Commonwealth of Australia

CONVENTION ON NUCLEAR SAFETY

AUSTRALIAN NATIONAL REPORT

Report prepared by the Australian Nuclear Safety Bureau

Abstract

This document addresses Australia's obligations under the International Convention on Nuclear Safety (1996) and includes a self-assessment and a report of compliance with its obligations.

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1. Introduction

Under the auspices of the International Atomic Energy Agency (IAEA), the International Convention on Nuclear Safety entered into force in October 1996. Australia ratified the Convention, becoming a Contracting Party, in December 1996. The Convention applies to land-based civil nuclear power plants, and places obligations on the signatory States (Contracting Parties), including requirements for a regulatory organisation as well as a number of other items important for safe operation.

Under the Convention, the safety of existing nuclear power plants must be assessed periodically by a peer review process, providing transparency to other countries. Where required, all reasonably practical improvements to safety must be made. If the safety improvements required by the Convention cannot be achieved, the affected power plant must be shut down as soon as it is practical to do so. Social, environmental and economic factors may be taken into account in the timing of a plant shutdown. Contracting Parties, including those not possessing civil nuclear power plants, are required to put in place emergency response plans to deal with the trans-boundary effects of an accident at a nuclear power plant.

2. Scope

Although Australia does not have any nuclear power plants, and none are planned, this report provides an opportunity for Australia to:

a) assess the effectiveness of the regulatory framework through its application to assessing the safety standards of Australia's research reactors from the point of view of the sound safety practices promoted by the Convention;
b) promote and contribute to a similarity of approach to nuclear safety worldwide;
c) promote transparency of nuclear operations within Australia and other countries; and
d) better understand the Convention obligations voluntarily accepted by Contracting Parties, thereby facilitating Australia's review of National Reports of other Contracting Parties for the upcoming review meetings.

The report is not seeking a judgement from the Review Conference on the level of safety of the research reactors, a subject that is recognised to be outside the scope of the convention.

In the interests of similarity of approach and transparency within Australia and other countries, this document is available to any Australian Government organisations, any Contracting Party to the Convention, and to the IAEA and any party designated by the IAEA. The report will be available to the Australian public.

3. Self-assessment of compliance

The Convention is an incentive instrument. It is not designed to ensure fulfilment of the obligations of the Contracting Parties through control and sanction, but is based on their common interest to achieve higher levels of safety that will be developed and promoted

through regular meetings. The Convention obliges Contracting Parties to prepare for peer review sessions to be held by the IAEA, self-assessment reports of compliance with their obligations and to report on the implementation of their obligations.

This mechanism is a central element of the Convention. Success of the Convention depends on Contracting Parties taking a self-critical approach to assessment, and reporting their findings in good faith, for peer review.

4. Self-assessment report by Article

In this section, Australia's compliance with the Convention's terms and obligations for the Contracting Parties are discussed article-by-article, in conformance with the agreed 'Guidelines Regarding National Reports'.

Australia does not have any nuclear power plant. It does, however, have an operational 10 MW(t) DIDO class research reactor, and an Argonaut class research reactor which is in the first phase of decommissioning. In this section, the self-assessment and reporting of compliance with its obligations under the Convention is based on application of the established regulatory process in that research reactor setting.

4.1 General provisions

4.1.1 Implementing measures (Article 4)

Each Contracting Party takes, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

Australia is a Federation of States and Territories. Constitutional responsibility for health and safety rests with the States and Territories. Federal bodies are not generally subject to State health and safety legislation or regulation.

The Commonwealth (Federal) Government's Australian Nuclear Science and Technology Organisation (ANSTO) is the only organisation that operates nuclear plant including nuclear research reactors. Australia does not have any nuclear power plants, and none are planned.

Commonwealth legislation establishes the Nuclear Safety Bureau (NSB) as an independent corporate body to monitor and review the safety of ANSTO's nuclear plant. The NSB authorises the operation of ANSTO's nuclear plant and sets the requirements for safety. The NSB also sets the framework for assessing safety and for surveillance and enforcement of compliance with the bureau's safety requirements. This framework is discussed further below.

The Nuclear Safety Bureau has been designated by the Commonwealth Government to take primary responsibility for Australia's obligations under the Convention, working in consultation with other agencies. The NSB's regulatory and safety policies, expectations and

guidelines are being revised and developed to reflect the Nuclear Safety Convention.

4.1.2 Reporting (Article 5)

Each Contracting Party submits for review, prior to each meeting referred to in item 'review meetings', a report on the measures it has taken to implement each of the obligations of this Convention.

As discussed above, this document addresses the safety regulation of Australian nuclear research reactors and is submitted to permit review of the nature and effectiveness of the regulatory process and related matters in accordance with Australia's obligation under the Convention.

4.1.3 Existing nuclear installations (Article 6)

Each Contracting Party takes 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. Where necessary in the context of this Convention, the Contracting Party ensures 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 are implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Australia has no nuclear installations as defined under the convention i.e. Australia has no nuclear power plant in operation or being decommissioned. As described in Section 4.1.2 above, this report addresses research reactors owned or planned by the Australian Nuclear Science and Technology Organisation (ANSTO):

a) HIFAR A 10 MW(t) heavy water, tank type, materials testing reactor, operating since 1958 at Lucas Heights, Sydney. (see Table 1)
b) Moata A 100 kW(t) Argonaut university type research reactor, at Lucas Heights, Sydney.

Moata has been permanently shut down, with the fuel removed, for the first phase of decommissioning, and is not discussed further.

CONTINUED OPERATION OF HIFAR

The Australian reactors are controlled through Authorisations issued by the NSB. These are essentially licences with safety-related conditions attached (see Appendix A).

At the request of the NSB in 1992, HIFAR management undertook a program for the overall upgrading of the Authorisation [1] for reactor operation, with a completion date of April

1995. The primary objective was to ensure that the safety arrangements in the Authorisation, addressing the bureau's conditions, are consistent with international safety standards for research reactors. In 1995 the NSB reviewed in detail the upgraded documentation against its expectations for the Authorisation [2] and concluded that ANSTO had met the upgrade requirement. In addition, the NSB recommended actions that should be taken by ANSTO to further improve the Authorisation. It was agreed that priorities should concentrate on addressing quality assurance programs, design information, the safety case, and operational safety limits and conditions for the operation of HIFAR. The majority of this work has been completed and agreed by the NSB.

In addition to the normal maintenance, testing and inspections, the NSB requires HIFAR to undergo an extended shut down every four years to carry out inspections and maintenance of safety related plant and systems that cannot be undertaken during routine operating cycles. ANSTO is required to report findings to the NSB and satisfy the bureau of the plant's safety before the bureau will agree to the reactor being restarted following these extended shutdowns. To date, inspections of HIFAR have not identified any life-limiting factors. The last extended shutdown was completed in late 1995, and the next will be required in early 2000.

As discussed in Section 4.3.5 below, a Safety Analysis Report (SAR) for HIFAR [3] was comprehensively revised and updated at the end of 1997. Additionally, a level 1+ probabilistic safety assessment [4] and a remaining life study [5] were completed in early 1998.

Neither the reviews of the Authorisation arrangements, the SAR, the level 1+ PSA nor the Remaining Life Studies identified serious safety concerns for the HIFAR reactor.

For continued NSB agreement to operation, the bureau expects ANSTO to continue to service, maintain and operate the reactor in accordance with the Authorisation for HIFAR operation, to the satisfaction of the NSB. The bureau's acceptance of operation is also dependent on any necessary updating and maintenance of the HIFAR SAR, and an acceptable outcome to the recommendations in the HIFAR PSA and remaining life study.

