The Parliament of the Commonwealth of Australia

Proposed replacement nuclear research reactor, Lucas Heights, NSW

Parliamentary Standing Committee on Public Works

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Membership of the Committee

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Deputy Chair	Hon. Janice Crosio MBE, MP	
Members	Mr John Forrest MP	Senator Paul Calvert
	Mr Colin Hollis MP	Senator Alan Ferguson
	Mr Peter Lindsay MP	Senator Shayne Murphy
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Committee Secretariat

Secretary	Mr Bjarne Nordin
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Extract from the Votes and Proceedings of the House of Representatives

No. 22 dated Wednesday, 17 February 1999

PUBLIC WORKS—PARLIAMENTARY STANDING COMMITTEE—REFERENCE OF WORK—REPLACEMENT NUCLEAR RESEARCH REACTOR, LUCAS HEIGHTS, NSW

Mr Slipper (Parliamentary Secretary to the Minister for Finance and Administration), pursuant to notice, moved—

> That, in accordance with the provisions of the *Public Works Committee Act 1969*, the following proposed work be referred to the Parliamentary Standing Committee on Public Works for consideration and report: Replacement nuclear research reactor, Lucas Heights, NSW.

Question—put and passed.

List of abbreviations

AAEC	Australian Atomic Energy Commission
AINSE	Australian Institute of Nuclear Science and Engineering
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASNO	Australian Safeguards and Non-Proliferation Office
DEIS	Draft Environmental Impact Statement
DISR	Department of Industry, Science and Resources
EAR	Environment Assessment Report
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environment Protection Authority
HIFAR	High Flux Australian Reactor
IAEA	International Atomic Energy Agency
LHSTC	Lucas Heights Science and Technology Centre
mSv	millisievert
NHMRC	National Health and Medical Research Council
PSAR	Preliminary Safety Analysis Report
RRR	Research Reactor Review
SEIS	Supplementary Environmental Impact Statement

List of conclusions and recommendations

The Need

Committee's Conclusions	Paragraph
HIFAR is obsolete and will need to be permanently decommissioned in 2005.	2.63
The estimated cost of refurbishing HIFAR to comply with safety requirements alone would be half of the cost of providing a new research reactor. This would not provide an enhancement of its research and operational capabilities which are considered by the scientific community to be limited. Such limitations have led to a reduction in national research and development opportunities.	2.64
A need exists to replace HIFAR with a modern research reactor. The new national research reactor must be operational some time before HIFAR is decommissioned.	2.65
The need for the replacement of HIFAR arises as a consequence of national interest considerations, research and development requirements and the need to sustain the local production of radiopharmaceuticals.	2.66
There has been substantial investment in infrastructure at Lucas Heights Science and Technology Centre.	2.67
Construction of a replacement research reactor at a greenfields site and decommissioning of HIFAR would require the provision of much of the infrastructure which already exists at Lucas Heights.	2.68
The comparative costs of locating the replacement research reactor at Lucas Heights or a greenfields site favour the former by a considerable margin.	2.69

On financial grounds there is merit in locating the replacement research reactor at Lucas Heights, subject to the suitability of the site on operational and public safety grounds. 2.70

The Proposal

Committee's Conclusions	Paragraph
The capabilities of the proposed research reactor and auxiliary facilities result from study and assessment by representatives of potential users and provides scope for later enhancement.	3.79

Committee's Recommendation

During the licensing, construction and commissioning phases ANSTO should provide the Committee with six-monthly reports on progress. 3.80

Codes, waste and hazards

Committee's Conclusion	Paragraph
The storage of radioactive waste at Lucas Heights is of major concern to the local community.	4.142

Committee's Recommendations

When moving the expediency motion for the work to proceed, the Minister should provide a guarantee to the House that all recommendations in the Environment Assessment Report will be implemented. This guarantee should include existing commitments and new commitments listed in Appendix A of the Environment Assessment Report. 4.143

Provided all recommendations and commitments contained in the Environment Assessment Report are implemented during construction and commissioning and for the expected life of the research reactor, the Committee believes, based on the evidence, that all known risks have been identified and their impact on public safety will be as low as technically possible. 4.144

Removal of all radioactive waste from Lucas Heights for disposal or storage at a National Repository must be a high priority and is dependent on the timely provision of the Repository and Store. 4.145

In its quarterly and annual reports to Parliament, the Australian Radiation Protection and Nuclear Safety Agency should report on the implementation of all recommendations in the 4.146

Environment Assessment Report falling within its direct responsibility.

In future, in its Annual Report to Parliament ANSTO should report on compliance and implementation of all recommendations in the Environment Assessment Report, including the commitments listed in Appendix A of the report.	4.147
As a matter of urgency, the Minister for Health and ARPANSA should appoint members to positions on committees identified in the Act.	4.148

Consultation

Committee's Recommendation	Paragraph
There is an urgent need for an agreement on the Community Right to Know Charter. Steps toward its development identified in the Environment Assessment Report should be undertaken as soon as possible to enable the public to be better informed about the further development of the project.	5.27

Project management and cost

Committee's Conclusions	Paragraph
The estimated cost is based on international precedents and national construction. There will be no scope for design variations during construction which could lead to cost increases.	8.52
A high level management structure will be established to oversight the project with representation from key departments—including the Department of Finance and Administration.	8.53

Committee's Recommendation

The Committee recommends provision of the reactor should not be at the expense of other Government science funding.	8.54
The Committee recommends the construction of a replacement research reactor at Lucas Heights at an estimated cost of $286.4 million at 1997 prices.	8.55

1

Introduction

1.1 On 17 February 1999, the House of Representatives referred to the Parliamentary Standing Committee on Public Works for consideration and report the proposed replacement nuclear research reactor, Lucas Heights, New South Wales.

The Reference

1.2 The terms of the reference were as follows:

> The Australian Nuclear Science and Technology Organisation (ANSTO) intends to construct and operate a replacement research reactor at the Lucas Heights Science and Technology Centre. The new facility will replace the 41 year old high flux Australian reactor, which is expected to reach the end of its operational life around the year 2005.
>
> ANSTO has engaged in the necessary and appropriate level of public consultation … a full Environmental Impact Statement on this project, which it has submitted pursuant to the provisions on the *Commonwealth Environment Protection (Impact of Proposals) Act 1974*. Consideration by the Public Works Committee is the next step in the acquisition process and is a standard requirement for all significant Commonwealth construction projects.
>
> The replacement research reactor will meet the specific objectives of:
>
> - maintaining and enhancing health care benefits provided to the Australian community;
> - maintaining Australia's nuclear technical expertise;

- providing a neutron beam research facility that will meet Australia's scientific and industrial needs and serve as a regional centre of scientific excellence;
- providing research and research training facilities and programs to enhance the educational opportunities available to Australia's scientists and engineers;
- providing radioisotopes, for use in industry and environmental applications, and facilities for neutron activation analysis, irradiation of materials, and neutron cardiography to service the needs of industry, environmental applications and agriculture; and
- meeting all health, safety, environmental and quality standards in its construction and operation.

Cost of proposed works

1.3 When referred to the Committee, the estimated cost of the facility was $286.4 million.

The Committee's Investigation

1.4 The Committee received a written submission from ANSTO and took evidence from ANSTO officials at public hearings held at Parliament House, Sydney, on 5 May and at Parliament House, Canberra on 14 May 1999. The Committee also received submissions and took evidence from a number of organisations and individuals in Sydney on 5 and 6 May. A list of witnesses is at Appendix A. A list of submissions is at Appendix B.

1.5 On 5 May, prior to the first day of public hearings, the Committee undertook an extensive inspection the facilities at Lucas Heights. The inspection, preceded by a detailed briefing, encompassed the following:

- High Flux Australian Reactor (HIFAR) and proposed site of replacement reactor;
- low level radioactive waste;
- radiopharmaceuticals production;
- environment division;
- materials division; and
- stored spent fuel rods.

Background

Nuclear and radiological reports

1.6 It is worth stating at the outset that the Committee has, in previous Parliaments, examined and reported on two major projects with radiological and nuclear components. These projects were:

- construction of National Medical Cyclotron facility, Royal Prince Alfred Hospital, Sydney[1]. This project, estimated to cost $8.9 million (1988 prices), involved the construction of buildings to house the national medical cyclotron, associated laboratories and facilities for radiopharmaceutical products, and
- Maralinga rehabilitation project, SA[2]. This project was aimed at reducing radiological hazards at former British atomic test sites at Maralinga. The estimated cost of the proposed work was $104.4 million (1994 prices). The British Government made an ex gratia payment of £20 million towards the cost of the project.

1.7 The current proposal continues the Commonwealth's involvement in projects designed to enhance Australia's nuclear medicine capabilities.

Australian Atomic Energy Commission

1.8 Development of a national nuclear research capability commenced in 1953 with the establishment of the Australian Atomic Energy Commission (AAEC).[3] At the time, the aim of the Government was to use nuclear technology to promote national development. Emphasis was placed on a research and development program to build up national nuclear expertise in nuclear physics and chemistry.

Construction

1.9 Lucas Heights, now known as the Lucas Heights Science and Technology Centre (LHSTC), was chosen as the site for Australian nuclear activities in 1955. The initial phase, from 1955–58, saw the construction and commissioning of the HIFAR and associated facilities. The design of HIFAR was based on design information and technical specifications of a 10 megawatt, heavy water moderated, high neutron flux materials test reactor under construction in the United Kingdom. HIFAR was designed

1 Committee's First Report of 1989, Parliamentary Paper 150/1989

2 Committee's Tenth Report of 1995, Parliamentary Paper 109/1995

3 *Atomic Energy Act 1953*

as a materials test reactor. Emphasis was given to a research and development program to build up national nuclear expertise, including nuclear chemistry, nuclear physics and nuclear engineering. The first self-sustaining atomic chain reaction was achieved within the reactor in 1958 and it has operated routinely at power since 1960.

1.10 The second construction phase, from 1958–63, saw completion of most of the major buildings and equipment on the site. A small experimental reactor, Moata (an Aboriginal word meaning 'fire sticks'), commenced operation in 1961. This was to be used to train nuclear physicists in reactor control and neutron behaviour.

1.11 Further development was undertaken between 1964 and 1981. The production of radioisotopes for use in nuclear medicine emerged during the late 1960s and 1970s. A major HIFAR refurbishment program was undertaken in 1981 and encompassed improvements to air-conditioning systems, modifications to the reactor aluminium tank and the replacement of non-inflammable material.

1.12 In 1987, as well as the completion of the Synroc demonstration plant, other major facilities provided were the Australian national tandem accelerator, the Australian small angle neutron scattering instrument and the establishment of a business technology park. In 1993, a secondary ion mass spectrometer was acquired for environmental science and materials science research.

1.13 In 1987, Parliament enacted legislation which replaced the AAEC with the Australian Nuclear Science and Technology Organisation (ANSTO).[4] ANSTO's charter emphasised applied and commercial applications of nuclear science and technology.

1.14 In summary, during its 40 year life HIFAR has been progressively adapted to changing requirements and research opportunities. The production of radioisotopes for use in nuclear medicine emerged during the late 1960s and 1970s. In addition to radioisotope production, HIFAR continues to be used for a wide range of industrial applications and research.

Location

1.15 LHSTC is situated in Sutherland Shire with a 1.6 kilometre radius buffer zone, about 30 kilometres south-west of Sydney CBD.

1.16 Extensive urban development has occurred over the past 30 years in western Sutherland Shire. Relatively new suburbs have been developed to the east and north-east of the buffer zone. The suburbs of Engadine and

4 *Australian Nuclear Science and Technology Organisation Act 1987*

Heathcote existed when LHSTC was established. To the south and west of the buffer zone are large areas of bushland comprising Heathcote National Park and the Holsworthy Military Area.

1.17 The Sutherland Shire Housing Strategy provides for 12,000 new dwellings in the local government area by 2011. An increase in encroachment towards the 1.6 kilometre buffer zone is not expected.

Other organisations located at Lucas Heights

A number of other organisations operate at LHSTC. These include:

- CSIRO—employing more than 100 staff in the Divisions of Energy Technology and Minerals and Process Engineering;
- Australian Institute of Nuclear Science and Engineering—a consortium of 36 Australian universities operating in partnership with ANSTO to promote research and training in nuclear science and engineering;
- Tracero Australia—a joint venture company between ANSTO and ORICA, which provides radioisotope tracer expertise; and
- Becquerel Laboratories—conducts commercial neutron activation analysis of mining and exploration samples.

Research Reactor Review

1.18 Commencing in 1993, a number of substantial reviews of AAEC / ANSTO were undertaken to assess the capabilities of HIFAR and its longevity.

1.19 In 1993, the Government established the Research Reactor Review (RRR), under the chairmanship of Professor Ken McKinnon. The terms of reference for the RRR were to investigate:

- whether, on review of the benefits and costs for scientific, commercial, industrial and national interest reasons, Australia has a need for a new research reactor;
- the present reactor, HIFAR, to include an assessment of the national and commercial benefits and costs of HIFAR operations, its likely remaining useful life and its eventual closure and decommissioning; and
- if the finding on the first term of reference was that Australia has a need for a new nuclear research reactor, to consider possible locations for a new reactor, its environmental impact at alternative locations, recommend a preferred location and evaluate matters associated with

regulation of the facility and organisational arrangements for reactor-based research.

1.20 Significantly, the terms of reference included the following provisions:

- In assessing the environmental impacts of the facility, the Review will take account of the objectives of the *Environment Protection (Impact of Proposals) Act 1974*, as amended. *In this regard the Review will schedule public hearings and call for submissions from any interested parties by advertisements in major newspapers.* [Italics added]

1.21 The review received more than 380 submissions and held public hearings in six mainland states and Canberra. These provided a forum for wide-ranging evidence to be presented. The report was published in August 1993[5] and proposed a holding operation. The review recommendations were to:

- keep HIFAR going;
- commission a Probabilistic Risk Assessment to ascertain HIFAR's remaining life and refurbishment possibilities;
- provide an additional $2 million per year for scientists to gain access to international advanced neutron scattering facilities;
- commence work immediately to identify and establish a high level waste repository;
- accept the financial implications of the fact that neither the current nor any new reactor can be completely commercial;
- accept in consequence that any decision on a new reactor or other neutron source must rest primarily on the assessed benefits to science and Australia's national interests; and
- make a decision on a new neutron source in about five years time when the relative arguments relating to spallation sources, cyclotrons and reactors might be clearer, and when Australia's scientific neutron scattering performance is more evident.

