to build a replacement research reactor which, when fully operational and licensed, would replace HIFAR.

(e) HIFAR, which previously operated with an authorisation from the Board of ANSTO requiring the Executive Director to meet conditions set by the NSB, was licensed by ARPANSA.

(f) The decommissioning of the Moata reactor has moved to the second stage, and ARPANSA has issued a decommissioning licence.

(g) ARPANSA has issued a licence for the storage of accumulated spent fuel from HIFAR and Moata.

(h) ARPANSA has issued a licence authorising preparation of a site for the proposed research reactor to replace HIFAR.

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 the IAEA's 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 are:

- 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 (near Sydney) (See **Annex 1** for details).
- The Moata Research Reactor. This is a 100 kW(t) Argonaut university type research reactor at Lucas Heights.

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.

6.3. Measures taken from 1992 to 1995 to reinforce the safety arrangements for HIFAR were reported in the last Australian National Report. ANSTO adequately addressed the recommendations made to it by the then regulatory body, the Nuclear Safety Bureau. The last Australian National Report also stated that significant refurbishment of HIFAR would be required if the reactor was to continue to operate beyond 2003, when it would have operated for 45 years.

6.4. In 1998, the Commonwealth Government announced its intention to replace the HIFAR reactor with a modern research reactor, with operation planned to commence in 2005. The decision to build a reactor to replace HIFAR has negated the need to plan the refurbishment of HIFAR.

Overview of safety assessments and measures for safety upgrading

HIFAR research reactor

6.5. The promulgation of the ARPANS Act and Regulations in 1998 and creation of ARPANSA in 1999 meant that ANSTO had to apply for an ARPANSA licence to operate HIFAR. Under the ARPANS Act and Regulations, an applicant for a facility licence must demonstrate acceptable plans and arrangements for managing safety of operations and present a safety case for the safety of the facility design. ARPANSA reviews the application to determine whether the facility can be operated without undue risk to the health and safety of people and the environment. The CEO may issue a licence and attach conditions to ensure the safety of operations.

6.6. ANSTO applied for a licence to operate HIFAR on 5 August 1999. The application was evaluated against legislative requirements and ARPANSA's Regulatory Assessment Principles and Guidelines, and ARPANSA prepared a Safety Evaluation Report (SER).

6.7. The Final Safety Analysis Report (FSAR) for HIFAR was the 1996 HIFAR Safety Document. This was updated and revised for public release in July 2000. Further, the report of the HIFAR Probabilistic Safety Assessment (HIFAR PSA) was released to the public in 1998. HIFAR was designed in the 1950s, before nuclear safety philosophy and standards were formalised. Nevertheless, the examination carried out by the ARPANSA assessors, operating experience of HIFAR and the other DIDO type reactors, and the HIFAR PSA show that the reactor, taking into account upgrades, is based upon proven engineering practice in design, manufacture, construction, installation, commissioning and operations.

6.8. There has been a substantial program of updating HIFAR plant, procedures, and safety analyses over the years. This has included:

- Production of a HIFAR Safety Document in 1972; supplemented in 1982 and extensively revised in 1996;
- Issue of an Authorisation to Operate HIFAR in 1983;
- A major reactor refurbishment program in the 1980's including upgrading of the electrical power supply; installation of the emergency core cooling system and improvements to the reactor containment system;
- Separate documentation of Operational Limits and Conditions in 1998;
- The HIFAR PSA in 1998;
- The major upgrade to HIFAR documentation leading to QA certification under ISO standards in 1997.

6.9. Although HIFAR would not fully meet modern standards, the ARPANSA review and the HIFAR FSAR 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.

6.10. ARPANSA issued ANSTO with a licence to operate HIFAR (subject to certain licence conditions) in June 2001. Among the licence conditions is one that requires ANSTO to submit any application for continued operation of HIFAR substantially beyond 2006 to ARPANSA by no later than January 2005. This would require review of the safety case against modern standards.

Moata

6.11. 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 in a facility adjacent to the reactor, awaiting return to the United States.