LIMIT OF OPERATING LIFE

HIFAR was designed in the mid-1950s, before nuclear safety philosophy and standards were formalised. Modern safety standards reflect the accumulated experience of the nuclear industry over its fifty-year history. The NSB expects plant operating in the next century to reflect modern standards and practices. Although considerable upgrading of safety systems has been achieved throughout HIFAR's operating life, and the reactor is presently considered to be safe, there is a growing gap between the design of existing plant safety systems and current safety standards and expectations, due to the age of the plant and its design. The length of time and extent to which the bureau will accept this current situation is finite.

Regulators typically licence nuclear reactors for the design life of the reactor, usually about 40 years. For operation beyond this period, regulators insist upon rigorous reassessments of plant

and operational safety against modern standards and expectations, and require upgrading of plant and procedures in order to address modern standards. In 2003 HIFAR will have been operating for 45 years.

In the judgement of the NSB, a significant refurbishment and upgrading program would be required in order to maintain satisfactory standards of safety if HIFAR is to operate for a significant period beyond about 2003. Consequently, the NSB requires further upgrading of the safety systems of HIFAR by about 2003, unless the reactor is to be permanently shut down within an acceptably short time period thereafter. In 1993, the NSB informed ANSTO of the bureau's positions on continued operation and upgrading, to allow for the adequate consideration, planning and implementation of any necessary upgrading strategy, taking into account the lead times to carry out any work.

In 1998, the Commonwealth Government announced its intention to replace the HIFAR reactor with a modern research reactor, with operation intended to commence in 2005. Achievement of this objective should preclude the need for any significant upgrading of HIFAR safety systems.

4.2 Legislation and regulation

4.2.1 Legislative and regulatory framework (Article 7)

Each Contracting Party establishes and maintains a legislative and regulatory framework to govern the safety of nuclear installations.

The legislative and regulatory framework provides for:

(i) the establishment of applicable national safety requirements and regulations;

The NSB is established by the *Australian Nuclear Science and Technology Organisation (ANSTO) Amendment Act 1992* as a corporate body with the following functions:

a) to monitor and review the safety of nuclear plant operated by ANSTO;
b) to provide technical advice to the Commonwealth on the safety of nuclear plant and related matters; and
c) such other functions as the Minister determines.

The NSB authorises the operation of ANSTO's nuclear reactors, under Section 37A.(1)(a) of the Act, and monitors the safety of operations against arrangements in the Authorisations.

This legislation also empowers the NSB to do all things necessary or convenient in connection with this function, and to impose such restrictions or conditions as it thinks appropriate on the operation of nuclear plant owned or operated by ANSTO. ANSTO must comply with such restrictions and conditions.

Although the current legislation allows for the monitoring and review of nuclear plant operated by ANSTO, it does not explicitly allow for its regulation and no regulations have been written. However, the practice of authorising the operation of ANSTO's nuclear plant is used to satisfy the IAEA recommendations on regulatory processes and is comparable to practices in other countries. The regulatory framework and safety standards are set out in NSB requirements, principles, expectations and guidelines.

To improve the legislative basis for regulation, a Commonwealth Bill has been drafted to establish an Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to provide a proper legislative basis for licensing and regulation of nuclear facilities and radiation sources and practices. Under the Commonwealth jurisdiction, this would absorb the role of the NSB.

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

Currently, there is no legislation explicitly providing for the licensing of nuclear facilities of the Commonwealth, but this is being addressed and new legislation is presently in preparation (see Section 5). Nevertheless, the NSB performs a regulatory function by monitoring compliance with Authorisations, which are effectively licences with attached conditions, for the safe operation of ANSTO's reactors. The bureau's safety objectives, requirements, and expectations for the Authorisations are given in Reference 1 and discussed below.

As a condition for the NSB's agreement to reactor operations, ANSTO must meet requirements set by the bureau in the Authorisations. The Authorisations consist of 23 Schedule Items, each of which contains:

a) specific safety requirements set by the NSB (see Appendix B); and
b) documentation of ANSTO's arrangements (which must be agreed by the Bureau) to satisfy these requirements.

The Schedule Items address all safety related aspects of operation of nuclear plant including: organisational arrangements; staff training and accreditation; quality system; significant plant changes; safety analysis report, upgrading; radiation protection; radioactive wastes; and emergency preparedness and response.

The ANSTO Board gives responsibility and authority to the ANSTO Executive Director to operate the reactor in accordance with these arrangements, and a Safety Directive from the Executive Director instructs staff to observe them. Procedures for amending the arrangements are set by the NSB.

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

Under Section 37.B of the Act the Nuclear Safety Bureau may do all things necessary or convenient to be done for, or in connection with, the performance of its functions.

To ascertain compliance with the NSB's safety objectives, requirements, and expectations, the safety of nuclear facilities is continually monitored and reviewed by the bureau using processes of formal safety submissions by ANSTO, and by safety assessments, audits and inspections conducted by the bureau.

The principal types of audits and inspections are: site inspections of plant and operations, audits of operating logs and other safety documentation including procedures and instructions; interviews with staff; and observing accreditation of staff. The objectives of the inspections are to verify compliance with the Authorisation for operation of the plant, monitor the safety culture of the operating organisation and to maintain the knowledge of plant by the staff of the NSB. Inspections by the bureau, of one sort or another, usually occur at ANSTO at least weekly. Formal reports of results of audits are normally published.

In developing its objectives, requirements and expectations for safety of operation of nuclear plant, the NSB draws extensively on the standards, codes and guides published by the International Atomic Energy Agency (IAEA). The NSB has established contacts with many nuclear regulatory agencies throughout the world, and participates in the programs of the IAEA and the OECD Nuclear Energy Agency, as appropriate to its role in nuclear regulation.

In summary, the NSB's processes for monitoring and reviewing the safety of ANSTO's nuclear plant complies with recommendations of the International Atomic Energy Agency for independent regulation of nuclear facilities, and is comparable to regulatory processes in other OECD countries. It is anticipated that these processes will be carried into the new regulatory agency for Commonwealth radiation practices presently under consideration.

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

Under Section 37C. of the Act, the NSB may impose restrictions or conditions on the operation of ANSTO's nuclear plant, and the operator must comply with any such restrictions or conditions, including any requirement to shut down or delay start-up.