1.22 The RRR report went on to suggest that it would be appropriate to make a decision about a possible new reactor at the end of about five years, provided the following requirements had been met:

- a high level waste site has been firmly identified and work started on proving its suitability;

5 *Future Reaction: report of the Research Reactor Review*, August 1993. (Hereafter *Future Reaction*)

- there is no evidence that spallation technology can economically offer as much or more than a new reactor;
- there has been no practical initiation of a cyclotron anywhere worldwide to produce technetium-99m;
- there is good evidence of strong and diverse applications of neutron scattering capability in Australian science, including many young scientists, and a complex of industrial uses; and
- the national interest remains a high priority.

A suitable site would therefore need to be identified.

1.23 In relation to the conditions, the report recommended that:

> If any of these onerous requirements is not met, either a negative decision, or a decision to delay further, would be indicated.[6]

Senate Select Committee

1.24 A high priority accorded by the RRR was the need to establish a national waste repository. The question of radioactive waste was addressed by a Senate Select Committee appointed in March 1995. Included in the Select Committee's terms of reference was a requirement to report on:

> the nature, efficiency, and effectiveness of the administration, storage, transport, treatment and disposal [of radioactive waste] and whether these are adequate to protect the public interest.[7]

1.25 The inquiry was launched following public concerns and publicity about an incident involving the transfer of radioactive material from Fishermens Bend (Vic) to Woomera (SA). During the transportation, a drum lid in one load became loose and water leaked from the drum while the waste was in transit through Port Augusta (SA).[8]

1.26 During the Select Committee inquiry, the Commonwealth announced a proposal to establish an Australian Institute of Radiation Protection by combining the Nuclear Safety Bureau and the Australian Radiation Laboratory. This proposal—to establish an independent regulator with functions of regulating, licensing, monitoring and imposing penalties for breaches, was strongly supported by the Select Committee. The Committee's misgivings about the agency to operate completely

6 ibid., p. xv.
7 *No time to waste: Report of the Senate Select Committee on the Dangers of Radioactive Waste*, April 1996 (Parliamentary Paper 7/1996) p. iv.
8 ibid., p. 4.

independently was reflected in a number of recommendations which dealt with:

- the lack of substantial operational functions or commercial activities in nuclear science;
- the administrative arrangements under which it is set up avoid a conflict of interest;
- the need for an arm's length relationship between the agency and the industry, and
- the need for community representation.

1.27 In relation to the wider issue of the storage of waste, the Select Committee recommended the establishment of a national above ground storage facility with the capacity to take low, intermediate and high level radioactive waste.

National Body Established

1.28 The Senate Select Committee recommendations and subsequent government action were held in abeyance until May 1998 when the House of Representatives passed the Australian Radiation Protection and Nuclear Safety Bill 1998. On 31 August, the House of Representatives was dissolved and Parliament was prorogued and the Senate was unable to consider the Bill. It was reintroduced in the House of Representatives on 11 November and was passed by the Senate on 10 December 1998, coming into force on 4 February 1999.[9] The importance of this legislation in the context of the proposed work and nuclear waste management is discussed later in this report.

Environmental impact assessment

1.29 The proposed construction of the replacement research reactor at Lucas Heights was announced by the Minister for Science and Technology on 3 September 1997. The Minister's announcement included the proviso that the proposed reactor

> Will meet the strictest international nuclear safety standards and its construction will be subject to a stringent environmental

9 *Australian Radiation Protection and Nuclear Safety Act 1998*

> assessment process under the *Environment Protection (Impact of Proposals) Act 1974*, which will be open to public comment.[10]

1.30 ANSTO was designated the proponent in accordance with the provisions of the Act.

1.31 On 27 September 1997, the Minister for the Environment and Heritage, using his discretion under the Act, directed that an Environmental Impact Statement (EIS) be prepared for the proposal. The Department of the Environment and Heritage prepared draft guidelines for the content of the EIS. These guidelines were released for public comment from 8 November to 6 December 1997. During the review period 118 submissions were received. Changes to the draft guidelines were made as a result of these submissions. On 23 December 1997, the Minister endorsed the final guidelines and ANSTO and consultants—PPK Environment and Infrastructure and NNC Limited, set about the task of preparing a Draft EIS (DEIS).

1.32 The DEIS was made available for public comment between 17 August and 9 November 1998, a period of 12 weeks. In all, 935 submissions were received; of these, 776 were pro forma submissions, with another 50 being based on the pro forma submissions. In parallel with public review of the DEIS, the Department of the Environment and Territories commissioned three independent scientific peer reviews of the DEIS.

1.33 The Administrative Procedures require proponents to prepare a Supplementary EIS (SEIS) addressing the substantive concerns raised in submissions. The supplement was delivered to the Department of Environment and Territories on 18 January 1999 and was also made available for public viewing. On 30 March 1999, the Minister for the Environment released the Department's Environment Assessment Report (EAR) on the proposed replacement reactor proposal. This document was prepared for the Minister for the Environment to provide advice and recommendations on the proposal to the responsible Minister, the Minister for Industry, Science and Resources (Senator the Hon Nick Minchin). The latter Minister is required to take any advice and recommendations into account in making further decisions with respect to the proposal. In evidence, it was suggested by a number of organisations that the EIS was inadequate. From the perspective of the Commonwealth's own environmental impact assessment agency, this assertion cannot be sustained. The DEIS and the SEIS were prepared in accordance with statutory requirements and in accordance with the agreed guidelines and addressed issues raised in public submissions during the DEIS exhibition period. Environment Australia's EAR states:

10 ANSTO, *Transcript*, p. 105.

> The Department considers that the requirements of the *Environment Protection (Impact of Proposals) Act 1974* have been met in regard to the proposal by ANSTO to construct and operate a replacement nuclear research reactor at the LHSTC. The environmental impacts of the proposal have been identified and examined as far as practicable.
>
> The Department assessment concludes that there are no environmental reasons, including on safety, health, hazard or risk grounds, to prevent the construction of the proposed reactor at Lucas Heights. This conclusion is subject to the implementation of the recommendations contained in the report.[11]

Approval conditions

1.34 The Minister's media release and approval conditions are at Appendix C.

1.35 There are 29 environmental approval conditions in the EAR. The overriding recommendations concern implementation of ANSTO commitments and undertakings. These are stated as the first and final condition:

> The construction and operation of the proposed reactor at Lucas Heights Science and Technology Centre (LHSTC) must be in accordance with the undertakings and commitments provided by the Australian Nuclear Science and Technology Organisation (ANSTO) in the Final Environmental Impact Statement (*Replacement Nuclear Research Reactor*, 1997/98, Volumes 1, 2 and 3), and as summarised in Appendix A to this report. If there is conflict between the ANSTO undertakings and the recommendations below, the recommendations will take precedence.[12]

1.36 The wide-ranging recommendations referred to, fall into two categories. First, construction impacts, and secondly, impacts associated with the operation of the replacement research reactor. They cover the following subjects:

- construction environmental management plan;
- other construction issues;
- operational impacts (non-radiological);

11 Environment Australia, *Environment Assessment Report: proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, p. viii. (Hereafter the *EAR*)

12 ibid., p.197.

- site emissions and monitoring;
- hazards and risks;
- emergency management plan;
- community consultation;
- nuclear wastes; and
- ANSTO environmental management system.

1.37 The second overriding recommendation also deals with the question of compliance with commitments and recommendations:

> ANSTO must report to the Minister for the Environment and Heritage on measures taken, or to be taken, to implement the above recommendations, including the undertakings and commitments referred to at Recommendation 1. This is to be done by way of an initial written report to the Minister prior to construction commencing and thereafter at six monthly intervals until all recommendations have been addressed to the satisfaction of the Minister for the Environment and Heritage. These reports must be made publicly available by ANSTO, following their acceptance by the Minister. (Recommendation 29)[13]

1.38 On 3 May 1999, the day before the Committee's first public hearings, Senator Minchin announced, by way of a media release, acceptance of the recommendations.[14] Whilst the media release mentioned the Public Works Committee's inquiry, actual media reports suggested the project had been given approval to proceed.

1.39 The announcement was reported in the media on the day of the hearing omitting references to the Committee's inquiry and the statutory requirement under the Public Works Committee Act that commencement of the project would be subject to a favourable report from the Committee and subsequent Parliamentary approval. This was despite the Minister's reference to Public Works scrutiny in the issued media release. Understandably, members of the Committee and indeed witnesses who appeared before the Committee, expressed considerable unease as a consequence. However, it reflected the lack of understanding by the press of the required Parliamentary approval process.

13 ibid., p. 203.

14 *Media release*, Senator Nick Minchin, Minister for Science and Resources, 3 May 1999.

Additional Government initiatives

1.40 Four complementary Government initiatives coincided with the decision announced on 3 September 1997 to construct a replacement research reactor. These initiatives and subsequent action are set out below:

- the establishment of a new agency, Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to regulate and licence the Commonwealth's future nuclear and radiation activities. This agency would combine the existing resources of the Australian Radiation Laboratory and the Nuclear Safety Bureau
  - ⇒ Action—the Radiation Protection and Nuclear Safety Agency has been established *(Australian Radiation Protection and Nuclear Safety Act 1998)*;
- the Government would not establish a reprocessing facility for spent nuclear fuel at Lucas Heights or anywhere else in Australia
  - ⇒ Action—Section 10 of the *Australian Radiation Protection and Nuclear Safety Act 1998* prohibits the construction or operation of a nuclear reprocessing facility in Australia;
- $88 million would be set aside to remove spent nuclear fuel rods from the existing facility at Lucas Heights and to meet the cost of reprocessing overseas;
  - ⇒ Action—ANSTO has entered into a contract with a French company, COGEMA, for the reprocessing of spent fuel and its eventual return to Australia;
- Government's continuing support of ANSTO initiatives in developing Synroc technology as a long term future option for safely disposing of waste arising from spent fuel and other nuclear activities from the replacement reactor.
  - ⇒ Action—Synroc technology is undergoing further development.

Further progress with the proposal

1.41 The contract for the replacement reactor will be let on a turnkey basis to a research reactor vendor.

1.42 To date, the process prior to tenders has entailed the pre-qualification of four reactor vendors following a detailed examination of the capabilities and experience of all prospective vendors registering interest. The successful reactor vendors were informed in December 1998. The next stage of the tender process involves the preparation of the Request for

Tender. Tenders are planned to close in December 1999 with awarding of a prime contract planned for mid-2000.

2

The Need

Capabilities

2.1 The Australian Nuclear Science and Technology Organisation (ANSTO) submitted that there is a need to replace the High Flux Nuclear Reactor (HIFAR) which, although it has been adapted over many years, is now constrained in terms of capabilities and is considered to be technologically obsolete. Capabilities which are required and in which HIFAR is deficient include:

- a continuing need to maintain and enhance Australia's nuclear technical expertise in order to provide sound advice to Government in support of nuclear policy issues of strategic national interest and its international obligations in this area;
- the need to provide a world-class neutron beam research facility to meet Australia's scientific, engineering, industrial research and training needs. As a regional centre of excellence, there is a need to provide research and research training facilities and programs to enhance the educational opportunities available to Australia's scientists and engineers. The quality of neutron beams extracted from HIFAR is inhibiting the range and output of research projects. HIFAR's capabilities compare unfavourably with modern research reactors in the region and internationally;
- enhancement of health care benefits provided to the community through the provision of medical radiopharmaceuticals and ensuring security of supply over the next 40 to 50 years. The demand for radiopharmaceuticals is growing and HIFAR would not be able to meet the demand beyond 2005;

- the lack of a cold source capable of producing slow neutron beams required for examination of the structure of biological and other molecules containing light elements; and
- a requirement to produce industrial isotopes and facilities for neutron activation analysis, irradiation of materials and neutron radiography to service the needs of agriculture and industry, particularly in the electronics, environmental, resource and minerals processing industries.

Nuclear expertise and national interest

2.2 National interest considerations must be included in the contributions made by a national nuclear research reactor . These contributions cover:

- national security and nuclear non-proliferation;
- nuclear safety; and
- economic development.

2.3 Australia remains committed to nuclear non-proliferation. The international nuclear non-proliferation regime, in which Australia is a key participant, comprises:

- the Treaty on the Non-Proliferation of Nuclear Weapons;
- membership of the International Atomic Energy Agency and the safeguards system;
- a nuclear export control regime; and
- regional nuclear weapon-free zone treaties.[1]

2.4 There is a continuing need to ensure that the immediate environment remains free of nuclear weapons. As one of the world's major exporters of uranium, there is a need to maintain a leading role in the international safeguards system. For these national interest requirements to have credibility, the Government must have technical expertise to pursue policies on nuclear issues and non-proliferation. ANSTO and the Department of Foreign Affairs and Trade advised the Committee that Australia's credibility as a regional leader in nuclear issues is becoming difficult to maintain, citing the lack of a modern research reactor as the

1 ANSTO, *Replacment Nuclear Research Reactor, draft Environmental Impact Statement*, Vol. 1, July 1998. pp. 3-19. (Hereafter *DEIS*)

prime reason. National capabilities which require continuing enhancement to match regional and international developments include:

- monitoring of international and regional nuclear activities;
- monitoring the use of Australian uranium in the nuclear fuel cycle;
- monitoring the adequacy of international nuclear safety, radiation practices and radioactive waste management norms and their implementation;
- assessing nuclear safety, radiation protection and radioactive waste management implications in emergencies;
- participating in assessments to determine regulations and guidelines on international arrangements for the transport of radioactive material;
- assessing the effectiveness of international non-proliferation, disarmament, nuclear safeguards, physical protection and export control and contributing to their development;
- providing assistance to developing countries on the peaceful uses of nuclear science and technology—consistent with national obligations under article IV of the Treaty on the Non-Proliferation of Nuclear Weapons; and
- determining and ensuring effective arrangements for visiting nuclear powered warships consistent with alliance obligations and public safety.[2]

2.5 The Government obtains expertise and advice from a number of other agencies, including the Australian Safeguards Office. Nevertheless, ANSTO remains the prime provider of expertise and technical advice to Government. ANSTO's core competencies, derived from the operation of a research reactor and which need to be enhanced to reflect contemporary technology, are in the areas of:

- nuclear research reactor operation;
- nuclear safety;
- radiation protection;
- radioactive waste management; and
- transport of radioactive materials.