6.12. In the last Australian National Report in 1998, it was reported that Moata had been permanently shut down and the fuel removed. Moata has since entered the second stage of decommissioning, and ARPANSA has 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 Australian Radiation Protection and Nuclear Safety Act 1998 was passed by the Commonwealth parliament in 1998. The Act established the statutory office of the Chief Executive Officer of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The Act applies to Commonwealth entities and Commonwealth 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 States and 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 agency. ANSTO is not generally subject to the health and safety legislation or regulation 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 were made under the ARPANS Act. The Act and the Regulations constitute the first tier documents in the framework under which ARPANSA manages the 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) *ARPANSA Expectation Guideline*, July 2000, Version 2 ;

(c) *Regulatory Assessment Principles for Controlled Facilities*, 2001 and

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

7.5. The ARPANSA Expectation Guideline 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 document is 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. It draws 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) 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 the CEO of ARPANSA. This part also prohibits the dealing with a controlled material or controlled apparatus without a source licence issued by the CEO. The CEO 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 a 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 of, take samples of, 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 that 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 entities. ANSTO is a Commonwealth entity and is the only organisation in Australian 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:

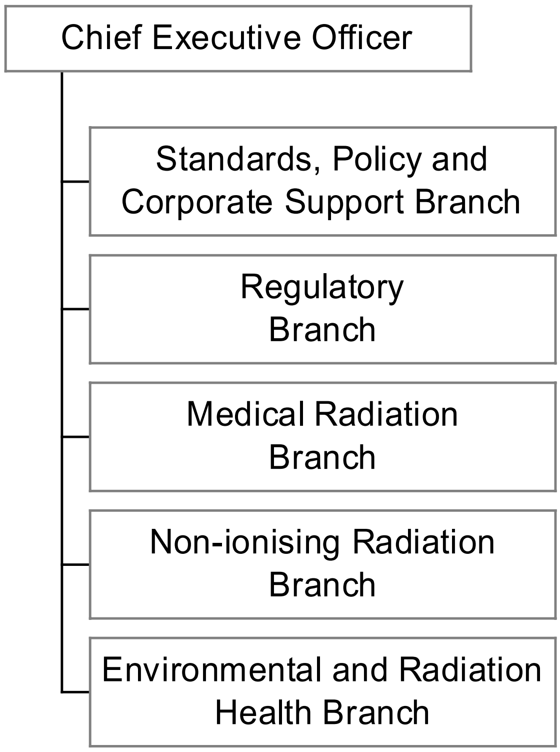
- Promotion of national uniformity of radiation protection and nuclear safety policy and practices across the jurisdictions of the Commonwealth of Australia, the States and Territories;
- Provision of advice on radiation protection and nuclear safety;
- Undertaking research and providing services in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

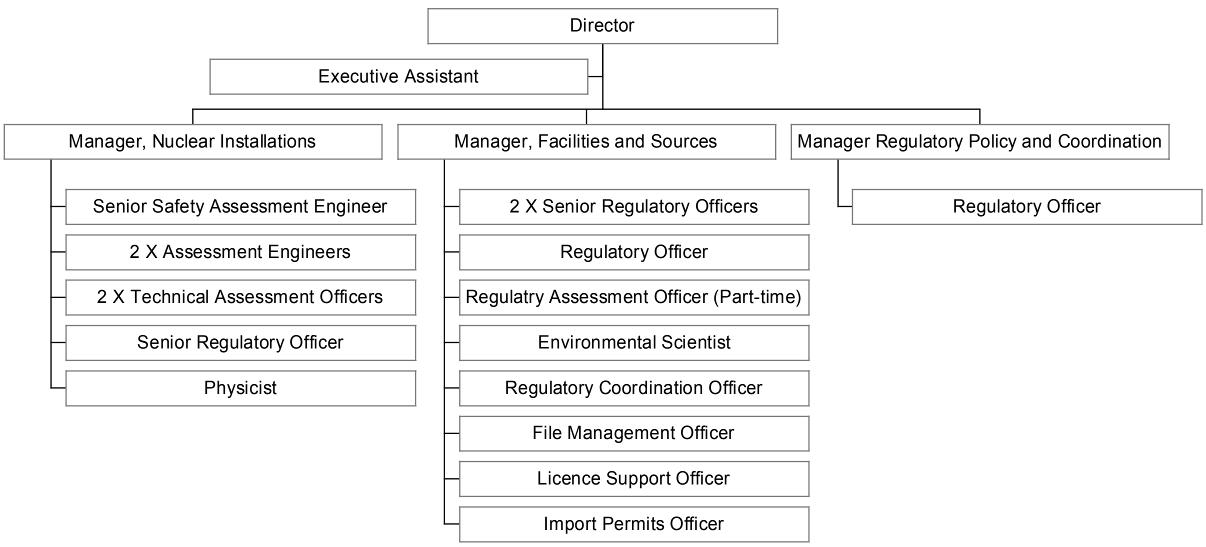
8.5. ARPANSA currently has 126 staff. The staff comprises a mixture of scientists, engineers, lawyers, policy professionals and administrative support personnel. The ARPANSA Regulatory Branch comprises 20 staff. ARPANSA's financial needs are adequately met through budget appropriation and licence fees. 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 Structure