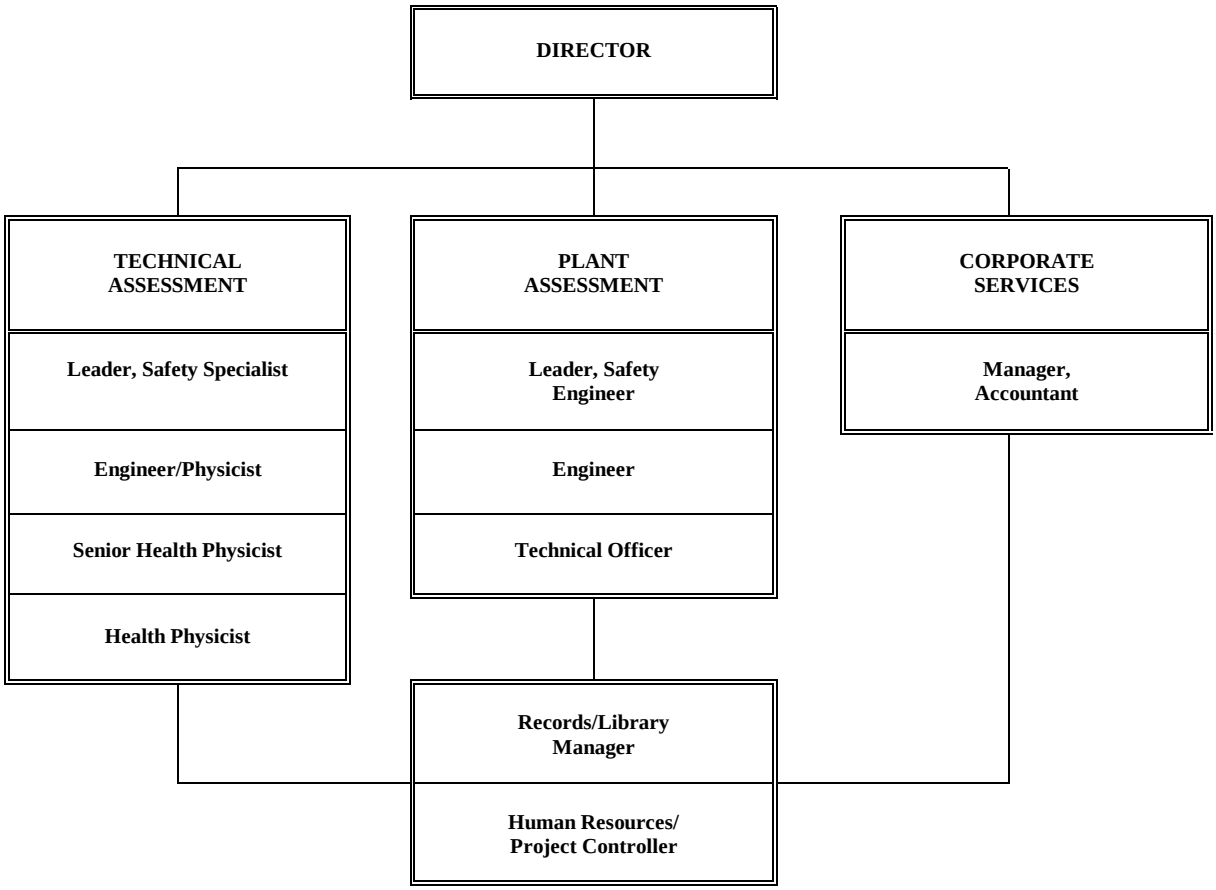
The Federal legislation establishing the NSB is presently being reviewed to establish a regulatory body (ARPANSA) with full regulatory surveillance and enforcement powers, and providing sanctions for non-compliance.

4.2.2 Regulatory body (Article 8)

Each Contracting Party establishes or designates a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in 'legislative and regulatory framework', and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

As outlined in section 4.2.1 above, the NSB is established by the *Australian Nuclear Science and Technology Organisation (ANSTO) Amendment Act 1992,* as a corporate body, to monitor and review the safety of nuclear plant operated by ANSTO.

The staff of the NSB consists of a Director and nine mainly senior, experienced, professional, technical and administrative staff. Staff expertise includes: nuclear, mechanical, electrical and chemical engineering; physics and health physics; mathematics; accountancy; human resources and records management. The average experience of the bureau's professionals is about 18 years in nuclear safety or radiation protection, both in Australia and OECD countries. When necessary, the bureau uses external consultants to supplement its own expertise.



As a Commonwealth statutory authority, the NSB must submit to Parliament an annual report on the performance of its functions. Additionally, Section 37U.(1) of the Act enables the NSB to submit to the Minister such reports as it considers appropriate. Section 37U.(2) requires the bureau to submit to the Minister such reports relating to the performance of its functions as the Minister directs. A Ministerial Direction of 11 September 1992 requires the NSB to provide the Minister with a report, each three months, on matters related to the performance of its functions. All reports to the Minister must be tabled in both House of Parliament within 15 sitting days of receipt by the Minister. The bureau also places these reports in public libraries and distributes them to interest groups.

Each Contracting Party takes 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.

The NSB is a corporate body established by legislation and fully funded by the Federal Government as a separate legal entity. By administrative arrangement, the bureau reports to the Minister for Health and Family Services, through the Parliamentary Secretary to the Minister. This is a portfolio different to that of ANSTO which reports to the Minister for Industry, Science and Tourism. The bureau is completely independent of bodies responsible for the promotion and utilisation of nuclear energy, and has no promotional functions.

The NSB has legislative, administrative and financial independence from the operator of the nuclear installations.

4.2.3 Responsibility of the licence holder (Article 9)

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

The conditions of the Authorisation, issued by the NSB for the operation of the nuclear installations, makes it clear that the responsibility for the safety of nuclear installations rests with the operating organisation. Monitoring and reviewing of operations, by the NSB, against the arrangements in the Authorisations, ensure that the operating organisation meets this responsibility for safety.

4.3 General safety considerations

4.3.1 Priority to safety (Article 10)

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

To provide consistency in its approach to nuclear safety and to address international best

practice, the NSB is in the process of finalising safety assessment principles, expectations, and guidelines for the various stages of the life of a nuclear installation. The NSB's basic approach to nuclear safety is strongly influenced by INSAG-3 and places significant importance on defence in depth. The guidelines cover for nuclear facilities, licensing, siting, design, modification and utilisation, maintenance, release of radioactive airborne effluents, criticality, investigation of safety-related events, life extension, and decommissioning.

Additionally, the safety principles of the NSB establish safety culture as a prime regulatory objective. A basis for favourable safety culture is reflected in the safety assessment reports, the quality system, and the maintenance, modification and operating procedures of the operating organisation. The conditions of the Authorisation require ANSTO to establish operating arrangements that address safety matters to the satisfaction of the NSB.

The NSB expects ANSTO to take into account the evolution in safety standards and, in particular, to recognise the importance of the concept of safety culture in the continual review and upgrading of the Authorisation and supporting documentation.

ANSTO promulgates its safety policies through a comprehensive set of 'Safety Directives' to its staff, informing them of their responsibilities and obligations in respect of 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. With respect to HIFAR, ANSTO's safety policies and programs are reviewed internally by the Reactors Safety Committee and externally by the Safety Review Committee.

The structure of the operating organisation defines the responsibilities and lines of communication for HIFAR, the relationships with other areas of ANSTO and the lines of communication with external organisations for normal modes of operation and for accidents. The duties and responsibilities of operations staff are adequately described in the operating documentation.

No operational activities that may affect safety are carried out except under the control of suitably qualified and experienced personnel appointed or approved by the Manager, HIFAR.

The Authorisation places emphasis on a safety case, including a Safety Analysis Report (SAR), which establishes the operational limits and conditions (OL&Cs) for safe operation and demonstrates that the reactor can be operated without undue radiological hazard to the public, the operators and the environment. ANSTO is committed to the timely updating of the safety case. Work remains to update the SAR with the results of the recently completed PSA.

4.3.2 Financial and human resources (Article 11)

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

Financial resources are provided to the operating organisation by the Federal Government, and

ANSTO generates additional revenue by the sale of products and services. These resources are judged to be adequate to maintain the infrastructure and the human and material resources necessary for the safe operation of the installation throughout all stages in its life.

Each Contracting Party takes 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.

The NSB requires ANSTO, as the operator of HIFAR, to establish and maintain detailed organisational arrangements to ensure that the experience and training of staff are appropriate for the responsibilities allocated, and that key staff are accredited and periodically re-accredited.