2 *DEIS*, op. cit., pp. 4-7.

Department of Foreign Affairs and Trade

2.6 A submission to the Committee from the Department of Foreign Affairs and Trade (DFAT) and the Australian Safeguards and Non-Proliferation Office (ASNO) expanded on national interest considerations. In summary, the two organisations expressed the belief that a replacement research reactor would assist Australia's national security and economic interests and would be of substantial scientific benefit to Australia.[3]

2.7 DFAT confirmed that Australia's growing uranium exports are underpinned by a strong and effective safeguards system. To ensure that Australia's strategic neighbourhood remains free of nuclear weapons proliferation requires a capability to comprehend, anticipate and influence nuclear developments in the region and internationally. If Australia is to participate effectively in multilateral, regional and bilateral arrangements aimed at keeping the region free of nuclear proliferation it is essential to have national expertise in nuclear fuel cycle matters supported by the continued operation of a modern research reactor.

2.8 In more detail, DFAT made the following points:

- multilateral, regional and bilateral arrangements keep our region free from nuclear proliferation—the national security imperative for Australia will be to maintain these arrangements well into the next century;
- it will be necessary for Australia to have the capacity to comprehend, anticipate and influence nuclear developments in its region and more broadly;
- if Australia is to do this effectively and with a degree of independence, it will be necessary for Australia to possess expertise on nuclear fuel cycle matters with support from the continued operation of a modern research reactor;
- the ability to assess the security, economic and safety implications of nuclear programs in the region would be curtailed if Australia withdrew from neutron science research altogether; and
- the basis for Australia's retention of its seat on the Board of Governors of the International Atomic Energy Agency would be undermined if Australia withdrew from neutron science—this would impact on Australia's ability to influence developments in international nuclear affairs, including nuclear safeguards.

3 Department of Foreign Affairs and Trade, *Transcript*, p. 947.

2.9 Expertise in the nuclear fuel cycle provides the technical basis of advice to Government on nuclear policy issues. Experience derived from the operation of the research reactor is important to the expertise of the ASNO and to the placement of Australians in the International Atomic Energy Agency's Safeguards Department. DFAT commented that since the 1980s Australian nuclear fuel cycle expertise has declined and believes that a replacement research reactor would be the single most important contribution which can be made to turn this decline around.

2.10 Internationally, Australia is involved in a variety of activities aimed at reducing the risk of nuclear weapons proliferation or preventing radiological hazards from threatening Australia's security and economic interests or the health of the Australian people.

2.11 DFAT suggested that the effectiveness of Australia's engagement in nuclear policy activities is based on being regarded by others as being credible. This credibility is dependent on technical experience and understanding of nuclear science and technology.

2.12 DFAT also stated:

> Developing countries in the region are becoming more technologically advanced in some aspects of nuclear technology than Australia. While there is no reason to believe that current regional plans for nuclear research and nuclear power reactors represent a proliferation threat to Australia, for other countries it is a fact that possession of nuclear fuel cycle technology and facilities may shorten the time required to develop a nuclear weapons capability should they want to do so.[4]

2.13 For these reasons, DFAT advised the Committee that construction of a replacement research reactor would provide the basis for active Australian participation in regional and bilateral cooperation arrangements encompassing research reactors and ancillary technology and techniques in the expanding nuclear programs in the Asia Pacific region. Technical cooperation with other nuclear programs would provide insights to enable informed assessments to be made of nuclear developments. These, in turn, will provide the basis for important security and commercial policy decisions.

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4 ibid., p. 942.

Research Reactor Review

2.14 The Committee notes that the Research Reactor Review (RRR) examined the national interest implications of the need for a replacement research reactor. The Review stated that whatever contribution HIFAR has made to the national interest during the past three decades has been at considerable expense. The RRR identified and examined four potential areas of contribution to the pursuit of the national interest:

- national security;
- provision of expert advice on nuclear issues;
- the ability to influence international and regional nuclear affairs; and
- commercial opportunities arising from nuclear facilities in the region.

2.15 The RRR also cited evidence from DFAT, similar to that provided to the Committee, to the effect that it was dependent on ANSTO's access to a reactor for a range of intelligence. Furthermore the Government needed reliable and independent technical advice for security assessments, intelligence, policy formulation and commercial advice.[5] Other departments made similar representations to the RRR and recommended that the national interest would be well served by maintaining local nuclear expertise.

2.16 The RRR also discussed briefly the role of the International Atomic Energy Agency (IAEA). This is an autonomous inter-governmental organisation established in 1957 by directive of the United Nations General Assembly. It is the major global nuclear forum. Its brief is to foster commerce in peaceful nuclear activities while ensuring these activities do not contribute to the proliferation of nuclear weapons.

2.17 Of significance, is that the establishment of the IAEA was based on the premise that the 'genie was out of the bottle' and therefore there was a need for an integrated agency to establish appropriate safety and security levels and to control the handling of nuclear materials.[6] Regarding Australia's involvement and influence on the IAEA as a 'designated' member, the RRR cites a submission from the IAEA:

> …its [Australia's] continuing important role on the Board of Governors on the Agency has been based on its status as a major exporter of uranium, its technical support for the safeguards system, and by the contribution of experienced personnel to a

5 *Future Reaction,* op. cit., p. 97.

6 ibid., p. 100.

> wide range of disciplines relating to nuclear energy and the applications of nuclear technology.[7]

2.18 The Committee heard claims that Australia's profile on the IAEA and international safeguards fora are not dependent on the presence of a research reactor on Australian soil. These claims are similar in nature to those advanced during the RRR. In response, the RRR accepted that participation in the IAEA may not be the only way of pursuing Australia's national interest, but accepted that there are national benefits in full participation in the IAEA. The Committee shares this view.

2.19 Professor John White, representing the Australian Academy of Science advised that the Academy of Science believes the justification for the reactor was

> …concerned firstly with the national interest, secondly with the strengthened integration of strategic research industry links, including of course the radiopharmaceuticals and other type technology; and, thirdly, the maintenance and renewal of internationally recognised Australian basic and strategic research. That is a deliberately chosen order…[8]

Science benefits

2.20 HIFAR was one of the first major national science research facilities in Australia. Neutrons produced by medium flux research reactors are recognised internationally as a unique and broadly applicable scientific tool. Neutrons are used for leading edge, basic and applied investigations across a wide range of scientific and technological disciplines in soft matter, materials and engineering science, physics, chemistry, biology, medicine and environmental science.

2.21 Currently, Australian scientists are applying neutron diffraction techniques in research on the fundamental structures and functioning of condensed and soft matter including high temperature superconductivity, the functioning of battery materials, structure of polymer blends and the performance of drilling muds.

2.22 Scientists in Australia will benefit not only from access to a local facility of international significance, but also, as a consequence of the enhanced quality of their work, they would attract international peers to work with them in Australia, thereby establishing important networks and enabling them to gain access to the complementary facilities elsewhere. The

7 ibid., p. 101.
8 Prof. White, *Transcript*, p. 426.

replacement research reactor, as a national facility, would be an important element of Australia's overall scientific infrastructure.

2.23 The availability of a modern Australian research reactor will ensure the ability to study a broad range of new and emerging materials locally as well as develop an understanding of important industrial processes. This will contribute to the basic technological capacity of Australian industry and assist it to maintain a leading, cost effective edge in the next century.

2.24 ANSTO submitted that a replacement research reactor would provide the opportunity for Australia to become a regional centre for research and training in cold neutron science and technology. In a cold source, neutrons are slowed by exposure to very low temperatures. The resulting beam of slow neutrons is particularly suitable for studies in the life sciences and polymer science.[9]

2.25 The Australian Institute of Nuclear Science and Engineering (AINSE) represents the interests of 36 universities in Australia and New Zealand involved in research using nuclear related facilities. Research areas represented are diverse ranging from materials science, plasma research, bioengineering, and environmental science to isotope based medicine, radiopharmaceuticals and engineering. AINSE submitted that current activities at ANSTO limit research possibilities and the age of associated facilities does not provide an incentive for new researchers or some of the more productive groups in Australia to attempt their work. For these reasons, AINSE advocate the provision of a replacement research reactor.

2.26 An earlier report, prepared for the Board of AINSE by Dr G. S. Laurence[10], commented that the RRR was a temporary holding operation which avoided the need for a determined outcome. The report placed the neutron scattering community in an invidious position—it was expected to rekindle vitality with an aging reactor without the cold neutron source which had been proposed as a means of broadening the research base and providing a much needed cutting edge facility. This was to be done in a climate of reductions in staffing in the universities and ANSTO.

2.27 In terms of the overall contribution the reactor would make, AINSE advised that in general terms, the relevance of the research use of neutrons is not disputed. However, it cannot be argued that the present scale of neutron research in Australia would justify a reactor in its own right; rather it must be viewed as a critically important auxiliary function to the

9 ANSTO, *Transcript*, pp. 107-8.

10 AINSE, *Transcript*, pp. 905.

more easily justified production aspects of radioisotope manufacture and materials processing which also require neutrons.

2.28 AINSE concluded that the construction of a replacement research reactor would be an investment for the future. Given the useful working life of a reactor, the present projected costings represent an expenditure well within the capacity of the Australian economy.

2.29 ANSTO advised that a Beam Facilities Consultative Group has been established to determine overall research priorities. Membership of the group will include representatives from the Academy of Science, the Academy of Technological Sciences and Engineering, Institute of Physics, Royal Australian Chemical Institute, a nominated life scientist, two Australian Institute of Nuclear Science and Engineering nominees and industrial representatives.

Industry

2.30 Scientists at the Lucas Heights Science and Technology Centre (LHSTC) have been closely involved in developing radioisotope applications and successfully transferring these applications to industry. The Committee was shown a number of examples involving the mining industry during the inspection of facilities at Lucas Heights and ANSTO cited a number of example of the benefits.

2.31 A significant spin off from research activity from the mid 1960s was the development of a range of nucleonic (or radioisotope) gauges for the minerals processing and coal industries. This was undertaken by the Australian Atomic Energy Commission (AAEC) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) at the LHSTC. The gauges, marketed by Amdel Ltd and MCI Ltd, contribute more than $7.5 million annually to Australia's export income. The Australian mining industry benefits from this technology through productivity increases estimated to be worth about $50 million annually. These developments led to a number of awards, culminating in the Australia Prize in 1992. Such achievements would not have been possible without direct access to the isotope sources and engineering infrastructure developed around HIFAR.

2.32 The field of radioisotope tracing, which complements applications of installed nucleonic gauges, has also developed over the years. In 1989, Tracerco Australasia (now ANSTO Process Diagnostics) was formed as a partnership between ANSTO and ICI Australia (now ORICA) for the commercial exploitation of the technology. The business operates in most States of Australia, New Zealand and Asia. The technology is based

primarily on reactor produced isotopes. The volume of business is steadily increasing and is leading to significant savings to Australian industry. Sales now exceed $1 million annually and the economic multiplier of such services has been estimated by ICI(UK) to be as high as 20:1. Because of recent realignment of its business activities, ORICA withdrew from the partnership in late 1998 and ANSTO is presently discussing future participation with other business organisations.

2.33 ANSTO continues to provide a range of services to industry, for example:

- neutron transmutation doping for the production of semi-conductor material from ultra-pure silicone. It is widely recognised that the use of neutrons produces a more uniform, and therefore a better product, than alternatives. Irradiation services currently generate income of $2.5 million annually;
- sterilisation, radiation dosimetry and irradiation services to industry and government using reactor produced isotopes. As an example, ANSTO has adapted to local conditions the sterile insect technique for the control or eradication of fruit fly. The project is being underwritten by the Tri-State Venture (NSW, Victoria and South Australia with the Commonwealth) and applied to the maintenance of the fruit fly eradication zone in the Riverina. Flies are bred in a purpose built facility at Camden by the NSW Department of Agriculture; ANSTO provides precision irradiation services;
- a $20 million contract to supply Thailand with specialised radioisotope handling facilities associated with their new nuclear research centre. The awarding of this contract was based on ANSTO's reputation for the reactor production and subsequent downstream processing of pharmaceutical quality radioisotopes; and
- collaboration with consulting engineers in investigating the impact of pollutant release on the coastal zone. The approach involves the development of predictive mathematical models and their validation using radiotracer techniques. Examples include investigation of the transport and dispersion of sewage released from ocean outfalls in Sydney and Hong Kong. Most recently, interest has focused on extending the range of application of transport computer codes to the detailed study of the deposition of contaminant particles in the immediate vicinity of the sewage outfalls, and the transport of sand and sediments under extreme sea (storm) conditions. Validation of complex models using short-lived radiotracers is an essential element of this research.

2.34 The impact of reactor-based products and capabilities extends beyond activities at the LHSTC. The Industry Commission (1995) indicated that the rate of return from industrial research and development is likely to be of the order of 150 per cent, with the social return, that is, the permanent increase in national output generated by a unit increase in the stock of knowledge as a further 50 per cent return. Access Economics suggests that the economic benefit from such research is usually in the range of two to five times the cost.