Regulatory Branch - ARPANSA



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;
- undertakes inspections of licensed activities to confirm compliance with legislative requirements;
- investigates incidents; and
- takes any enforcement actions 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 fcilities such as the nuclear research reactor operated by ANSTO and the proposed replacement research reactor, large radioisotope production facilities and large radioactive waste facilities;
- 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 entities. The enabling Acts under which the two organisations were established and operate are distinct. ARPANSA operates under the Australian Radiation Protection and Nuclear Safety Act 1998. ANSTO operates under the Australian Nuclear Science and Technology Organisation Act 1987.

8.10. The CEO of ARPANSA comes under the Health and Aged Care portfolio, whilst ANSTO comes under the Industry, Science and Resources portfolio. 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 Minister for Health and Aged Care.

(d) The requirement for the Minister of Health and Aged Care to table in parliament any direction that he makes to the CEO of ARPANSA.

(e) 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 the 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 the Regulatory Branch regularly monitor and review the operations of ANSTO to ensure that the Organisation meets its responsibility for safety as spelled out in the legislation and ARPANSA’s regulatory guidelines and in the conditions attached to the HIFAR operating 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 authority and responsibility. 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 Environmental Monitoring Committee, the Safety Assessment Committee, and the Facilities Safety Unit. The interactions between these committees and the Facilities Safety Unit are also provided for.

9.6. Since ARPANSA was formed there has been no breach of its legislation by ANSTO.

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 obrained from 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 and State laws and regulations on health, safety and the environment;

(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 1999/2000, revenues from the Government formed 76% of ANSTO's A$133.9 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 had to demonstrate to ARPANSA's satisfaction that all necessary steps have been and will be taken to ensure that ANSTO's resources are adequately skilled and experienced in safety before ANSTO's HIFAR operating licence was issued in June 2001.

11.6. 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.

11.7. Most of the safety staff work in ANSTO's Safety 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. In addition, ANSTO has also undertaken internal strategies to ensure that its staff is 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.

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 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

13.2. 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.

13.3. A formal HIFAR quality assurance program has existed since May 1997, and certification to AS/NZS ISO 9001-1994 has been given to the HIFAR quality systems. This 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.

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. The 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" (FSAR) 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 a 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. 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.

14.8. A Facility Licence, Site Authorisation was issued by ARPANSA for the Replacement Research Reactor (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 has been submitted in May 2001 with the application for a Facility Licence, Authorisation to Construct. ARPANSA's assessment will take account of a Peer Review by an IAEA team and public comment; a successful outcome of the assessment would provide the basis for issue of a Authorisation to Construct early in 2002. The PSAR will be developed into the FSAR during the detail engineering, construction and commissioning phases to provide a basis for the final Authorisation to Operate.

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

14.9. 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

14.10. 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.

14.11. 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.

14.12. 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 assessed in determining that ANSTO adheres to the radiation protection requirements and principles.

15.2. Essentially, ARPANSA assesses that 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 calender years for occupational exposure. However, the effective dose for an occupationally exposed person imust 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 3.2 (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 1998 to 2000.