The NSB expects arrangements in the Authorisation to include an organisation plan giving numbers of staff and their qualifications, and including periodic reviews with measurable outcomes to demonstrate that:

a) there is an adequate number of staff for the safe operation of the plant,
b) training plans and schedules are specified for various staff categories, including retraining, to limit the risk of human error,
c) qualified operations staff are used as instructors,
d) all staff receive training in radiation protection and response to emergencies before they commence their duties,
e) training is appropriate to the operational function, noting that the operations group includes the professional, technical and handling staff directly involved with reactor operations, and the HIFAR support staff include technicians and craft persons involved in maintenance and technical services,
f) training includes plant malfunction situations and accident conditions,
g) formal accreditation and re-accreditation is by interview, and/or written examination.

Before being authorised to perform their duties, key reactor operations staff undergo a formal accreditation, and periodic re-accreditation is required. Appropriate training and periodic retraining of reactor operations and maintenance personnel is essential for the safe operation of nuclear plant, and is a prerequisite for gaining and maintaining accreditation. The NSB monitors these processes closely, and generally attends ANSTO's accreditation and re-accreditation interviews of key operating staff.

ANSTO staff regularly participate in international nuclear programs and conferences relevant to the safety of HIFAR. Meetings between operators of reactors similar to HIFAR (DIDO class research reactors) are held each two years and provide information for ANSTO staff.

Under the Authorisation, the NSB expects arrangements to be in place to ensure that other personnel, such as contractors, who are required to perform work on the reactor but are not included in the operating organisation, have: a basic understanding of radiation protection; adequate training on what is expected of them in other areas (including emergency situations); and are accredited to an appropriate level.

The NSB has reviewed the arrangements of the operating organisation and concludes that the number of staff, the continued training of staff and the qualification of staff are appropriate for the operation of the installation. While it has been difficult to maintain the resources of technical support personnel in an ageing organisation, such as those needed to maintain a safety case, the operating organisation is successfully achieving the retention and recruitment of appropriate numbers and expertise of technical support personnel.

4.3.3 Human factors (Article 12)

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

Operating procedures and instructions have improved substantially over the last several years, due to effort of the operating organisation to implement and gain accreditation for a quality system, certified to the Standard AS/NZS ISO 9001.

The man-machine interface for HIFAR is becoming outdated due to its age and design, and this is an area that the NSB will require to be addressed if the plant is to continue to operate significantly beyond about 2003. Operational experience is fed back through the analysis of abnormal occurrences, including incidents, to determine their root cause and the extent of human factors involved.

The management and organisational structure of the operating organisation is considered to be generally sound. Areas where attention is focussed by the NSB include the functioning of safety overview committees and the flow of responsibility for services provided to the operating arm of the organisation from other areas within the organisation.

While this aspect of HIFAR operation is judged to be satisfactory, the NSB is of the opinion that, for research reactors generally, human factors is an area where more effort could be usefully spent and one where greater emphasis will be given by the NSB when considering the safety of a replacement Australian nuclear research reactor.

4.3.4 Quality assurance (Article 13)

Each Contracting Party takes 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.

ANSTO is required to provide arrangements for QA programs for activities throughout all principal stages (siting to decommissioning) in the life of the installation, including maintenance and modifications, which may affect safety.

The Authorisation provides for arrangements for maintaining adequate records and reports and for providing the NSB with access to those records and reports to satisfy itself that the requirements of the Authorisation are being met.

Throughout the last year, ANSTO worked to upgrade safety documentation for HIFAR, with priority being given to quality assurance, design information, the safety case and operational safety limits and conditions. During the year, the HIFAR Quality System was certified to the Standard AS/NZS ISO 9001, the Safety Analysis report was updated and OL&Cs were reissued. These are significant achievements for HIFAR management and staff, which provide substantial contributions to the safety documentation for the reactor and significantly enhance the safety of operations.

4.3.5 Assessment and verification of safety (Article 14)

Each Contracting Party takes 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 are well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body.

The construction and commissioning of HIFAR preceded the existence of the NSB. The NSB has hold points to satisfy itself of the safety of nuclear installations before authorising the continuation of a project at the stages of siting, construction, commissioning, operation and decommissioning. These are documented in the bureau's licensing guideline. The SAR is viewed as a living document and is required to be updated on a periodic basis throughout the life of the installation, to the satisfaction of the NSB. The NSB has drafted guidelines on its safety expectations for each stage of plant life.

The HIFAR operating Authorisation requires the systematic ongoing review and upgrading of plant and procedures throughout the life of the plant. This is reported to ANSTO management and the NSB annually. Additionally, the bureau's requirements in the Authorisation (essentially conditions of licence), and ANSTO's arrangements to satisfy these requirements, are updated throughout the life of the plant to reflect the current stage of plant life and plant status.

As described in Section 4.1.3 above, HIFAR management undertook a program for the overall upgrading of the Authorisation for reactor operation, with a completion date of April 1995. The NSB reviewed in detail the upgraded documentation and concluded that ANSTO had met the upgrade requirement.

The Safety Analysis Report (SAR) for HIFAR (entitled the HIFAR Safety Document[3]) was comprehensively revised and updated at the end of 1997, in accordance with a requirement of the NSB. Some matters arising during the revision are continuing to be addressed. The NSB has agreed the revised SAR.

A level 1+ probabilistic safety assessment (PSA) [4] and remaining life study [5] was completed for HIFAR in early 1998, addressing internally and externally initiated event fault sequences and active containment systems. The NSB considers that the PSA was full scope and comprehensive, with detailed and very clear event sequence diagrams and dependency matrices, providing insight into possible system interactions. An IAEA peer-review service (IPERS) team visited Australia and undertook an independent review of the draft PSA. They considered the approach to be acceptable and state-of-the-art, with the scope being complete and conforming to best practice, and modelling of accident sequences appearing to be consistent and correct. The IPERS team recommended that a more detailed seismic study should be carried out in the longer term to reduce the level of conservatism in the present models. This is presently being pursued, and other suggestions were taken into consideration in finalising the PSA.

The PSA complements the deterministic analyses in the HIFAR Safety Analysis Report. The NSB and ANSTO are examining recommendations arising from the PSA associated with plant and procedural changes, and accident management measures, to determine any practicable measures that may be taken to improve safety.

In parallel with undertaking the PSA, a specialist consultant firm conducted a Remaining Life Study, concentrating on components critical to HIFAR operation or safety that were judged to be non-replaceable. The strength of the study is that it identified passive and structural components that merited further attention, complementing the PSA which identified active systems. The general conclusion is that HIFAR is in good condition with no obvious evidence of major damage or age-related degradation. However, the consultant raised an issue relating to the reactor tank plenum plate which, after additional analyses, has been dismissed. The NSB accepts this conclusion.

NSB reviews of the Authorisation arrangements, the revised SAR, the level 1+ PSA and the remaining Life Study have not identified serious safety concerns for the HIFAR reactor. Comprehensive and systematic safety assessments for the replacement reactor are being undertaken from the conceptual stage of the project.

(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.

ANSTO 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 and the Authorisation. 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.

As described in Section 4.1.3 above, in addition to the normal maintenance, testing and inspections, the NSB requires HIFAR to undergo an extended shut down every four years to carry out inspections and maintenance of safety related plant and systems that cannot be undertaken during routine operating cycles.

The Authorisation provides for reviewing and, where necessary, upgrading the safety of the reactor, taking account of the NSB's regulatory criteria, and evolving safety practice. The items reviewed include: factors which limit the safe operating life of the plant such as systems or components susceptible to ageing; compliance with the OL&Cs; the results of operational experiences; the reliability of the plant; the updating of safety analyses and supporting documentation such as calculations, reports, manuals and drawings; and performance indicators from the HIFAR Quality System.