Nuclear medicine and health

2.35 Australia has played a leading role in the early development of nuclear medicine and is considered an advanced country in the utilisation of nuclear medicine. ANSTO has well established production infrastructure and radiopharmaceutical supply arrangements and for over 35 years has been providing radiopharmaceuticals to the Australian health and medical sector, including:

- the production of iodine-131, which is used as a therapeutic agent for thyroid cancer;
- the production of Quadramet, a samarium-153 labelled agent for palliation of bone pain caused by breast, lung and prostate metastases. Australia was the second country to register this agent for general marketing approval; and
- the production of both yttrium-90 and holmium-166 containing microspheres, which are in clinical use for the therapeutic treatment of liver cancer. These agents are joint Australian developments between ANSTO and medical clinicians.

2.36 ANSTO currently produces about 350,000 patient doses of reactor-produced radiopharmaceuticals annually (mainly molybdenum-99 for generation of technetium-99m) together with 80,000 patient doses of cyclotron-produced radiopharmaceuticals.

2.37 Despite some competition from overseas sources for some of the longer lived isotopes, ANSTO has maintained its role as the major cost-efficient domestic supplier by developing a strong distribution network and an appropriate range of radiopharmaceutical products. This is due to the reliability and cost effectiveness of its products and services and its ability to trial new radioisotopes locally for early introduction into Australia. It is estimated that ANSTO provides 85 to 90 per cent of Australia's radiopharmaceuticals, providing 100 per cent of iodine-131 and 90 per cent of technetium-99m in the form of molybdenum-99 generators to

the marketplace. In addition to the Australian market, the Australian radiopharmaceutical industry has also developed a significant regional market for these longer-lived products.

2.38 As ANSTO does not produce all the isotopes needed within Australia for radiopharmaceuticals, some are imported. However, the importation of a number of shorter-lived isotopes is not practical. Furthermore, where a shipment delay occurs, the activity of the isotope may have decayed to levels that leave it useless, or at best cause a substantial increase in the cost of the product as more must be used per patient dose.

2.39 Additional benefits to health care would be derived from the development of new radiopharmaceutical and drug delivery systems.

2.40 Estimates of the annual economic net benefit from medical radioisotopes range between $8 million and $10 million currently and are expected to increase to between $27 million and $32 million in 2005/06. These figures exclude the economic benefit arising from lives saved, improvements in quality of life, minimisation of hospital stays and the contribution to maintaining a research network across Australia. The total Australian radiopharmaceutical market, including the complementary non-radioactive cold kit component supplied by other companies, is expected to grow to over $40 million annually over the next 10 years. In addition, the export of some longer lived radiopharmaceuticals to nearby countries should expand, with the potential regional market for radiopharmaceuticals expected to increase to more than $150 million annually over the same period based on the projected increase in demand. This growth will be kept under review in the context of the recent economic problems in Asia.

2.41 A number of organisations and individuals challenged the need for a research reactor based on a requirement to produce medical radiopharmaceuticals. It was asserted that alternative technologies are now emerging which, in future years, could replace reactor-produced radiopharmaceuticals. The Committee heard conflicting evidence in this regard. On the one hand, it was asserted that the spallation technology can produce the full range of isotopes produced by a reactor. In addition, papers in specialist technical articles published overseas indicate that since the RRR and the early days of spallation technology, it has now matured to the stage of being a viable alternative. The counter argument presented suggests spallation would not be a viable way to produce neutrons.

2.42 The Committee recognises that this issue has been raised in the Environmental Impact Statement (EIS) process and has not been resolved satisfactorily. ANSTO advised the Committee that there are scientific and

technical limitations, in some cases insurmountable, to the production by non-nuclear technologies of important radioisotopes for routine medical use. Advice to the Committee from ANSTO was that while cyclotrons and spallation sources can be used to produce some isotopes, the range of isotopes produced complement, but do not substitute for, the extensive range and quantity possible with a reactor.

2.43 ANSTO further advised:

> Radiopharmaceuticals based on Technetium-99m are currently the most widely used diagnostic agents in nuclear medicine. Technetium has a short half-life (six hours) and must, therefore, be produced daily. Nuclear medicine clinics normally obtain technetium-99m by elution from a generator, which is based on the parent isotope, molybdenum-99. This is produced commercially by the fission of uranium-235 by neutrons in research reactors. In principle, cyclotrons can be used to produce technetium by direct bombardment of appropriate targets. It is not possible at present to use cyclotrons to produce the most commonly used reactor-produced radioisotope, molybdenum-99, and this is likely to continue to be the case in the foreseeable future.[11]

2.44 The Committee notes that the pro and anti-spallation debate is covered in the supplement to the Draft EIS (DEIS) (Chapter 6) and in the Environment Assessment Report (EAR). The conclusions are that:

- cyclotrons are not sources of neutrons and therefore cannot be used for neutron-based research, nor can they economically produce many of the medical radioisotopes required; and
- spallation sources can be used for neutron research, but development for a source for dual medical isotope production and research would be more expensive than the proposed reactor and as 'cutting edge' technology, would have less certain outcomes in terms of effectiveness and efficiency.[12]

2.45 Suggestions were made in response to the DEIS from a number of quarters that the implementation of a number of alternative strategies could satisfy the requirements. These strategies include greater reliance on imported isotopes, use of cyclotrons and the provision of a domestic spallation source. It was suggested, as a start, that further independent studies into

11 ANSTO, *Transcript*, p. 106.

12 *EAR*, op.cit., p. 39.

the current status of overseas research projects into accelerator and spallation production of molybdenum / technetium and other isotopes be undertaken.

2.46 The EAR acknowledges that:

> the proposed reactor provides a certain outcome to address Australia's identified research and medical needs. However, it [the Department of the Environment and Heritage] also acknowledges that a combination of alternatives, such as funding for 'suitcase science', importation of radioisotopes, and possible development of spallation and other technologies, could substitute or compensate in part for not constructing a new reactor.[13]

2.47 ANSTO's position remains that the national interest criterion could not be satisfied by alternatives. This criterion, therefore, forms the cornerstone of the need for a replacement research reactor—Australia's international commitments in the nuclear fuel cycle and technology, nuclear safety and nuclear non-proliferation.

Alternatives considered

Outline

2.48 The DEIS provides a detailed analysis by ANSTO of a range of six alternatives which were considered against six project objectives and criteria.[14] ANSTO submitted that assessments have shown that replacing HIFAR with a pool type reactor on the Lucas Heights site is the only option that meets all project objectives, uses proven technology, and fully satisfies the location criteria in the most cost effective manner.

2.49 Alternatives to a pool type replacement research reactor at LHSTC were:

- technologies—alternative technologies and techniques for the production and supply of nuclear services and products, in particular spallation sources and cyclotrons;
- sources of nuclear products and services—alternative sources such as importing products from overseas, using overseas services for industrial applications and using overseas facilities for scientific research;

13 ibid., p. 40.

14 *DEIS*, op. cit., p. 6-2.

- reactor types—different reactor types, designs and capacities;
- sites—alternative sites outside and within the Lucas Heights Science and Technology Centre; and
- refurbishing HIFAR.

2.50 ANSTO assessed each alternative against project objectives and the capabilities required. The project objectives implicitly require the provision of a multi-purpose research reactor which meets all capabilities. Some objectives could be met by alternative technologies or sources but not all.

2.51 Other alternatives relate to the design features of a replacement reactor, siting and fuel and waste management. These include alternative reactor types and designs, alternative sites within and outside the LHSTC and alternative fuel and waste management strategies.

Alternative reactors

2.52 Multi-purpose research reactors, by their nature, require an intense source of neutrons (high flux). According to the DEIS[15], high flux reactors represent the main class of research reactors used around the world. There are two main types of designs for high flux multi-purpose research reactors—tank type reactors such as HIFAR or pool type reactors. The main difference between them is that in a tank type reactor, the core is housed in a tank surrounded by shielding material such as concrete. In a pool type reactor, the core is located at the bottom of a pool containing water. Modern research reactors are based on pool type designs because of improved fuel handling and the separation of areas for neutron scattering research from isotope production. Again, according to the DEIS[16] the separation of functions which pool type reactors provide, would result in lower operator radiation exposures. Pool type reactors incorporate safety improvements which have evolved in response to international safety regulations.

Alternative fuels

2.53 HIFAR uses enriched uranium—i.e. uranium 235 enriched to greater than 20 per cent. The DEIS states:

15 ibid., p. 6-21.

16 ibid., p. 6-22.

> Many countries and nuclear organisations such as the International Atomic Energy Agency, consider that fuel enriched to greater than 20 per cent could simplify further enrichment steps required to construct simple nuclear weapons. ... Low enriched uranium [when the enrichment is less than 20 per cent] is more difficult to use for non-peaceful purposes as it would require more extensive stages of further enrichment.[17]

2.54 ANSTO advised the Committee that agreed arrangements between Australia and the United States for the return of further United States-origin HIFAR spent fuel to the United States are dependent on ongoing action toward a replacement nuclear research reactor operating with low-enriched uranium fuel and closing the operation of HIFAR which uses high-enriched uranium fuel. For this reason, ANSTO believes that the fuel to be used in any replacement research reactor would need to be low-enriched.

Refurbishment of HIFAR

2.55 In 1998, HIFAR was the subject of a Probabilistic Safety Assessment and Remaining Life Study. These studies found that HIFAR is in good condition with no obvious evidence of major damage and age-related degradation which can be considered life-limiting. The DEIS stated that a refurbishment to address the technical obsolescence of HIFAR would take six years, cost $150 million and require a shutdown of at least 15 months.

2.56 ANSTO advised the Committee that limited refurbishment of the 40 year-old HIFAR to meet modern operation and safety system standards would involve an expenditure of more than half the cost of a new reactor, would still leave Australia with dated reactor technology and carry the economic risk of premature component failure with loss of the investment. Such a limited refurbishment would not increase the neutron flux and would therefore not meet major stakeholder requirements. For this alternative to be viable would also require conversion to low-enriched uranium, increased power and the provision of a cold neutron source, neutron beam hall and associated instruments.

Alternative sites

2.57 Alternative locations were considered by ANSTO, but without reference to a specific site.[18] As well as meeting generic site selection criteria such as

17 ibid., p. 6-23.

18 ibid., p. 6-29.

health, safety and environmental protection, other factors such as the requirements of reactor users would need to be met at local, regional and national levels. ANSTO advised the Committee that site selection criteria were based on international guidelines and were endorsed by the RRR and cover[19]:

- accessibility—
  - ⇒ within 60 minutes by road from a major international airport;
  - ⇒ same day travel from major centres of research;
  - ⇒ proximity for staff to residential and research centres;
- health and safety—
  - ⇒ area of low seismic activity and stable geology;
  - ⇒ low cyclonic activity and low flood potential;
  - ⇒ favourable airborne dispersion characteristics and low potential for waterborne pathways;
  - ⇒ not affected by other hazardous or incompatible land use;
  - ⇒ feasible emergency response capability;
- environmental protection—
  - ⇒ not in unique ecological or conservation areas;
  - ⇒ without potential for significant adverse impact on physical or cultural environment;
- availability of resources—
  - ⇒ adequate and reliable power and water supplies;
  - ⇒ proximity to reliable service providers and contractors;
- cost factors—
  - ⇒ cost of site-related construction;
  - ⇒ infrastructure and land acquisition (including a buffer zone);
  - ⇒ operating costs.

Relocation to a greenfield site

2.58 A study of alternative sites was undertaken by the Department of Industry, Science and Tourism with input from ANSTO. The study

19 ANSTO, *Transcript*, pp. 118-119.

revealed that greenfield sites, fulfilling all criteria except cost were available around most capital cities and some regional centres.[20]

2.59 The Committee sought further clarification from ANSTO of studies into alternative locations and was advised:

> …in our EIS statement we gave the issues of the requirements for a site. We have also previously stated to a Senate committee that appropriate locations for a reactor per se could be found adjacent to some of the other Australian capital cities. But the issue, when you take a desirable site together with the issue of maximum utilisation of existing infrastructure, was brought back to Lucas Heights because, as I think you are aware, there is very considerable investment in infrastructure on that site and much of that infrastructure would need to be duplicated for efficient use. As for the costing of an alternative site, the minimum was twice, and depending on the site went up. This was using parameters that exist within the building industry in Australia for civil works, which the Department of Defence uses. Depending on where they were to locate the facility, the variance was at least twice and up to three times the cost of the $286 million.[21]

2.60 The establishment of a replacement research reactor on a greenfield site would, in the medium term, result in the establishment of a second nuclear site in Australia. The two sites would operate until the decommissioning of HIFAR. Further, a significant amount of support infrastructure would need to be provided at a new location. This, coupled with land acquisition costs would lower the comparative cost of locating the replacement research reactor at Lucas Heights.

2.61 The DEIS provides the following comparative costs between Lucas Heights and a generic greenfield site.

20 ibid., p. 119.

21 Prof. Garnett, *Transcript*, p.151.

Table 1 Comparison of Costs of Lucas Heights Against an Alternative Site

Type of Cost	Lucas Heights	Alternative Greenfield Site[1]
Cost of site related construction[2]	Estimated to be $134 million	Similar.
Costs of infrastructure[3]	Modification to support buildings and facilities are estimated to be $2.7 million	Capital costs associated with establishment of supporting infrastructure are estimated to be $350 million
Cost of land acquisition[4]	No additional land would need to be acquired.	Estimated to be $10 million
Estimated Total Costs[5]	$286 million	$600 to $650 million

Source: *DEIS,* op. cit., pp. 6-32.

Notes:

1. Assumes site is within one kilometre of a main road and power supply, has access to communications systems and is not characterised by abnormal site conditions.
2. Excludes overseas project management, engineering, technical services and equipment costs.
3. Figure factored from 1993 costs to 1997 values.
4. Land acquisition assumes the cost of purchasing non-urban land with an equivalent area to the existing 1.6 kilometre buffer zone.
5. Includes overseas project management, engineering, technical services and equipment costs.