Effective dose for HIFAR staff groups - 1998

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Engineering	20.53	0.98	1.44
General Operations	9.76	1.39	1.81
Active Handling	33.63	3.74	4.98
Maintenance	17.74	1.37	2.18
Reactor Operators	64.28	3.22	4.11
Shift Supervisors	30.87	5.15	5.6

Effective dose for HIFAR staff groups - 1999

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Engineering	16.5	0.83	1.32
General Operations	7.83	1.12	1.75
Active Handling	31.67	3.52	4.86
Maintenance	16.55	1.27	1.61
Reactor Operators	61.3	3.07	4.1
Shift Supervisors	27.39	4.57	4.7

Effective dose for HIFAR staff groups - 2000

Group	Collective dose (person-mSv)	Average effective dose (mSv)	Maximum annual effective dose (mSv)
Engineering	8.84	0.63	1.15
General Operations	6.11	1.02	1.41
Active Handling	30.15	3.35	4.91
Maintenance	18.52	1.32	2.79
Reactor Operators	50.98	2.55	3.35
Shift Supervisors	25.35	4.23	6.21

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. There is a downward trend of doses and attention continues to be given by ANSTO to achieving the ALARA objective. ARPANSA has recommended that ANSTO consider further review of the optimisation of exposures.

15.8. ANSTO's Safety Directive 3.2 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

> ***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.***
>
> ***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 123 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.

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 any sheltering would be limited to a small number of people.

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 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 Committee. 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.

> ***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 ARPANSA will issue a Facility Licence Authorisation to prepared 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 is 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 Replacement Research Reactor (see below). These principles and siting criteria are based on international standards and recommendations, particularly those of the International Atomic Energy Agency (IAEA), and the contemporary practices in the nuclear industries of developed countries.

17.4. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains provisions 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 basis has a mean zero period ground acceleration of 0.37g for an earthquake with a return period of 10,000 years.

17.6. ANSTO has described the dispersion of radioactivity from accidents. The relationship is described 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.

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 Proposed Replacement Research Reactor (RRR)

17.9. On 7 April 1999, ANSTO applied to ARPANSA for a facility licence to prepare a site for the proposed RRR. ANTSO proposed to build the RRR at the western end of the Lucas Heights Science and Technology Centre, adjacent to HIFAR. The proposed 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 proposed 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 will require this to be confirmed in the PSAR at the detailed design stage of the RRR as part of any 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 proposed 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 replacement research reactor 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 replacement reactor 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;

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 envelopes 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.

Factual Compliance

18.5. The report below is a summary of the ARPANSA's findings in its 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

18.6. 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.

18.7. 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.

18.8. 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.

18.9. 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

18.10. 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.

18.11. 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.

18.12. 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 also dependent on gravity, which limits their drop time to about 1 second.

Emergency core cooling system

18.13. 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).

18.14. 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.

18.15. 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.

18.16. 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

18.17. 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.

18.18. 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.

18.19. 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

18.20. 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.

18.21. 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

18.22. The HIFAR Emergency Control Room (ECR) is an ESP, designed to be occupied when 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.

18.23. 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.

Conclusion

18.24. 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.

> ***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

18.25. 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

18.26. 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.

18.27. 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.

18.28. 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.

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

18.30. 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

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 in August 1999 for an operating licence from ARPANSA. 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 is constrained within the safety system settings (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. Under 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, and will have to be addressed by ANSTO and reported on following its next annual review of its plans and arrangements for HIFAR in 2002.

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 has 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 Height 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 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 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 1999 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 notice and or facsimile to the CEO of ARPANSA as provided in the Regulation 63(1)(b) Guideline should also be given.

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. ANSTO has 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. 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 radioactive waste

19.28. Arrangements for the management of 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 need to be updated. The updating should address arrangements for the control and safe acquisition, handling, treatment, transport, storage, transfer, discharge and disposal of all controlled material, including 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.