4.3.6 Radiation protection (Article 15)

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

RADIATION DOSES

Under the Authorisation, the NSB requires ANSTO to have in place adequate arrangements to ensure that radiation doses to operating personnel and the public both onsite and offsite do not exceed the appropriate limits for individuals as recommended by Australia's National Health & Medical Research Council (NHMRC) and, additionally, that doses are kept as low as reasonably achievable (ALARA) in accordance with procedures recommended by the ICRP.

In line with ICRP Publication 60, the NHMRC's recommended radiation dose limit for the public is 1 mSv per year. For occupational exposures, the dose limit is 20 mSv per year averaged over 5 consecutive years and not exceeding 50 mSv in any one year.

A dose constraint of 100 µSv per year to the public has been set as an operational dose limit for HIFAR, to ensure that the NHMRC individual public dose limit would not be exceeded when additional exposures from other sources or practices are added, and to promote good management. ANSTO has adopted a dose constraint of 15 mSv per year for occupationally exposed workers and an investigation level of 1 mSv per month, so that exposures above this level will initiate a documented investigation and follow up action to reduce radiological exposure, where applicable.

Additionally, an ANSTO Safety Directive sets policy and processes for ensuring that radiation exposures are as low as reasonably achievable, and specifies an ALARA dose objective of 20 µSv per year for the public. For radiation workers the objective has been set at 2 mSv per

year. Below these levels it is not considered necessary to demonstrate that the doses are as low as reasonably achievable. The NSB considers that the policy is consistent with national and international standards and best practice.

Airborne radiation doses to the public have been calculated using PC-CREAM, a code developed by the United Kingdom National Radiation Protection Board under a contract for the European Commission, based on measured routine airborne radioactive discharges and measured weather conditions. The highest doses to hypothetical members of the public during each of the past two years to June, were less than 5 μSv per year. Doses resulting from liquid discharges into the sewage system were negligible. In the year to June 1998, the highest exposed operator received an effective dose of 6.0 mSv, while the average to all operators was 3.9 mSv and 1.3 mSv to maintenance staff. It should be noted that the reactor operators spent most of their shift within the Containment Building. The total exposure to all workers in the HIFAR area was 212 man-mSv.

In summary, the results of radioactive effluent discharge monitoring and dose assessments show that doses to staff and the public due to radioactive discharges are well within the annual limits recommended by the NHMRC, a fraction of the dose constraints adopted by ANSTO and, for the public, less than ANSTO's ALARA objective, and close to the objective for operators.

ROUTINE DISCHARGES OF RADIOACTIVE MATERIALS

The NSB recently completed a review of international recommendations and practices for the regulation of airborne radioactive discharges. Subsequently, an airborne discharge authorisation for HIFAR was established. The authorisation requires the NSB to be notified if the discharges exceed specified monthly, quarterly or annual 'notification' levels, which are based on the requirement that radioactive discharges, and consequent doses, should be as low as reasonably achievable. The reactor is required to be shut down if releases exceed 'correction' levels based on the public dose constraint.

Quantities of airborne radioactive discharges from HIFAR are given in the table below.

Year	**Ar-41 (Bq)**	**H-3 (Bq)**	**I-131 (Bq)**	**Gross Beta (a) (Bq)**
96/97	1.5×10^{14}	4.2×10^{12}	9.6×10^{6}	2.0×10^{6}
97/98	1.4×10^{14}	4.1×10^{12}	1.2×10^{6}	1.3×10^{6}

(a) Assessed as all strontium-90

Liquid discharges from ANSTO's site are authorised by the Sydney Water under a Trade Waste Agreement that specifies limits on the concentration of radioactive materials in the effluent. Measured concentrations at the ANSTO discharge point are compared to limits specified in the NSW Radioactive Substances Regulations (1959). Additionally, calculated concentrations at the Cronulla Sewerage Discharge Plant are compared to the World Health

Organisation's Guidelines for Drinking Water Quality (1993). The concentrations of radioactivity in liquid discharges from the site for the year were within both discharge limits. ANSTO's measurements of the radioactivity in liquid effluents were verified independently by the Australian Radiation Laboratory.

Quantities of liquid radioactive discharges from the whole site, including HIFAR, are given in the table below.

Year	Unspecified Alpha Emitters (a) (MBq)	Unspecified Beta Emitters (b) (MBq)	Tritium (G Bq)	% of NSW Concentration Limits	% of WHO Concentration Limits
96/97	70	1812	375	32	30
97/98	255	2951	650	60	57

(a) Assessed as all radium-226 (b) Assessed as all strontium-90

In addition to routinely reviewing the amounts of radioactivity discharged from HIFAR to the environment, the NSB conducted during the last year an audit of the arrangements and equipment associated with monitoring radioactive discharges. The Australian Radiation Laboratory independently analyses random samples of discharges to verify the analyses by ANSTO.

Radiation doses to the public arising from the discharges were well within the annual limits recommended by the NHMRC. Nevertheless, work is continuing at HIFAR to further reduce the amount of radioactive discharges from the reactor, particularly argon-41, and make improvements to the arrangements as recommended in the NSB audit.

ENVIRONMENTAL MONITORING

ANSTO conducts an annual survey of radiation in the environment around the reactor site [8], using samples of soil, creek water, storm water, seawater, vegetation and air, to confirm compliance by ANSTO with relevant regulatory limits. The NSB reviews these environmental reports.

4.3.7 Emergency preparedness (Article 16)

Each Contracting Party takes the appropriate steps to ensure that there are onsite and offsite 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 are prepared and tested before it commences operation above a low power level agreed with the regulatory body.

The operating organisation maintains a 24-hour emergency response capability. A professional reactor engineer is available on call, on site, at all times, in an arrangement similar to the Swiss 'picket engineer' system. ANSTO cooperates with State and local government authorities and agencies to maintain viable emergency arrangements to protect the health and

safety of workers and the public in accordance with the recommendations of the NHMRC. These recommendations have been derived from those of the ICRP and IAEA. The emergency arrangements are periodically tested for effectiveness and to assess the need to provide further training and improvements. The NSB judges the effectiveness, flexibility and extendability of the emergency arrangements by reviewing the arrangements, acting as an observer on committees and witnessing emergency exercises.

The ANSTO Local Liaison Working Party, formed under the State Emergency and Rescue Management Act 1989, coordinates the involvement of State agencies having responsibilities under the arrangements for emergencies at the LHSTC. Meetings of the working party are held each quarter to ensure that arrangements are current and that there is continued communication between all combat agencies. An NSB officer attends these meetings as an observer.

The Lucas Heights Site Emergency Plan and the ANSTO Emergency Plan (DISPLAN) clearly set down responsibilities, functions and organisational arrangements for accidents at HIFAR and the relationship of ANSTO staff with the controllers and State combat agencies that are integral to the arrangements under the above Act. Standing Operating Procedures, which detail the response of each of ANSTO's operational units and the State agencies, support the Emergency Plan. These are periodically reviewed.

The policy adopted by ANSTO and the working party is to test the emergency plans with a major exercise every few years and to complement this with the exercising of particular elements of the plans on a more regular basis.

The NSB considers that the emergency arrangements at the LHSTC are suitable and in a satisfactory state of preparedness.

Each Contracting Party takes 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.

Information on the emergency arrangements is provided to the local community around the Lucas Heights site through brochures that are periodically updated and distributed, and in meetings.