2.62 The DEIS states that much of the existing infrastructure at LHSTC would need to be replicated to support the operation of the reactor. The LHSTC would need to continue operations associated with radiopharmaceutical production from the National Medical Cyclotron and associated hot cells, waste treatment and handling facilities. A further requirement would be a need to provide site security for the care and maintenance of a decommissioned HIFAR. According to the DEIS, additional operating costs associated with operations at two sites would be several tens of millions of dollars annually.[22]

Committee's Conclusions

2.63 **HIFAR is obsolete and will need to be permanently decommissioned in 2005.**

2.64 **The estimated cost of refurbishing HIFAR to comply with safety requirements alone would be half of the cost of providing a new research reactor. This would not provide an enhancement of its research and operational capabilities which are considered by the scientific community to be limited. Such limitations have led to a reduction in national research and development opportunities.**

22 *DEIS*, op. cit., p. 6-32.

2.65 **A need exists to replace HIFAR with a modern research reactor. The new national research reactor must be operational some time before HIFAR is decommissioned.**

2.66 **The need for the replacement of HIFAR arises as a consequence of national interest considerations, research and development requirements and the need to sustain the local production of radiopharmaceuticals.**

2.67 **There has been substantial investment in infrastructure at Lucas Heights Science and Technology Centre.**

2.68 **Construction of a replacement research reactor at a greenfields site and decommissioning of HIFAR would require the provision of much of the infrastructure which already exists at Lucas Heights.**

2.69 **The comparative costs of locating the replacement research reactor at Lucas Heights or a greenfields site favour the former by a considerable margin.**

2.70 **On financial grounds there is merit in locating the replacement research reactor at Lucas Heights, subject to the suitability of the site on operational and public safety grounds.**

3

The Proposal

Location

3.1 The proposed replacement research reactor will be located within the 70 hectare Lucas Heights Science and Technology Centre (LHSTC), adjacent to the High Flux Nuclear Reactor (HIFAR). The LHSTC is surrounded by a buffer zone with a 1.6 kilometre radius centred on HIFAR. This buffer zone will continue to be maintained around the replacement reactor.

3.2 The Australian Nuclear Science and Technology Organisation (ANSTO) advised the Committee that there are no requirements for the acquisition of additional land to accommodate the replacement reactor or the maintenance of the buffer zone.

Site

3.3 The site proposed for the replacement research reactor will have an area of about four hectares, located at the western side of LHSTC. It is bounded by bushland to the north, south and west, and by the developed areas to the east.

Geotechnical

3.4 Assessment of the geotechnical conditions in the vicinity of the proposed site was undertaken by geotechnical consultants using a range of methodologies to determine its suitability, namely:

- seismic refraction;
- resistivity soundings;
- magnetometry; and
- hydrogeology.

3.5 The geology of the site consists of weathered and eroded Hawkesbury sandstone of the Woronora Plateau with a thickness of more than 200 metres. Recent studies found no geological faults in the general area of the site. A dolerite dyke occurs outside the western boundary of the site but there are no anomalous features which could be attributed to a dyke within the proposed site.

3.6 The site for the replacement reactor and surrounding areas have a relatively low potential for earthquakes and other seismic activity and there are no geological structures indicating recent seismic activity.

3.7 The Committee was advised that groundwater utilisation is low within the region and groundwater flow and quality are unlikely to be affected by the replacement reactor. Groundwater levels of tritium from bores at the proposed site are currently 2 per cent or less of the derived guideline values for drinking water of the World Health Organisation. ANSTO advised that the emission of tritium will be at least a factor of 10 less than that from HIFAR because the replacement research reactor will be cooled by light water.

Final approvals

3.8 Final approvals for the site, the design, commissioning and operation are the responsibility of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) whose oversighting and licencing and approval roles are discussed in Chapter 4.

Coordination of requirements

3.9 Two consultative groups, with representation from universities, other research organisations and industry were established to identify the needs, capabilities and requirements for neutron beam and irradiation facilities. The two groups are:

- the Beam Facilities Consultative Group—which identified broad areas of science and other potential industrial and medical uses of beams which should be supported by the replacement reactor project. This process resulted in the identification of specific capabilities, beam facilities and instruments required; and
- the Irradiation Facilities Consultative Group—which identified needs and priorities in isotope production and irradiation services.

3.10 Both groups were involved in developing reactor specifications.[1]

1 *DEIS*, op. cit., p. 5-9.

Scope of proposal

3.11 The project includes all works necessary for provision of a functioning research reactor facility, including the buildings, provision of interfaces with existing site infrastructure, and the necessary plant and equipment.

3.12 A summary of some of the key features specified for the replacement reactor and their comparison with HIFAR are shown in Table 2.

Table 2 Comparison of Main Features of the Replacement Reactor with HIFAR

Feature	HIFAR	Replacement Reactor
Reactor Type	Closed Tank	Open Pool
Reactor Power (heat output)	10 to 15 Megawatts thermal	Maximum of 20 Megawatts Thermal
Peak Neutron Flux[1]	1 x 10^{14}	At least 3 x 10^{14}
Fuel Enrichment[2]	High (60 per cent)	Low (less than 20 per cent)
Core	Loose array of fuel elements (large spaces between elements)	Compact array of fuel elements (little space between elements)
	Heavy water cooling/moderation	Light water cooling/moderation
Reflector	Heavy water	Heavy water[4]
Number of neutron beam instrument positions	11 (maximum)	17 (with provision for an increase)
Neutron Guide Hall	No	Yes
Beamline Geometry	Radial	Tangential
Cold Neutron Source	No	Yes
Hot Neutron Source	No	(3)
Radioisotope production		Four times greater for Mo-99[5]
		Higher flux for Ir-192[6] production
		Other isotope production capacity as identified by the user groups

Source ANSTO, *Transcript*, p. 20.

Notes:
1. Neutrons per square centimetre per second in the reflector.
2. Enrichment refers to the content of Uranium-235. Material at 20 percent or greater enrichment is called high-enriched uranium, while below 20 percent the material is described as low enriched uranium.
3. The requirement for a hot neutron source would be dependent on the priorities given to the research facilities recommendations of the Beam Users Consultative Group.
4. Some vendors may offer a reflector design which also includes beryllium in combination with heavy water.
5. Molybdenum-99.
6. Iridium-192.

Reactor

3.13 The replacement reactor will be a pool type reactor—the reactor assembly will be located near the bottom of a deep pool of demineralised water. A connected storage pool will be provided for the handling of irradiated materials and the temporary storage of spent fuel. The reactor and the

storage pool will be enclosed within a building designed to maintain its integrity and withstand external events such as bushfires. A neutron guide hall will provide better separation of operating, research and production functions. This will allow for greater flexibility.

3.14 ANSTO advised the Committee that the pool type construction provides a high level of inherent safety and will facilitate ease of materials handling. Pool type reactors are also more easily decommissioned at the end of their operational lives.

3.15 The main elements of the reactor facility will include buildings and structures comprising:

- a reactor building;
- reactor and service pools;
- a neutron guide hall;
- a stack;
- cooling towers; and
- infrastructure additions, such as a workshop and office accommodation.

3.16 The reactor assembly will comprise:

- an array of fuel elements called the reactor core;
- the control and shutdown neutron absorbers;
- the neutron reflector;
- the cooling systems for the reactor core and the neutron reflector;
- the reactor control and instrumentation system;
- the reactor safety systems; and
- the neutron beam experimentation facilities.

Generic design requirements

3.17 Needs are defined in terms of performance and safety characteristics and outputs required of the reactor rather than prescribing a specific design. Each of the four reactor vendors, pre-qualified to tender, will be required to ensure that reactor design and construction are based on proven construction standards and codes of practice.

3.18 The generic design requirement is for a pool type reactor. The detailed design for the replacement reactor can only be finalised after the

successful tenderer has been selected and will involve ongoing interaction between ANSTO and the reactor vendor.

3.19 The approach adopted is for a design which meets current and future national needs for a neutron source consistent with all health, environmental and safety standards. Needs are defined primarily in terms of performance and safety characteristics and the outputs required of the reactor, rather than prescribing in detail a specific design. Buildings will have a 50 year design life.

3.20 Each of the four reactor vendors pre-qualified to tender will be required to ensure that the reactor design and construction are based upon proven design, construction and operating criteria, in accordance with national and international design and construction standards and codes of practice.

3.21 A detailed evaluation of proposed designs will be undertaken prior to a selection of the successful tenderer and the finalisation of the contract to design and construct the replacement reactor.

3.22 Major building works will be concrete and steel structures with massive foundations designed for safe operation under various loads. Modifications to existing site infrastructure will encompass roads, paving, car-parks and underground services. Excavation materials will be reused within the buffer zone.

Reactor building

3.23 The reactor building will house the reactor and service pools, the primary cooling system and most of the auxiliary plant. Areas will be provided for facilities to handle and prepare radioisotopes for transport to other parts of the Centre and for neutron beam facilities which require location close to the reactor.

3.24 The reactor building will have a floor area of about 1,200 square metres and a height of about 30 metres.

3.25 The reactor building may be a concrete structure, a steel frame structure with brick or other exterior cladding or a steel structure, depending on the vendor selected to construct the replacement reactor.

3.26 The building will have an important safety function in mitigating potential radioactivity releases. These were described to the Committee as 'consequences of postulated accident scenarios.' The exterior of the reactor building will have a visual appearance consistent with other existing laboratory buildings at the Centre.

Reactor and service pools

3.27 The reactor and service pools will be located within the reactor building. The reactor pool walls will be thick reinforced concrete to provide a high level of structural integrity and a radiation shield. The pool will have a metal liner and will be filled with demineralised water.

3.28 The reactor pool will have an internal diameter of about five metres and will be about ten metres deep. The Committee was assured that this depth will provide sufficient radiation shielding in the vertical direction.

3.29 The service pool for the handling of irradiated materials and for the interim storage of spent fuel, will be contiguous with the reactor pool.

Type of fuel

3.30 The fuel material will be low enriched uranium, a material which is less than 20 per cent uranium 235.

Power

3.31 The maximum power will be 20 megawatts. Periods of full power operation greater than 20 days and regular shutdowns of less than 4 days will be required. The operating cycle will be designed for full power operation for as long as practicable to meet beam user and isotope production requirements. Shutdown times for refuelling and maintenance will be kept as short as practicable.[2]

3.32 The Committee sought to establish the level of confidence that the design of cooling systems will enable the power output to be achieved. ANSTO advised the Committee:

> If you design the cooling system for a reactor to allow it to operate at a certain power level, then it will operate at that power level, because the qualification of the fuel used includes the capacity of that fuel to generate a certain amount of heat and a certain amount of neutrons. When you put these fuel elements together, you will have a reactor core capable of delivering the power that you design it for. If the cooling system can take away that heat, you can proceed on that basis.[3]

3.33 The Committee pointed out to ANSTO that in two instances, overseas research reactors are not performing according to design specifications and sought details of the reasons. ANSTO commented:

2 *DEIS*, op.cit., p. 5-11.

3 ANSTO, *Transcript*, p. 1103.

> In Indonesia, they are not running at full power—and this is a complexity that we are going to avoid—because the Indonesians participated in the design to a large extent. When the top of the pool water system was designed, it was not designed sufficiently well to form a barrier for radioactivity getting from the core of the reactor to the surface of the water. Therefore, they are not running at full power. They are undertaking modifications to improve the control of the water layer so they can run at full power.[4]

3.34 In relation to the second instance, the Committee was advised:

> …and the Korean reactor is also running at lower than full power. The Koreans are making their own fuel. Their regulator is asking them to do a demonstration of fuel performance which is at the far end of conservatism, but that is something between the fuel maker in Korea and the regulator in Korea. We are not going to make our own fuel. We are going to use fully qualified fuel. That is part of our EIS condition.[5]

Neutron guide hall

3.35 The majority of neutron beam experiment facilities will be located in a separate building—a neutron guide hall adjacent to the reactor building. The neutron guide hall will have a footprint floor area of about 2,100 square metres and a height of about 12 metres.

3.36 Collimated beams of neutrons will pass from the reactor through shielded, mirrored guides to the experiment systems in the neutron guide hall. The guide hall will provide greater experimental space, and more effective utilisation of the neutron beams than could be achieved in the reactor building itself.

3.37 Support workshops for the neutron scattering facilities, a visitors centre and viewing area will be included in the guide hall.

Neutron beam facilities

3.38 The proposed reactor will have the following neutron beam facilities:

- a cold neutron source, including source cooling system and any auxiliary systems;
- provision for a hot source, including any auxiliary systems;
- neutron guides for the delivery of neutrons to research instruments;

4 ibid., p. 1010.

5 ibid., p. 1011.

- tangential beam lines to provide better signal to noise ratios in research instruments;
- adequate space in the neutron guide hall and in the reactor beam hall to accommodate larger and higher resolution instruments; and
- an increase in the number of neutron beam instrument positions from the current 11 in HIFAR to 17 in the replacement reactor.

3.39 It is anticipated that only 8 instruments will be provided initially with the remaining instruments coming on line during a period of five years after the reactor commences operation.[6]

Flux characteristics

3.40 The maximum neutron flux will be three times the corresponding flux in HIFAR.

3.41 The greater neutron flux, combined with larger irradiation volumes available for isotope production and other irradiations is required for:

- greater radioisotope production capacity;
- the production of isotopes not currently available in Australia for medical research and with potential for therapeutic use;
- enhanced and expanded research capabilities in neutron beam applications and improved resolution of residual stress studies;
- greater throughput, sensitivity, shorter irradiation times and faster counting times for neutron activation analysis; and
- greater silicone irradiation production capacity.

Hot cells

3.42 There will be one or two hot cells in the reactor building for handling fuel issues in the building, but the other existing hot cells will not be reproduced.[7]

World class facility

Professor White addressed this in the following terms:

> …this should be a much better reactor than any of those that I know about in [this] region, and indeed it should be better than

6 *DEIS*, op. cit., p. 5-13.

7 ANSTO, *Transcript*, p. 1000.

> the most modern reactor in this region, the one that has been recently refurbished at the Japanese Atomic Energy Institute near Tokyo. It should be much better because a lot of the lessons that have been learnt from most recent reactor constructions will have been incorporated in, for example, the delivery of the neutron beams that were talked about earlier on.[8]

Stack

3.43 The reactor building ventilation systems will discharge to the atmosphere via a stack expected to be about 15 metres higher than the reactor building. The Committee was assured that discharges through the stack will be treated to remove radioactive materials and will be continuously monitored for radioactivity, in accordance with regulatory requirements. If preset levels are exceeded—considered by ANSTO to be unlikely, discharge would be shut off and the reactor shut down.