19.30. The HIFAR operating licence application made reference to a Waste Management Section Procedure, but there are no HIFAR specific procedures or instructions for the handling of liquid and solid wastes arising from HIFAR operations. The update to the procedures and instructions should include HIFAR specific instructions on handling solid and liquid wastes, and specific Procedures for monitoring, sampling and reporting of discharges.

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

19.31. 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 is the basis for HIFAR liquid discharges.

19.32. 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.

19.33. Although the ANSTO Radioactive Waste Management Policy is committed to the maintenance of radioactive waste from source to disposal, there needs to be a Safety Directive on how the inventory is to be maintained at either general site level, or at specific sites such as HIFAR.

Packaging and containment of radioactive waste

19.34. All solid waste is stored on-site, but the amount of radioactive liquid that can be stored is limited by storage capacity and liquids are being solidified. There are no statutory limits on the quantity of solid waste stored on-site.

19.35. Although ANSTO Radioactive Waste Management Policy states a commitment to minimisation of radioactive waste and maintenance of inventories, there are no detailed HIFAR procedures or instructions for waste minimisation and storage at HIFAR.

Interim storage of radioactive waste

19.36. 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.

19.37. 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.

19.38. ARPANSA considers that the interim storage within HIFAR of radioactive waste is acceptable, but there is a need for additional documentation.

Documentation of radioactive waste

19.39. There was no reference in ANSTO’s application for an operating licence for HIFAR to the documentation of liquid wastes or solid wastes arising from HIFAR. ARPANSA considers that there should be specific arrangements for documenting measurements of the liquid wastes and solid wastes arising from HIFAR.

Routine discharge of radioactive waste to the sewer

19.40. 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.

19.41. ARPANSA considers that HIFAR liquid discharge levels should be set in a manner similar to what is done for gaseous discharges, and there should be monitoring against those levels. Safety Division staff undertake the monitoring of discharges from HIFAR. However, there is a need for HIFAR specific procedures on monitoring, sampling and reporting of discharges. 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.

19.42. ARPANSA considers that routine discharge from HIFAR to the sewer is acceptable provided there are measurements at the HIFAR liquid waste tanks of the levels and concentrations of the various radioactive nuclides in the liquid waste.

Routine discharge of radioactive waste to the atmosphere

19.43. The document, HIFAR Operational Limits and Conditions, covers airborne discharges from HIFAR and gives notification and correction levels for a four weekly, quarterly and annual sampling period. 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 10 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.

19.44. 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 ANSTO and the actual values for the last three 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	200 See note 2	50 See note 3	10	25
Correction Level	2000	1000	200	
Actual 1997-98	140	1.2	4.1	
Actual 1998-99	160	11.4	2.6	
Actual 1999-00	90	4		12.8

Note 1: MSD means during major shutdowns.
2: This figure has been revised to 180 TBq in ARPANSA's airborne discharge authorisation (June 2001).
3: This figure has been revised to 40 MBq in ARPANSA's airborne discharge authorisation (June 2001).

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

19.45. In addition to the OLC, there should be HIFAR specific procedures on monitoring, sampling and reporting of discharges. The monitoring should provide modern real-time data reporting the quantity and isotopic composition of radioactivity released in the stack emissions, including radioactive particulate, iodine, noble gases, and tritium.

Routine discharge of solid radioactive waste to the municipal tip

19.46. Routine discharge in this manner does not occur.

Routine discharge of radioactive waste by incineration.

19.47. Routine discharge in this manner does not occur.

Management of ultimate disposal or transfer of radioactive wastes.

19.48. 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 application for Waste Operations.

Spent fuel management strategy

19.49. The Australian 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.

19.50. Present arrangements for HIFAR spent fuel are as follows:

(a) US-origin spent fuel is to be repatriated by the US (no waste will be returned to Australia).

(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) Balance of HIFAR fuel rods of non-US origin to be sent to France (COGEMA, La Hague) and will also be returned as LLILW. Return is expected around 2015. A contract with COGEMA covers this.

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 to Improve Safety

The report in this section is based on requirements communicated to ANSTO for the HIFAR Reactor as "Special Licence Conditions" to the HIFAR operating licence issued in June 2001.