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 IAEA Convention on the Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. ANSTO is the contact point for emergencies and both ANSTO and the Australian Radiation Laboratory are Competent Authorities for the provision of resources in the event of a nuclear or radiological 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, 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.

As stated above, Australia is a Party to the IAEA 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. It provides the Regional Specialised Meteorological Centre for Australian/South East Asia in the IAEA/WMO Emergency Notification and Assistance Network.

4.4 Safety of installations

4.4.1 Siting (Article 17)

Each Contracting Party takes 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;

The NSB has drafted guidelines on siting and design of nuclear facilities [6]. Appropriate arrangements are in place for the NSB and ANSTO to evaluate all relevant site-related factors likely to affect the safety of the design and operation of a nuclear installation, in order to specify the design bases for the facility over its projected lifetime. This includes geology, seismicity, meteorology, hydrology, demography, land use, population distribution and events such as aircraft crash, transportation and industrial accidents. The site information and the way it has been accommodated in the design of the facility is required to be documented in a safety analysis report provided to the NSB for review.

(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

RADIOLOGICAL SITING CRITERIA

The NSB's safety assessment principles require that the siting of a nuclear facility should provide a layer of defence in depth of public safety which is, as far as practicable, independent of the design of the facility or controls on its operation. In recognition of the need to consider the safety of individuals, society and the environment, the NSB's siting criteria require that, following a Reference Accident used for the siting assessment:

a) the implementation of emergency countermeasures to protect individual members of the public would be feasible at radiation dose intervention levels recommended by national and international bodies;
b) the health consequences to the exposed population, measured in terms of maximum collective effective dose, would be acceptable; and
c) there would be no long-term restrictions on use of affected land.

The Reference Accident selected for site evaluation purposes is a severe accident, beyond the design basis of the reactor, the consequences of which would be extremely unlikely to be exceeded in any actual accident. It represents the upper bound of risk for the purposes of emergency planning.

Long-term effects of a nuclear accident are considered in the siting criteria by requiring that long-term restrictions on the use of land would not be needed to protect the public, following such an accident. This criterion was set in recognition of experience after the Chernobyl accident, which contaminated extensive areas of land to the extent that they are considered unsafe to farm or inhabit. The NHMRC and the IAEA limits on contamination and intervention levels for relocation of residents were used to assess the compliance of the siting of HIFAR with this criterion.

(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;

As part of the ongoing review and upgrading throughout the life of the plant, required by the NSB in the Authorisation, the operator must periodically re-evaluate site-related factors and demonstrate that the safety design bases remain valid or that the plant and procedures have been upgraded appropriately. Periodic re-evaluation of the radiological impact of the installation on individuals and society, against radiological criteria, is required and reviewed by the NSB.

Items (i)-(ii) have been reassessed periodically throughout the life of the HIFAR reactor resulting in, for example, seismic hardening of the plant to the extent practicable, revision of the emergency arrangements and lifting of restrictions on land usage beyond the 1.6 km exclusion zone around the reactor [7].

(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.

Due to geographical isolation and small power level of the reactors, the operation of the existing and the proposed nuclear installations in Australia will not affect the Contracting

Parties in neighbouring countries. However, as stated above, Australia is a Party to the IAEA 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.

4.4.2 Design and construction (Article 18)

Each Contracting Party takes the appropriate steps to ensure that:

(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

The NSB's draft Safety Assessment Principles [6] build on the IAEA's defence in depth policy (INSAG-10) and make them prerequisites for the design of new installations. The NSB's guideline for the design of nuclear facilities also emphasises defence in depth. Both documents are themselves structured in terms of defence in depth levels.

The Authorisation addresses the need to maintain design records, including plant descriptions, design calculations, design reviews, specifications and drawings as may be needed to safely maintain and operate the reactor and to establish that it is being safely maintained and operated throughout the life of the plant.

The NSB's draft licensing guideline addresses criteria that are used by the NSB for the design and construction stages, to ensure that the proposed design will result in a safe nuclear installation, and that the construction will achieve the safety objectives on which the design was based.

Defence in depth has been fundamental in the design concept of HIFAR and is described in the SAR. HIFAR's layers of defence in depth include an emergency core cooling system and a containment system. The functionality and reliability of these systems is routinely tested to ensure their adequacy. The robustness of these measures in preventing the occurrence of accidents and mitigating their radiological consequences has been demonstrated in the level 1+ PSA for HIFAR. Nevertheless, as outlined in Section 4.1.3 above, the NSB will require further upgrading of safety systems to improve defence in depth if HIFAR is to operate much beyond 2003.

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

Proven engineering practice is addressed in the Safety Assessment Principles of the NSB and is required as a basis for the design of any modifications. Innovative features must be demonstrated fully by testing and analysis. These principles must be demonstrated to the satisfaction of the NSB in safety case submissions prior to installation.

(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.

These aspects of design are addressed in the NSB's Safety Assessment Principles and design guideline. However, HIFAR was designed and constructed before modern safety requirements were formalised and before a formal regulatory regime was introduced into Australia. Nevertheless, the initial design and subsequent and upgrading has achieved and demonstrated reliable, stable and easily manageable operation based on feedback from 40 years of operational experience.

4.4.3 Operation (Article 19)

Each Contracting Party takes the appropriate steps to ensure that:

(i) the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning program demonstrating that the installation, as constructed, is consistent with design and safety requirements;

The NSB's licensing guideline addresses criteria that are used by the NSB for the operation stage, to ensure that the commissioning and operation of the 'as constructed' installation achieves the safety objectives on which the siting and design was based and authorised, as described in Safety Analysis Reports.

HIFAR started operating before a formal regulatory regime was introduced into Australia. The current authorisation to operate is based on a thorough deterministic safety analysis that covers the recommendations of the IAEA and 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 the requirements of an independent regulatory body.

(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;

The envelope of plant and procedural requirements for safe operation of the HIFAR reactor are established in the SAR and set by the OL&Cs, as a requirement under the Authorisation. The NSB recently reviewed a revised set of comprehensive OL&Cs which include a minimum plant configuration, surveillance requirements, action statements and bases, and which conform with the recommendations of the IAEA .The OL&Cs reflect provisions made in the design of the reactor to ensure safe operation during startup, operation at power, shut-down, maintenance, testing, refuelling and the conduct of irradiations and experiments. Their implementation achieved a significant upgrading in reactor safety.

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

The HIFAR Authorisation addresses written arrangements, under the HIFAR Quality System, for the following:

a) operating instructions and procedures to be followed by the reactor operating organisation during normal operation of the reactor, including irradiations experiments, abnormal occurrences and accident conditions to ensure safe operation within the operational limits and conditions. It also addresses arrangements for the regular review, revision and updating of operating instructions and procedures.

b) a program of maintenance, periodic testing and inspection activities, carried out in accordance with written procedures, which will enable the reactor, including irradiation rigs and experimental equipment, to be operated safely. The arrangements provide for regular review of the program and appropriate modification with respect to any problems identified.design modifications and change control, providing for arrangements for the review by the NSB of all proposals to the reactor plant which may involve significant safety issues. An NSB guideline sets out the criteria used by the NSB to assess modifications.

c) Design modification and change control, with arrangements providing for review by the NSB of proposals which may involve safety significant issues. An NSB guideline sets out the criteria used by the NSB for assessing modifications.

d) security arrangements which minimise the possibility of any deliberate act against the reactor or associated plant and which support a rapid response to mitigate the effects of sabotage. The Australian Safeguards Office (ASO) has classified materials and facilities at the LHSTC, and, in consultation with the Australian intelligence community, has defined the design basis threat. Accordingly, ANSTO has implemented a Physical Protection System to protect the HIFAR reactor and associated plant against the design basis threat to the level necessary to comply with guidelines prepared by the Australian Safeguards Office. This provides protection to the level required in IAEA INFCIRC/225/Rev3 [9].

e) conducting irradiations and experiments in the various facilities of the reactor, including arrangements for the design, safety analysis, manufacture and installation of the associated rigs and experiments. The NSB reviews all proposals for irradiations and experiments that could, under normal or fault conditions, affect safety.