Pumphouse and cooling towers

3.44 Cooling towers will be provided to dissipate the heat from the reactor to the atmosphere. A pumphouse will be provided, either as a freestanding structure or as part of the cooling towers or reactor building, to accommodate the pumps that circulate the water from the cooling towers to the primary / secondary heat exchangers of the reactor.

Office accommodation

3.45 An office block, not exceeding three storeys, will be located adjacent to the reactor building. Office and workshop space for 40 personnel will be provided and amenities will include a conference room, document storage area, print room, tea room and toilet facilities. The workshop will include an office for the workshop foreman, space for workbenches and machinery, storage space for immediate spares, tea room and toilet facilities.

Hydraulic services

3.46 Water is supplied to LHSTC via a 300 millimetre diameter gravity-fed pipeline from the 230 megalitre Lucas Heights Reservoir, located 2.1 kilometres north-east of the site. Water is received into two balance tanks before being pumped by a multiple pump system to a water tower from which it is gravity fed throughout the system by ring mains around each

8 Prof. White, *Transcript*, p. 427.

sector. The multiple pump system is controlled with valves and the water tower can be bypassed. This enables water to be pumped directly from a balance tank into the ring main to increase the general site pressure. The total water storage capacity is 1.5 megalitres.

Construction supply

3.47 During the construction phase, water demand will increase by up to 20 per cent. The Lucas Heights Reservoir has the capacity to supply twice current usage rates—another 20 megalitres per month. ANSTO is confident that the reservoir will easily accommodate the additional water requirements during construction.

Operational supply

3.48 The Committee was assured that the existing water supply system has sufficient capacity to meet the operational requirements of the replacement reactor as well as that of HIFAR, when both reactors are operational during the research reactor's commissioning phase. Water supply to the reactor involves extending the existing site distribution system to the proposed site. A new reticulation main will be required to provide the additional capacity and the existing fire hydrant system will be extended to the site to provide additional coverage. Water will be drawn from the Lucas Heights Reservoir over longer periods to accommodate the likely water demand during operation of the replacement reactor.

3.49 ANSTO advised that actual operational water usage will depend on the design of the reactor cooling system. If it is assumed that the cooling system is similar in type to the existing HIFAR system, and that the replacement reactor operates at 20 megawatts thermal power, then the water usage by ANSTO would increase by 40 per cent, from approximately 20 megalitres to approximately 28 megalitres per month.

Wastewater collection and treatment

3.50 Wastewater from areas of the Centre not situated within the site of the replacement reactor will continue to be segregated into three categories:

- "B" line wastewater, arising from active drains in laboratories where radioactive materials are routinely handled, which contain low levels of beta and gamma emitting radionuclides;
- "C" line trade waste effluent, arising from laboratories and workshops in which radioactive materials are not normally handled; and

- non-radioactive sewage from the Centre including approximately 8,000 cubic metres of leachate received annually from the Lucas Heights Waste Management Centre.

3.51 Wastewater treatment infrastructure for the replacement reactor will be similar to the system that will be servicing HIFAR by 2003. Extensions to the existing active and trade wastewater collection pipe work and new collection tank installations on the replacement reactor site will complement these systems.

3.52 ANSTO is planning to construct a new, state-of-the-art facility for treatment of ANSTO's site wastewater. This will improve a system that already meets all requirements by a wide margin. The estimated cost of this facility is about $4 million and it is currently scheduled to be operational within three to four years, well ahead of the replacement reactor. Recycled and treated wastewater produced by this facility will be considered within the site Waste Management Action Plan.

Sewage

3.53 The Centre is connected to Sydney Water's Engadine sewer tunnel system by a three kilometre long, 150 millimetre diameter, cast iron, cement lined pipeline. Non-radioactive sewage generated at the Centre and leachate from the Lucas Heights Waste Management Centre is treated at the Centre's effluent treatment plant. Treated effluent from the Centre flows to the Cronulla Sewage Treatment Plant which discharges its effluent to the ocean at the Potter Point Outfall. The replacement reactor will be connected to the system.

3.54 The existing Centre effluent treatment plant has in the past serviced a much larger site population and it has the design capacity to accommodate the increase in demand from the construction and operation of the replacement reactor. Waste water is discussed further in paragraphs 4.51–4.54.

Stormwater

3.55 Construction of the replacement reactor will necessitate additional stormwater control systems for existing drainage catchments, with implementation of contouring, bunds, retention ponds and stormwater litter collection. The system will be designed to current best practice and in accordance with NSW Environment Protection Authority guidelines and monitoring requirements, and ANSTO land management constraints.

Electrical services

3.56 The existing electricity supply to the LHSTC consists of two independent 33 kilovolt feeders, which converge on an Energy Australia main substation located at the northern boundary. The power is then converted by two transformers to 11 kilovolts, and distributed from ANSTO's main 11 kilovolt switchboard located within the main substation, to other ANSTO substations. The existing electrical supply feeders to the Centre have sufficient capacity to accommodate the replacement reactor. However, the present total capacity of the main substation at the Centre is 12 MVA, in the form of two redundant 6 MVA systems, which is insufficient for the projected maximum demand of 7.8 MVA during operation of the replacement reactor.

Construction supply

3.57 Electricity requirements during construction of the proposal would be addressed using portable power boards or mobile generators, depending on the contractor's preference. Power boards could draw power from existing substations near buildings adjacent to the site of the replacement reactor.

Operational supply

3.58 Energy usage during operation of the replacement research reactor will depend on the final design of the reactor. Likely energy demand is set out in Table 3.

Table 3 Likely Energy Usage during Operation of the Replacement Reactor

Facility	Reactor	Beam Hall	Total	HIFAR	Replacement Reactor/ Beam Hall + HIFAR[1]
Maximum Power Use (Kilowatts)	2,400	400	2,800	900	3,700
Annual Energy Use (Gigawatt hours)	13.5	1.5	15.0	5.0	20.0

Source: ANSTO, *Transcript*, p. 47.

Notes:

1. Likely total energy usage in the event of temporary dual operation of HIFAR with the replacement reactor until replacement reactor is fully commissioned and ANSTO authorised for routine operations.

3.59 The electricity infrastructure requirements to meet these energy usage demands involve:

- modifications by Energy Australia of their main substation to accommodate the increase in demand;
- installation of two new high voltage circuit breakers to Energy Australia's high voltage supply in the main (zone) substation;
- construction of a new high voltage/low voltage substation with switch gear, located adjacent to or within the reactor building; and
- installation of two new underground high voltage feeders from the main substation to the new substation.

3.60 The Committee notes that at the public hearing, energy usage during operation of the reactor was estimated, at maximum, to be 2.4 megawatts. The Committee also notes that energy usage of HIFAR would not require this level of power. The Committee therefore asked ANSTO to explain the reasons for this increase in power requirements. ANSTO advised the Committee:

> There is power concerned with just operating the circuits themselves, to remove heat generated by the reactor. You have to pump water through the reactor to a secondary cooling system where there are heat exchangers, and then you pump that secondary cooling water to cooling towers where the heat is given up to the atmosphere in evaporation. All of that absorbs power. Plus there is space conditioning, plus all the normal services.[9]

Mechanical services

All essential mechanical services will be contained within the building structures to ensure their reliability, integrity and maintainability. Provision will be made for all plant to be upgraded when it reaches the end of its working life or is superseded by later technology.

Other services

3.61 The existing public address system will be extended to the replacement reactor site from the amplifier room, situated in Building 8, for distribution to loud speakers.

3.62 The existing telephone system will be extended into the replacement reactor site by an underground multi-core cable, from the PABX room to

9 ANSTO, *Transcript*, p. 155.

the reactor building and other buildings associated with the replacement reactor. Telephones and related equipment will be installed throughout the area to meet the communication needs. Safety alarms and access control systems will be extended from the existing access and alarm network system in the form of connections to the new telephone cable.

3.63 Computing requirements will be met by extending the existing underground high-speed fibre optic network system to the replacement reactor buildings.

3.64 Gaseous nitrogen will be reticulated from the existing system vessels near Building 23 and linked to a new bulk storage at the site of the replacement reactor. The new storage vessels will also supply liquid nitrogen for use in the neutron guide hall research installations.

Infrastructure facilities

3.65 The new reactor will be integrated into the following existing support infrastructure at ANSTO which will be modified if required, to meet all statutory requirements:

- Isotope separation in Building 23;
- High activity cells for Molybdenum-99 separation in Building 54;
- High activity cells for inspection and maintenance of components in Building 41;
- Isotope research in Buildings 19, 23 and 76;
- Fire response from Building 8 at the main gate and training in Building 21 area;
- Emergency control centres at Buildings 53 and 8;
- University research via Australian Institute of Nuclear Science and Engineering in Building 5;
- Safety support from Buildings 55 and 4;
- Decontamination facilities in Building 20;
- Effluent control from Buildings 11 and 12;
- Radioactive waste stores at Buildings 27 and 54;
- Environmental research in Buildings 21 and 34;
- Meteorology in Buildings 44 and 47;
- Physics research in Building 58;
- Materials research in Building 3;
- Computer support from Building 51;
- Reception centre and public relations facilities in Buildings 1 and 65;
- Engineering Design, Testing and Workshops in Buildings 3, 4, 25, 26 and 63;
- Administration buildings for corporate support in Buildings 1, 18 and 25;
- Library and Information management in Buildings 1 and 51;

- Canteen and staff amenities around Buildings 35 and 52;
- Business and Technology Park;
- Fencing and security patrols;
- Access roads, car-parks and pathways;
- Site landscaping and native plant environment;
- Bushfire control systems;
- Public address system;
- Telephones and communications systems;
- Computer networks;
- Alarm and safety systems;
- Access control, intruder alarm and security systems;
- Mains and stand-by power systems;
- Stormwater collection and bund systems;
- Water mains;
- Compressed air and pneumatic systems;
- Nitrogen and other gases;
- Petrol bowsers;
- Liquid waste treatment systems;
- Low level waste store;
- Intermediate level waste store;
- Gaseous waste treatment systems; and
- Temporary construction facilities.

Reactions from Peak Environmental Groups

Friends of the Earth (FOE)

3.66 At the outset, it is pertinent to state Friends of the Earth's position:

> …Friends of the Earth as a body is totally opposed to the concept of any new nuclear reactor and anything that would further enmesh us in the nuclear fuel cycle…broadly we are totally ideologically opposed to any new nuclear reactor, to any further involvement in the nuclear fuel cycle.[10]

3.67 FOE submitted that based on the description of the reactor in the EIS, it is not possible to make an assessment of the reactor's operational capabilities, or the cost and safety measures which will be provided. A proper assessment of the latter would require detailed engineering data. Furthermore, in terms of the general capabilities described, FOE believe the proposal will not adequately satisfy the claim of being a leading

10 FOE, *Transcript*, p. 466.

facility. Rather, it was suggested, the reactor will place Australia at the bottom of the top ten in the world's neutron scattering league.

3.68 FOE stated that the EIS was defective because it did not contain a description of the new reactor—only operational parameters of a non-detailed nature. FOE submitted that the EIS Act and Administrative procedures under the Act demand that detailed proposal be submitted. The environmental review process cannot proceed until there is a definite proposal.

3.69 FOE submitted that there should be a design which, if not totally finalised, should be sufficiently detailed for the informed public. The process of environmental review involves submitting a finished or semi-finished proposal and modifying the proposal in the light of public comment. The SEIS repeats what is in the DEIS.

3.70 Furthermore, according to FOE, without a proper idea of the capabilities and how much it would cost, it is not possible to make intelligent evaluations of whether the Government should be spending $300 million on a new reactor or if it would be better spent on spallation source.

3.71 FOE advised that the purpose of the EIS requires that the project be justified. This requires an examination of whether it is in the national interest for the project to proceed. It is not possible to know this without knowing what the value of the project will be to the research community.

3.72 According to FOE, the EIS process is foremost a process of public consultation whereby it must be decided if it is in the national interest to have a project.

Australian Conservation Foundation (ACF)

3.73 Again, at the outset, it is useful to state the Australian Conservation Foundation's fundamental position:

> The ACF has a policy position that has been developed over…three decades from both a position of policy and a position in response to practical experience and operational and industrial experience domestically and internationally. That position leads ACF to advocate non-nuclear alternatives at every opportunity. We believe that we are at an opportunity here. We believe we are in a situation where we can choose a nuclear alternative or we can choose to embrace instead a non-nuclear alternative. ACF believes that there is such a range of unresolved, continuing and deep issues—environmental, economic, social, technical—that are raised by nuclear activities that we strongly feel that there is a case to say, 'The reactor proposal does not make a compelling case that is the

> only one,' and the argument accordingly should not be approved.[11]

3.74 ACF opposition includes process and assessment deficiencies, alternatives, ANSTO operational history and cost. ACF believe it prudent and responsible to have a comprehensive assessment process and do not believe that this has happened to date and feel that before the project is further developed there should be a comprehensive section 11 inquiry under the *Environment Protection (Impact of Proposals) Act*. ACF also consider that the project is undermining people's confidence in the integrity of environmental processes and its impartiality.

3.75 The ACF stated:

> …the volume and activity levels of the waste are unknown...The size, the reactor design, the safety features, the fuel handling mechanisms, the fuel cladding, the volume and activity levels of the waste to be generated, the full range of costings and the siting alternatives—a whole range of pivotal material—are not here in sufficient detail to make a considered judgement.[12]

Greenpeace

3.76 The position of Greenpeace on the proposal is as follows:

> In an industry which is globally in decline and where you have alternatives to nuclear and fossil fuels coming on line more rapidly, Australia should be investing its money in developing new technology as opposed to entrenching ourselves in the nuclear fuel cycle.[13]

3.77 Greenpeace raised the following concerns:

- weakness of domestic legislation and international regulation on which it is based. The regulation of the nuclear industry is performed by the same agencies responsible for the promotion of the nuclear industry;
- potential liabilities;
- radioactive waste crises;
- the agreement with COGEMA involving the transport of waste has inherent dangers; and
- accidents.