Article 9 – Responsibility of the Licence Holder

1. Update the Quality System documentation to reflect the existence of a formal Operating Licence and current organisational 'Safety Directives'.

Article 10 – Priority to Safety

2. Document service level agreements for services provided to HIFAR as health physics support, waste management support and engineering support from other parts of the operating organisation.
3. Implement any outstanding accident management recommendations from the HIFAR PSA.

Article 11 – Financial and Human Resources

Nil

Article 12 – Human Factors

4. Undertake accreditation of key maintenance staff of HIFAR Engineering and Support Sections.
5. Implement any outstanding human factor related recommendations from the HIFAR PSA.

Article 14 – Assessment and Verification of Safety

6. Upgrade the HIFAR Final Safety Analysis Report to include:
    - all completed HIFAR safety analyses and the HIFAR PSA follow-up actions,
    - a sensitivity study of the off-site risk, using the core damage frequencies arising from the HIFAR PSA,
    - consideration of wet deposition and rainfall localisation of the radioactive plume in a Reference Accident
    - re-calculation of the core damage frequency on completion of all the actions arising from the HIFAR PSA.
7. Undertake a check of all reactivity excursion analyses using overseas-validated codes as well as ANSTO codes. This is to include :
    - analyses of both design-basis and beyond-design-basis accidents, such as failure of the coarse control arms and safety rods to insert for losses of main coolant flow.
    - reactivity transients for which the safety analysis assumes some inherent safety characteristics due to temperature and void coefficients of reactivity and the neutron lifetime.

8. Re-examine:

- the fragility curves for the HIFAR structures, systems and components using the most recent seismic hazards curves, to determine the failure modes and likely consequences of failure on the primary circuit, the heavy water plant room, and leak tightness of the containment,
- the contribution of seismicity to core damage frequency using the most recent seismic hazard curves,
- the vulnerability of HIFAR's safety systems to high temperatures resulting from design-basis –accidents,
- the vulnerability of HIFAR to seismic failure of the water supply from the site water tower. This should take into account the seismic upgrading work to the site water tower as recommended on the Horoschun report in 1985.

Article 15 – Radiation Protection

9. Establish and maintain an area that is appropriately classified in which the operating shift staff can eat.

Article 16 – Emergency Preparedness

10. Address in the emergency plan the role of ARPANSA in emergencies.
11. Revise the intervention levels used for emergency planning in line with the current IAEA recommendations on intervention levels.
12. Formalise the conduct of a major exercise every two years to check the adequacy of all site personnel and off-site agencies.

Article 17 – Siting

13. Confirm that the collective dose resulting from the Reference Accident used for siting is less than 200 person-sieverts and consider the potential for disruption of land use. ARPANSA recommends that this analysis use the PC COSYMA code, a cut-off level of individual dose of 10 microSv, and the most recent census information.

Article 18 – Design and Construction

Nil

Article 19 - Operation

14. Formalise the limit on reactivity controlled by a 'moveable rig' to less than one dollar in the HIFAR operational limits and conditions.
15. Develop detailed HIFAR procedures/instructions for:

- aintaining an inventory of radioactive materials and waste at HIFAR,
- waste minimisation and storage at HIFAR, and
- monitoring, sampling, recording and reporting gaseous and liquid discharges.
- arrangements for the control and safe acquisition, handling, treatment, transport, storage, transfer, and ultimate disposal of all controlled material.

Annex 1 – HIFAR Reactor

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	3 elements every 28 day operating cycle
Total weight U-235	2.7 – 3.2 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 ^oC
Outlet temperature	50 ^oC
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 signal arm type, cadmium/europium clad 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 - Glossary and Acronyms

ALARA	As low as reasonably achievable
ANSTO	Australian Nuclear Science and Technology Organisation
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. An apparatus prescribed by the regulation that produces harmful non-ionizing radiation when energised.
controlled facilities	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 tan-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 Aerosol
HIFAR	High Flux Australian Reactor
HSD	HIFAR Safety Document
HSEC	ANSTO’s Health Safety and Environment Committee

IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IEEE	Institution 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 state 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 an 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

Annex 3 – References[3]

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