The NSB continually monitors and reviews the safety of nuclear plant operated by ANSTO, through an ongoing regime of safety reviews and audits against the authorised arrangements in ANSTO’s safety documentation and the NSB's expectations for nuclear plant, drawn from international best practice.

Aspects of ANSTO's operation of nuclear plant reviewed recently by the NSB included training and accreditation of operations staff, abnormal occurrences and emergency arrangements and exercises for the LHSTC. Audits of HIFAR were also conducted on operating logs, modifications to plant, radiation protection and radioactive discharges. Based on the reviews and audits conducted by the NSB, and ANSTO's actions in responding to the NSB's requests and requirements for actions, the NSB concluded that ANSTO's nuclear plant operated safely throughout last year, and that risks to on-site personnel and the public were maintained at acceptably low levels.

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

As required by the Authorisation, procedures are established and operators are trained and exercised to respond to anticipated operational occurrences and accidents. An emergency control room and operational centre are maintained for the purposes of managing the severity and consequences of accidents and regaining control.

Unusual operating events, classified by HIFAR management as abnormal occurrences, are required to be reported to the NSB, together with analyses of the events and actions to correct inadequacies or prevent recurrence.

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

ANSTO maintains an organisation capable of providing necessary engineering and technical support in safety-related fields. The resources are available to call on consultants having expertise outside the disciplines of ANSTO. This allows ANSTO to service the operation and documentation of the safety of the facility.

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

As required under the Authorisation, unusual operating events at the reactor, classified by HIFAR management as abnormal occurrences, are reported by ANSTO to the NSB on a quarterly basis, with events violating the OL&Cs reported promptly.

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

These, and other unusual operating events, are reviewed by the both ANSTO and the NSB to assess the safety implications and to determine the root causes. The NSB's guideline on the investigation of safety-related events records the criteria used by the NSB to ensure that all events from incidents to accidents are adequately addressed by ANSTO.

Experience and information is shared with operators of other DIDO reactors, the same class as HIFAR, at conferences. Information may be sought as required and this could be undertaken in a more systematic manner. The NSB would encourage ANSTO participation in the IAEA research reactor incident reporting system.

Since 1991 the NSB has assigned levels on the INES on a trial basis to events at ANSTO's reactors. This process has involved the rating of events, by the NSB, up to three months after their occurrence. Three level 1 events on the INES scale, ie anomalies beyond the normal operating regime, in each of the two previous years to June.

From 1 July 1997 ANSTO is formally assigning INES levels to HIFAR Abnormal Occurrences and providing this information to the NSB, and Australia has joined the INES Information Service on an interim basis until the formal adoption of INES by Australia.

(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.

Under the Authorisation, ANSTO is required to make arrangements acceptable to the NSB for the treatment, storage and disposal of radioactive waste in accordance with established procedures.

ANSTO facilities for the treatment and storage of radioactive waste are designed and operated to prevent inadvertent criticality, undue radiation exposure and unacceptable release of radioactivity during normal and accident conditions. Leakage of rainwater into some dry spent fuel storage facilities was detected recently and is being addressed. Investigations showed that the stainless steel liners were not affected and there was no release of radioactivity to the ground water.

Adequate records are produced and retained, detailing the quantities of radioactive effluent discharged and the waste accumulated and disposed of. Facilities and equipment are subjected to regular inspection, testing and monitoring to ensure that they are adequately maintained. A formal quality system applies to these activities and the NSB audits their operation.

ANSTO was running out of storage space for spent fuel and presently shipments are taking place to the country of origin of the fuel. In cases where the spent fuel is to be reprocessed, radioactive waste may be returned to Australia after conditioning for storage and disposal.

The NSB will require an acceptable strategy for the disposition and disposal of spent nuclear fuel before agreeing to the construction of any new reactor.

5. Planned activities to improve safety

LEGISLATIVE AND REGULATORY FRAMEWORK

Australia is a federation of States and Territories. Most uses of radiation are regulated by State and Territory authorities, but Commonwealth (Federal) activities are not fully covered by legislation. A Bill (the Australian Radiation Protection and Nuclear Safety Bill 1998) has been drafted which, if passed by Federal Parliament, would address this gap. The legislation would establish a statutory officer with broad responsibilities to:

a) establish the regulation of activities within the Commonwealth which involve radiation and nuclear safety, most of which are not presently regulated;
b) develop, jointly with the states and territories, uniform radiation protection and nuclear safety controls throughout Australia, to protect workers and the public, including for uranium mining and the management of radioactive waste;
c) provide advice on radiation protection and nuclear safety to the Government and public; and
d) undertake research and provide services of a high standard to ensure radiation protection and nuclear safety.

Under the Bill, Commonwealth persons would be prohibited from preparing a site, constructing, possessing, operating, or decommissioning, disposing of, or abandoning a nuclear installation unless authorised to do so by a licence. It is intended that the statutory officer would have extensive powers to issue licences, enforce standards and licence conditions, perform inspections, enter premises, seize materials and records, and impose financial and criminal penalties for breaches of the Act or Regulations. The present arrangements for authorising reactor facilities would be carried into the new regulatory process. Regulations are presently being prepared in anticipation of a new agency being formed.

This would provide an appropriate legislative framework, with unambiguous and effective sanctions, for the independent regulation of all Commonwealth radiation sources and practices including ANSTO's research reactors, in line with recommendations of the IAEA and international best practice. Following Commonwealth elections, the new Government will give consideration to the Bill.

UPGRADING OF REACTOR PLANT AND PROCEDURES

As outlined in the report, if HIFAR is to operate significantly beyond about 2003, the NSB requires significant upgrading of safety systems to improve defence in depth and will assess improvements in safety against modern standards and practices.

In the meantime, improvements to HIFAR plant, operating procedures and emergency management will be required in order to address the recently completed probabilistic safety assessment and updated safety analysis report.

Table 1
AUSTRALIAN NUCLEAR RESEARCH REACTOR HIFAR

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 physicist
Exclusion boundary		1.6 km

Appendix A
NSB REQUIREMENTS FOR THE AUTHORISATION-HIFAR OPERATION

1. THE REACTOR HIFAR

HIFAR is a high flux thermal neutron research reactor located at the coordinates 298.091.043 East and 1230.638.600 North on ANSTO Drawing No. AE 100.000 "Lucas Heights - Plan of Permanent Marks", fuelled with enriched uranium/aluminium fuel elements; moderated and cooled by heavy water; contained in a steel shell and having a designed normal thermal power output of 10 MW; and including associated equipment required for the operation of the reactor or capable of affecting its safety.

2. INTERPRETATIONS

Terms used in the arrangements to Authorisation and its Schedules are defined in this section.