11 ACF, *Transcript*, p. 487.
12 ibid., p. 492.
13 Greenpeace, *Transcript*, p. 525.

Environment Assessment Report recommendations

3.78 The EAR recommends that:

- The consequences resulting from loss of off-site electricity for water supply and fire fighting purposes must be examined as part of the PSAR. If risks are significant, on-site provisions for water pumps should be provided to the satisfaction of ARPANSA.
- The safety implications of an inter-linked store for spent fuel elements must be assessed in detail in the PSAR, to the satisfaction of ARPANSA.
- The final design of the reactor should include a fixed and possibly automatic fire suppression system within the containment building, to the satisfaction of ARPANSA. The PSAR should also examine the need for a drencher system for the cooling towers.
- The risk of a common mode failure involving both HIFAR and the replacement reactor during the commissioning period and resourcing requirements to ensure adequate infrastructure and staffing safety, must be addressed as part of the PSAR to the satisfaction of ARPANSA. The results of the PSAR analysis should also be reflected in emergency plans.
- In the event of dual operation occurring for a longer period than six months, ANSTO must obtain separate approval and authorisation from ARPANSA. This authorisation should specify safety, infrastructure and occupational requirements to ensure that doses are minimised during any extended commissioning period.[14]

Committee's Conclusion

3.79 **The capabilities of the proposed research reactor and auxiliary facilities result from study and assessment by representatives of potential users and provides scope for later enhancement.**

Committee's Recommendation

3.80 **During the licensing, construction and commissioning phases ANSTO should provide the Committee with six-monthly reports on progress.**

14 *EAR*, op. cit., p. 201.

4

Codes, waste and hazards

Codes

4.1 The Committee believes very strongly that the question of the effects and management of radioactive waste, in all forms, produced by research reactor operations and processes are pivotal to the acceptability of any proposed replacement research reactor and, indeed, the continuing operations of High Flux Nuclear Reactor (HIFAR).

4.2 In reporting to Parliament on the need for the construction of a replacement research reactor, members of the Committee believe it to be vital to report on the evidence relating to radioactive emissions and waste and public safety

4.3 This Chapter covers, at length, the production and management of radioactive emissions and solid waste. These were discussed in the Research Reactor Review (RRR), in the Senate Select Committee's report, the Draft Environmental Impact Statement (DEIS), Supplementary EIS (SEIS), the Environment Assessment Report (EAR) and more recently, in the Department of Science and Resources Phase 3 report on the site selection study into a national waste repository. All previous reports, which span six years, were based on extensive public consultation processes. It is in recent years that the future of radioactive waste generation and management has been considered in detail. This has been prompted by the magnitude of the task confronting authorities as well as against the background of a need for HIFAR to be replaced.

4.4 Much of the Committee's consideration of the issues raised in submissions has been influenced by the EAR which provides definitive responses, within a legislative framework promoting and responding to

environmental safety and public reaction. It is a case of the executive reporting to the executive in accordance with statutory requirements.

4.5 In simple terms, it is clear that nuclear research reactors and associated processes:

- produce radioactive gaseous and liquid emissions with varying frequency which are either released into the environment or stored;
- produce radioactive solid waste; and
- require spent radioactive fuel rods to be replaced at regular intervals. These remain radioactive for long periods and need to be stored for long periods on site.

ANSTO commitments

4.6 The Australian Nuclear Science and Technology Organisation has given public environmental commitments on emissions and radioactive wastes. These encompass complying with all relevant legislative and regulatory requirements, in particular:

- ensuring all discharges are within authorised limits;
- monitoring and reporting regularly on radioactive releases into the environment;
- ensuring that radiation exposures would be kept as low as reasonably achievable, taking into account economic and social factors;
- ensuring that the maximum off-site dose to a member of the public remains below one per cent of the public dose limit adopted by the National Health and Medical Research Council of one millisievert (mSv) per year as a result of any future operations at the Lucas Heights Science and Technology Centre (LHSTC);
- ensuring that comprehensive assessments of future emissions will be undertaken and independently reviewed by the regulatory authority (ARPANSA) as part of the approval process before construction;
- minimising the production and volume of future wastes, taking into account economic and social factors;
- implementing the Waste Management Plan in a way which ensures that best practice is adopted by the year 2001 as defined in the Radioactive Waste Safety Standards and Guidelines which are being developed by the International Atomic Energy Agency; and
- transporting all low level and short lived intermediate level waste to the national radioactive waste repository when it becomes operational

and transporting all long lived intermediate level waste to the national storage facility when it becomes operational.[1]

4.7 ANSTO also provided a commitment that the following action would be completed before the proposed replacement research reactor is commissioned:

- solidifying all existing intermediate level wastes from molybdenum-99 production. After all existing wastes are processed, all future liquid wastes (including those arising from the replacement reactor) would be solidified soon after they are generated;
- constructing a new state-of-the-art facility for treating waste waters generated at LHSTC;
- improving the off-gas treatment in the radioisotope production facility (Building 54) to ensure that, notwithstanding the increase in the production of molybdenum-99, airborne emissions from LHSTC would remain below one per cent of the public dose limit; and
- conditioning, as appropriate, most of ANSTO's solid waste inventory for disposal or storage in the national waste repository.

International Atomic Energy Agency

4.8 The role of the International Atomic Energy Agency (IAEA) is taken as the starting point in any consideration of radioactive waste and public safety. It is from this international framework that codes and standards relating to emissions, waste and public safety derive their legitimacy.

4.9 The IAEA is an inter-governmental organisation established in 1957 in accordance with a United National General Assembly directive and is an agency of the United Nations. ANSTO advised the Committee that the IAEA is responsible for developing and issuing international safety codes and guidelines for nuclear activities.

4.10 IAEA safety standards are based on recommendations of the International Commission for Radiological Protection (ICRP), a non-governmental scientific organisation and the International Nuclear Safety Advisory Group (INSAG). This is an independent group of experts, founded in 1985, which under the IAEA elaborates nuclear safety principles. The IAEA provides detailed guidance in all areas of radioactive waste management and has developed nuclear and radiation standards and criteria to ensure that public risks are minimised.

1 *DEIS*, op. cit., pp. 10-52, 3.

4.11 Radiation dose limits, recommended by the ICRP, and adopted by the IAEA, to ensure protection against radiation are:

- for occupational exposure, 20 mSv per year, averaged over a five year period and not to exceed 50 mSv in any one year; and
- for a member of the public, 1 mSv per year—additional to any natural or medical radiation dose received by a member of the public.

Australia

4.12 Radiation standards are promulgated by the National Health and Medical Research Council (NHMRC). The NHMRC publication 'Recommendations for limiting exposure to ionising radiation' recommends maximum limits. These are based on ICRP recommendations and their stated objective are to avoid unnecessary radiation exposures, keep necessary exposures to individuals to As Low As Reasonably Achievable (ALARA) and not to exceed prescribed dose limits.

4.13 Environment Australia comments that:

> The current standards are the result of detailed investigation by Australian authorities and take into account the latest international standards...there are review and statutory mechanisms in place in Australia to ensure that world best practice in radiation protection is followed.[2]

Community health and safety

4.14 Based on studies, the RRR concluded that it was very unlikely that any relationship existed between the operation of the current reactor and community health in Sutherland Shire. A more recent study was included in the SEIS. This used data supplied by the NSW Central Cancer Registry and examined differences and time trends in the incidence of leukemia, lymphoma and all cancers in the population of Sutherland Shire compared with nearby Warringah Shire and NSW as a whole during the period 1972–1995 by gender.

4.15 No substantial or significant reactor related differences in health were found.

4.16 While many submissions to the DEIS called for additional and more detailed health studies, the SEIS advised there was sufficient scientific evidence available to show that no effect would be detectable no matter what studies were to be conducted.

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2 *EAR*, op. cit., p. 69.

4.17 ANSTO considered it reasonable to assume that there would not be any marked likelihood of adverse effects from the replacement research reactor because overall gaseous emissions, especially tritium and Argon-41, would decrease.

4.18 The NHMRC has a dose limit to members of the public of 1 mSv per year above background. Average annual natural radiation background was 1.5 to 1.8 mSv. ANSTO has made public commitments to an overall dose limit to the most exposed member of the public of 0.01 mSv per year, which is one per cent of the NHMRC limit of acceptability.

4.19 The Senate Select Committee reported that radioactive waste management is based on the ALARA principle—As Low As Reasonably Achievable, social and economic factors being taken into account. This principle attempts to balance the benefits against the harms of the use of radioactive materials. This approach is regarded with mistrust by some as being a way of justifying economically profitable strategies without regard to best practice. It was suggested to the Senate Select Committee that ALARA is unscientific and should be replaced with a principle entitled 'ALATA'—As Low As Technically Possible.[3]

National radiation audit body established

4.20 The Senate Select Committee on the Dangers of Radioactive Waste reported to the Senate on 30 April 1996.[4] Government action on the Committee's recommendations concerning the establishment and functions of an Australian Institute of Radiation Protection took two more years to be implemented. In May 1998, the House of Representatives passed the Australian Radiation Protection and Nuclear Safety Bill 1998. On 31 August, the House of Representatives was dissolved, Parliament was prorogued and the Senate was unable to consider the Bill. It was reintroduced in the House of Representatives on 11 November, passed by the Senate on 10 December 1998[5] and came into force on 4 February 1999.[6]

4.21 The Act, and subordinate legislation, established the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The two agencies previously responsible for regulating Commonwealth radiation sources and practices were:

- the Australian Radiation Laboratory—responsible for providing advice to the Government and the community on the health effects of radiation as well as for undertaking research and providing services; and

3 *No time to waste*, op. cit., pp. 149-150.
4 Commonwealth Parliamentary Debates, Senate, 30 April 1996, p. 24.
5 Commonwealth Parliamentary Debates, Senate, 10 December 1998, p. 1725.
6 *Australian Radiation Protection and Nuclear Safety Act 1998*

- the Nuclear Safety Bureau—responsible for monitoring and reviewing the safety of nuclear plants operated by ANSTO as well as advising the Commonwealth on nuclear safety.

4.22 The object of the Act and subordinate legislation is to give a statutory basis and framework for the protection of the health and safety of people and the environment from the harmful effects of radiation. The Act also prohibits the construction or operation of any of the following installations:

- a nuclear fuel fabrication plant;
- a nuclear power plant;
- an enrichment plant; and
- a reprocessing facility.[7]

4.23 The Act vests considerable power in the office of the Chief Executive Officer (CEO) who is responsible for:

- promoting uniformity of radiation protection and nuclear safety policy and practices across jurisdictions of the Commonwealth, States and Territories;
- providing advice to Government and the community on radiation protection and nuclear safety; and
- undertaking research and providing services in relation to radiation protection, nuclear safety and medical exposures to radiation.

4.24 One of the main features of the Act involves the need for Commonwealth agencies dealing with radioactive material or apparatus, or any nuclear facility to be licensed by the CEO. In this context, ANSTO will need to obtain licences from the ARPANSA CEO at various stages of the construction and commissioning of the replacement research reactor. ANSTO will be required to submit applications for the licensing of the site, construction, commissioning, operation and decommissioning. Licensing decisions will be made in accordance with the provisions of the Act and Regulations. These include the consideration of matters raised in submissions following public advertisements of licence applications.

4.25 The Act establishes three advisory bodies:

- the Radiation Health and Safety Advisory Council;
- the Radiation Health Committee; and
- the Nuclear Safety Committee.[8]

7 ibid., subsection 10(1).

4.26 Appointment of members (including the Chair) to the Radiation Health and Safety Advisory Council are made by the Minister. Subsection 21(4) provides obliges the Minister to consult such consumer and environmental groups as the Minister considers appropriate before appointing a member.

4.27 Appointments (including Chairs) to the Radiation Health Committee and the Nuclear Safety Committee are made by the CEO. Membership of both Committees include a person to represent the interests of the general public.

ARPANSA approval process

4.28 ARPANSA will be vitally involved in the duration of the project, from the site selection phase to operations at full power. In summary, ARPANSA will be responsible for approval of:

- the proposed site—it must be demonstrated that the characteristics of the site are acceptable, i.e. the risks resulting from natural hazards such as earthquakes, aircraft crashes and bushfires would be acceptably low;
- the design—when the successful tender has been selected, detailed design of the proposal would be developed and safety analyses would need to be undertaken to demonstrate that the chosen design meets criteria specified by ARPANSA and any commitments associated with environmental approval are met. Safety assessment of the proposed design would need to be reported by ANSTO to ARPANSA in the Preliminary Safety Analysis Report. This would need to demonstrate that:
  - ⇒ the reactor design could withstand external hazards applicable to the site;
  - ⇒ safety-related equipment would operate successfully and with the reliability required by ARPANSA;
  - ⇒ consequences of design basis and beyond design basis accidents are acceptably low for their frequency—the design basis accident is one where safety-related equipment operates successfully if an accident were to occur.
- major components—if ARPANSA approves the Preliminary Safety Analysis report, detailed design of the reactor can proceed. ARPANSA would assess the design and testing of every major plant item during the detailed design;

8 ibid., sections 19-27.

- commissioning—after ARPANSA has approved the design and construction of all major components, the reactor operator receives approval to load fuel, reach criticality, operate at low power and approach full power operation as part of the commissioning process;
- operation—involving upgrading of the Preliminary Safety Analysis report to the Safety Analysis Report. The Final Analysis Report would include an updated analysis of design basis and beyond design basis accidents which would assess their consequences and the likelihood of their occurrence. The reactor would only be allowed to operate if ARPANSA approves the Final Safety Analysis Report; and
- modifications—any proposed modifications to the reactor would need to be assessed against the final Safety Analysis Report and approved by ARPANSA.[9]

Committee questioning

4.29 Representatives of ARPANSA, including the acting CEO, presented a submission and gave evidence to the Committee at the public hearing and provided answers to matters of concern raised by the Committee.