3. GENERAL REQUIREMENTS

3.1 Ongoing Review and Upgrading

The Executive Director shall make and implement arrangements acceptable to the NSB for reviewing and, where necessary, upgrading the safety of the reactor, taking account of the criteria for the radiological safety of ANSTO nuclear reactors in Regulatory Bureau Memorandum No.1 as amended from time to time, and evolving reactor safety practice. The Executive Director shall provide the Board and the NSB with an annual progress report on the review and upgrading, including the upgrading which is proposed for the following year.

4. ORGANISATION AND MANAGEMENT OF OPERATIONS

4.1 Operating Organisation

The Executive Director shall make and implement arrangements acceptable to the NSB for a reactor operating organisation having the primary responsibility to the Executive Director for the safe operation of the reactor. The arrangements shall provide a description of the organisation, including structures and lines of communication, delegations, responsibilities and authorities, functions, duties, and competencies required.

4.2 Training and retraining

The Executive Director shall make and implement arrangements acceptable to the NSB for training and retraining of all personnel in the reactor operating organisation.

4.3 Accreditation of Reactor Operating Personnel

The Executive Director shall make and implement arrangements acceptable to the NSB for accreditation and re-accreditation of the key reactor operating personnel.

4.4 Accreditation of Other Personnel

The Executive Director shall make and implement arrangements acceptable to the NSB for appropriate accreditation of persons, whether employed by ANSTO or otherwise, who are required to perform work on the reactor but are not included in the reactor operating organisation specified in Schedule Item 4.1.

4.5 Quality Assurance Programs

The Executive Director shall make and implement arrangements acceptable to the NSB for a quality system covering all activities associated with the operation, maintenance and modification of the reactor, which may have an influence on the safe operation of the reactor.

4.6 Records and Reports

The Executive Director shall make and implement arrangements acceptable to the NSB for maintaining adequate records and reports and provide the Nuclear Safety Bureau with access to these records and reports in order to satisfy the Nuclear Safety Bureau that the requirements of this Authorisation are being met.

4.7 Security

The Executive Director shall make and implement arrangements acceptable to the NSB to prevent persons from carrying out unauthorised actions capable of affecting the safe operation of the reactor. These arrangements shall take account of any relevant requirement imposed by the Australian Safeguards Office.

4.8 External Hazards

The Executive Director shall make and implement arrangements acceptable to the NSB for limiting any risk to the safe operation of the reactor from external events.

5. REACTOR DESIGN REQUIREMENTS

5.1 Design Information

The Executive Director shall maintain such design records, including plant descriptions, design calculations, design reviews, specifications and drawings, as may be needed to maintain and operate the reactor safely in a manner acceptable to the NSB and to establish that it is being maintained and operated safely.

5.2 A Safety Case for Safe Operation of HIFAR

The Executive Director shall provide a Safety Case acceptable to the NSB demonstrating that the reactor can be operated safely.

5.3 Operational Limits and Conditions

The Executive Director shall make and implement a set of operational limits and conditions acceptable to the NSB which reflect the provisions made in the design and operation of the reactor plant to ensure safe operation during normal start-up, operation at power, shutting down, shutdown, maintenance, testing, fuel handling and the conduct of irradiations and experiments.

6. REACTOR OPERATION REQUIREMENTS

6.1 Operating Procedures

The Executive Director shall make and implement written operating procedures and instructions acceptable to the NSB to be followed by the reactor operating organisation during normal operation of the reactor, including irradiations and experiments, abnormal occurrences and accident conditions to ensure safe operation within the operational limits and conditions approved in accordance with Schedule Item 5.3.

6.2 Regular Review and Updating of Operating Instructions and Procedures

The Executive Director shall ensure that the operating instructions and procedures are regularly reviewed, revised and updated in a manner acceptable to the NSB.

6.3 Abnormal Occurrences

The Executive Director shall make and implement arrangements acceptable to the NSB for the review, evaluation and notification to the Bureau of abnormal occurrences and accident conditions.

6.4 Handling of Fuel and Radioactive Material

The Executive Director shall make and implement arrangements acceptable to the NSB for the safe handling of fuel and of radioactive materials by the reactor operating organisation.

7. REACTOR MAINTENANCE, TESTING AND INSPECTION AND MODIFICATIONS

7.1 Maintenance, Periodic Testing and Inspection

The Executive Director shall make and implement arrangements acceptable to the NSB for a program of maintenance, periodic testing and inspection activities that will enable the reactor, irradiation rigs and experimental equipment to be operated safely. The activities shall be carried out in accordance with written procedures. The arrangements shall provide for regular review of the program and appropriate modification with respect to any problems identified.

7.2 Modifications to Reactor Plant

The Executive Director shall ensure the review of all proposals for modifications to the reactor plant, which involve significant safety issues, in a manner acceptable to the NSB. Such modifications shall be agreed by the Director, Nuclear Safety Bureau. The Executive Director shall notify the Director, NSB, in a quarterly listing, of all modifications of reactor plant.

8. HEALTH AND SAFETY

8.1 Health and Safety Procedures

The Executive Director shall make and implement arrangements for health and safety surveillance of reactor operations by the site safety organisation in accordance with written procedures in a manner acceptable to the NSB. The procedures shall be in accordance with applicable statutory requirements and shall cover normal operation of the reactor, abnormal occurrences and accident conditions. The procedures shall be directed to protecting the health and safety of ANSTO employees and others and to ensuring the fitness of staff for the effective performance of their duties.

8.2 Radiation Protection

The Executive Director shall make arrangements, acceptable to the NSB, to ensure the radiation protection of ANSTO employees and others, whether on site or elsewhere. The arrangements shall ensure that, under all operating states of the reactor, radiation doses received do not exceed the appropriate limits of the Australian National Health and Medical Research Council, current at the time of exposure, and are kept as low as reasonably achievable.

8.3 The Treatment, Storage and Disposal of Radioactive Solid, Liquid and Gaseous Wastes

The Executive Director shall make and implement arrangements acceptable to the NSB for the treatment, safe storage and disposal of radioactive wastes from the reactor.

9. IRRADIATIONS AND EXPERIMENTS

9.1 Irradiations and Experiments

The Executive Director shall make and implement arrangements acceptable to the NSB for conducting irradiations and experiments in the various facilities of the reactor, which involve safety significant issues. Such irradiations and experiments shall be agreed by the Director, NSB. The Executive Director shall notify the Director, NSB, in a quarterly listing, of all new and modified irradiations and experiments.

10. EMERGENCY ARRANGEMENTS

10.1 Emergency Arrangements

The Executive Director shall make and implement arrangements acceptable to the NSB for dealing with the effects, both on and off the site of the Lucas Heights Research Laboratories, of accident conditions or other emergencies arising from the operation of the reactor or capable of affecting its safe operation. These arrangements shall address the role of ANSTO and of other agencies that might be involved.

Glossary and Acronyms

ALARA As low as reasonably achievable

ANSTO Australian Nuclear Science and Technology Organisation (the operator).

Bq Becquerel (1 disintegration per second)

Bureau Nuclear Safety Bureau (the regulatory body

HIFAR High Flux Australian Reactor

IAEA International Atomic Energy Agency

ICRP International Commission on Radiological Protection

INES International Nuclear Event Scale

Licence any authorisation granted by the regulatory body to the applicant to have the responsibility for the siting, design, construction, commissioning, operation or decommissioning of a nuclear installation.

NHMRC Australian National Health and Medical Research Council

NSB Nuclear Safety Bureau (the regulatory body)

NSW New South Wales

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 nuclear research reactors.

OL&Cs Operational Limits and Conditions

PSA Probabilistic safety assessment

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.

SAR Safety analysis report

Sv Sievert (unit of radiation dose)

WHO World Health Organisation

m micro

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