4.30 Bearing in mind the relatively short time that the organisation has been in existence, the Committee sought to establish the extent of expertise of ARPANSA personnel to undertake the tasks envisaged by the Parliament. The Committee was advised that within the regulatory branch, staff have more than 100 years experience between them in various aspects of the nuclear industry. There is a wide variety of technical expertise, namely mechanical, chemical, nuclear engineers and physicists. ARPANSA believes it has the required core expertise to make appropriate assessments. As well, ARPANSA maintains very close relationships with other regulators around the world. There are bilateral arrangements with North American, European and Asian agencies and ARPANSA personnel attend many international fora to maintain a knowledge of the state of the industry. ARPANSA has staff with experience in the nuclear industry in Canada on various types of reactors and from the USA and the UK.

> We believe we have the expertise available to us and available in Australia at this point. As the project goes through and we make subsequent licensing decisions, there will no doubt be particular parts of those decisions where we will be seeking to essentially purchase additional expertise to help us with making those

9 *DEIS*, op. cit., pp. 11-12–13.

> decisions. It will be impossible for us to keep on our staff the full range of expertise we need as the project goes ahead.[10]

4.31 Current staffing of 100 is expected to increase by between five and ten personnel.[11]

4.32 The submission to the Committee from ARPANSA stated:

> Research reactors have a small product inventory and generally have less demanding physical operating conditions than nuclear power plants, but the utilisation of research reactors is less predictable. Therefore, the INSAG-3 principles need to be applied as carefully to research reactors as they do to nuclear power plants.[12]

4.33 The Committee asked ARPANSA to expand on the meaning of 'less predictable' and the mechanisms proposed to ensure compliance by ANSTO with the INSAG-3 principles.

4.34 In relation to the 'less predictable' nature of research reactors, ANSTO advised the Committee:

> Power reactors, generally, are taken to power and operated at full power or high power for a long length of time—18 months or thereabouts. A research reactor by its nature is one in which there are experiments going on. HIFAR, for example is operated on a 28 day cycle instead of an 18 month cycle. There are rigs that are placed in the reactors and taken from the reactor for radioisotopes and other experiments that are going on... They [the risks] are somewhat different. The fission product inventory is much smaller because it [the research reactor] operates on a shorter time frame and at a much lower power level. So the inherent risk in relation to the fission product inventory is much smaller, but there are more opportunities for human factors to cause uncertainties—there are more operations going on in a research reactor. So we will look very closely at the human factors associated with the operation of the research reactor.[13]

4.35 In relation to compliance mechanisms, ARPANSA advised the Committee:

> In assessing the safety of the reactor, ARPANSA has developed some safety principles that are derived largely from INSAG-3 [IAEA publication 'Basic Safety Principles for Nuclear Power

10 ARPANSA, *Transcript*, p. 178.

11 ibid.

12 ibid., p. 171.

13 ANSTO, *Transcript*, p. 180.

> Plants'], other recommendations of the International Atomic Energy Agency and precedents that are set around the world by other regulatory organisations. We believe it provides a very thorough framework against which to judge the safety of the reactor and its operation.[14]

4.36 The Committee then asked ARPANSA to provide details of how compliance with these principles will be adhered to and the mechanisms available to reconcile disputes between ANSTO and ARPANSA in relation to compliance. The Committee was advised that:

> We can assess it [compliance] through the safety analysis report, procedures, quality documentation, and so on. We can carry out inspections to see that the plant is constructed as it has been designed and that the procedures being used are as they have been written. We can carry out audits of processes. So we do it through review of documentation, inspections of plant operations and audits of processes as well. If there is something that we are concerned about, within the legislation the CEO has the ability to put conditions on the operation of the plant, and at any time conditions can be attached to that licence, with which the licence must comply. Dispute mechanisms that allow the testing of the requirements upon ARPANSA and decisions made by the CEO are written into the legislation.[15]

Report to Parliament

4.37 The Act requires ARPANSA to provide quarterly and annual reports to Parliament. The first quarterly report was transmitted to the Minister on 4 May, covering the period 5 February to 31 March.[16]

Public comment on licence applications

4.38 ARPANSA advised the Committee that the *Australian Radiation Protection and Nuclear Safety Act 1998*

> …requires that the CEO gazette the receipt of all applications for facility licence, and, in the case of nuclear installations such [as] the proposed replacement research reactor, invite public comment on the application. In deciding whether to grant a licence, the CEO is required to take into account public comments submitted.[17]

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14 ARPANSA, *Transcript*, p. 180.
15 ibid., p.181.
16 ibid., p. 182.
17 ibid., p. 168, see also p. 183.

4.39 At the public hearing, the Committee was advised by ARPANSA that an application for licensing the proposed site for the replacement research reactor had been received. In consequence, the provisions of the *Australian Radiation Protection and Nuclear Safety Act 1998* now apply. ARPANSA advertised the application in the Gazette and newspapers and submissions from the public have been called. This will be ARPANSA's first formal licensing decision on a reactor project.

4.40 The Committee notes that the provisions for public comment on licence applications are not prescribed in the Act. Rather, Regulations made pursuant to section 85 of the Act make these provisions[18], notified in the Commonwealth of Australia Gazette, 18 March 1999.

4.41 Matters which the CEO must take into account in granting a licence were paraphrased by ANSTO in the following terms:

> The Act...sets out that the CEO must take into account 'international best practice'.

4.42 When asked what this means, ARPANSA stated:

> It could have a very precise meaning in some circumstances and it could have a very generalised meaning in others. The precise meaning might be: if ANSTO were proposing a certain practice that was very similar, almost identical, to practices carried out by other operators of similar equipment and other operators were achieving lower exposures—doses—for their workers, then we would expect ANSTO to meet that level. That would be a precise use of international best practice. In other senses of the word I think it would be saying that the guidance laid down in the internationally accepted documents should also be used in my decision making.[19]

4.43 Licences will have a series of conditions attached. Penalties will apply to breaches of the Act, regulations and the licence conditions.

Overall responsibilities

4.44 In addition to being involved in the development of the design and operation of the proposed research reactor, ARPANSA will be responsible for monitoring and auditing the storage and movement of nuclear wastes as well as emissions.

18 *Australian Radiation Protection and Nuclear Safety Regulations 1999*, Statutory Rules 1999, No 37.

19 ARPANSA, *Transcript*, p. 184.

Emissions And waste

Emissions

4.45 The sources of radioactive airborne emissions are at HIFAR and various buildings in which nuclear operations take place. All chimney stacks and ventilation exhausts have controls and filters to remove airborne particulates. Measurements of gaseous emissions, carried out by ANSTO, are at the following locations:

- discharges from each stack;
- detectors on the boundary of LHSTC; and
- a computer model—stated to give a conservative (overestimate) of the calculation of off-site doses.

4.46 According to the DEIS, independent calculations show that the maximum dose to the atmosphere of measured emissions from LHSTC is 0.003 mSv per year. This is 0.3 per cent of the dose limit adopted by the NHMRC and one per cent of the dose limit adopted by ANSTO.[20] Independent regulating authorities use their own detectors to verify the results.

Replacement research reactor

4.47 According to ANSTO, emissions from a pool-type reactor would be much lower than those for HIFAR and these emissions would not pose a measurable risk to the surrounding community. This assertion was supported by an independent review, commissioned by Environment Australia, undertaken by CH2M Hill. This study concluded that the quantity of the two major radionuclides produced by HIFAR—Argon (Ar-41) and tritium, would both be significantly reduced when HIFAR is replaced.[21] Nevertheless, Environment Australia took the view that for a light-water cooled and moderated reactor, tritium production and release should be almost eliminated. Environment Australia also expected that design requirements for the replacement reactor should include all possible measures to reduce Argon-41 emissions.

Production activities

4.48 Emissions are not confined to HIFAR—they are also associated with radiopharmaceutical production, in particular the production of

20 *DEIS*, op. cit., pp. 10-60, 10-26.

21 *EAR*, op. cit., p. 74.

molybdenum-99 and iodine-131 from specific production facilities. As previously mentioned, the DEIS postulated the maximum dose to any member of the public due to normal operation of the research reactor to be in the order of 0.003mSv per annum. Any doses from increased radiopharmaceutical production would need to be added to this. The proposed reactor will have the capacity to produce four times the current production rate of molybdenum-99 and emissions will increase unless new processes are adopted.

4.49 The DEIS contains a commitment from ANSTO that the maximum off-site dose to a member of the public would remain at less that 0.01mSv. Environment Australia adopted the following position:

- the commitment by ANSTO that the maximum off-site dose would remain at less than 0.01mSv should be translated into a binding agreement between ANSTO and the nuclear regulator;
- any licensing agreement between ANSTO and the regulator should list isotopes discharged and set a limit for each; and
- any decrease in emissions from one source—for example, the research reactor, should not be 'balanced' by increases from other sources.[22]

4.50 The EAR recommends and ANSTO has accepted that:

- radioactive gaseous emissions discharged via stacks from buildings associated with radiopharmaceutical production (primarily Buildings 23 and 54) must not increase above existing levels regardless of any future production increases. This requirement should be recognised by ARPANSA as part of its licensing of emissions from radiopharmaceutical facilities at the LHSTC. The objective of this approach is to ensure implementation of existing and emergent technologies to further contain or reduce such emissions;
- ANSTO, in consultation with ARPANSA, should re-examine the issue of coordination and timing of processes which give rise to gaseous emissions from stacks with a view to minimising the impacts of radioactive gaseous discharges, to the extent practicable; and
- a review of the method of molybdenum-99 production process must be undertaken by ANSTO, in consultation with ARPANSA, to investigate means whereby the isotope can be produced and isolated with decreased releases of subsidiary radioactive waste products. This should be completed to the satisfaction of ARPANSA.[23]

22 ibid., p. 77.

23 ibid., p. 199.

Liquid waste emissions

4.51 Liquid effluents permitted to be discharged, are currently treated on site and discharged under licence, as industrial sewage, for treatment at the Sydney Water Cronulla Sewage Treatment Plant (CSTP) which discharges into the ocean at Potter Point.

4.52 Annual discharges are 90,000 cubic metres or 90 megalitres. Water released from LHSTC under the terms of the agreement with Sydney Water must satisfy quantitative and qualitative criteria. Discharge quality is defined by the level in the discharge when it reaches CSTP being below the derived reference levels for radionuclides in drinking water guidelines issued by the World Health Organisation, based on a dose limit of 0.1mSv per annum. Sydney Water has an independent sampling point in the sewer and the activity can also be monitored at Potter Point.

4.53 Yearly arisings of low level liquid waste from the replacement reactor are expected to remain comparable with current levels. A minor reduction in tritium is expected. ANSTO has sampled shellfish and algae at the Potter Point discharge point and this revealed no traces of radioactivity above background levels.

4.54 The Committee notes, however, some evidence that current limits are based on dilution. This is undesirable. The EAR recommended that:

- a high priority must be given to review the licensing of radioactive waste discharges to sewer by ANSTO. As part of this, ANSTO should be required to undertaken further assessment and analysis to ensure that all possible exposure pathways and future events at the Cronulla Sewage Treatment Plant are taken into account. Monitoring and assessment of individual discharges within LHSTC is also desirable, to enable understanding of the various sources and their relative contributions. This assessment must be prepared to the satisfaction of ARPANSA and prior to reactor operations commencing;
- as part of the groundwater monitoring program…ANSTO or its contractors must establish bores at appropriate locations in the LHSTC and the buffer zone to ensure coverage of contaminates from the site overall and aquifer flows downstream of the proposed reactor. The locations and monitoring regimes must be agreed with ARPANSA; and
- ANSTO must consult with ARPANSA with a view to establishing a radiological site characterisation, or 'footprint', for the reactor site and LHSTC / buffer zone in general. The objective of this characterisation is to provide a fundamental basis for ongoing radiological monitoring programs and the detection of radiological trends over time. The current radiological monitoring should be reviewed on the basis of the

site characterisation. The characterisation and monitoring review must be completed prior to commissioning of the proposed reactor.[24]

Spent fuel from HIFAR

4.55 Spent fuel rods from HIFAR are stored under water, usually for 12 months, in a concrete storage block adjacent to the reactor. From here, spent fuel rods are transferred inside a shielded transfer flask to a cropping pond where non-fuel containing ends are sheared off. This becomes intermediate level waste which is stored in the intermediate level waste storage area. The remaining spent fuel section is transferred under water to storage racks in the irradiation pond, connected to the cropping pond. Spent fuel is stored in the irradiation pond for 3-4 years. Following this, the rods are transferred, again in transfer flasks, to Building 27—an engineered fuel dry storage facility.

Number of spent fuel rods and their future

4.56 The number of HIFAR spent fuel rods stored at LHSTC is given in the DEIS and EAR as follows:

- 883 elements in dry storage in Building 27 which has a maximum capacity of 1100 elements but 1086 elements is regarded as full;
- 175 elements in 7 Dounreay flasks. These flasks, each with a capacity of 25 elements were originally built to transport spent fuel to the reprocessing facility at Dounreay;
- 331 elements in underwater storage in a pond in Building 23. The pond has a capacity of 391 elements;
- 22 elements in a cropping pond and testing pond; and
- 14 elements in reactor storage blocks.

4.57 In April 1996, ANSTO dispatched a shipment of 114 spent fuel rods to Dounreay, Scotland, for reprocessing and eventual return to Australia, in encapsulated cement, as long-lived intermediate level waste. Also in 1996, the United States Government announced it would accept all spent fuel rods of US origin from research reactors until 2006. In September 1997, the Commonwealth Government announced that:

- $88 million had been set aside to remove spent fuel rods from LHSTC and to meet the cost of overseas reprocessing;

24 *EAR*, op. cit., p. 200.

- Australia would enter into an agreement with the US Government to repatriate 689 spent fuel rods of US origin, with shipments commencing during the next 12 months; and
- the balance of 1300 spent fuel rods would be shipped to Dounreay for reprocessing, encapsulation in cement and eventual return to Australia.

4.58 In April 1998, ANSTO sent a shipment of 240 spent fuel rods to the United States. No waste will be returned to Australia.

4.59 On 5 June 1998, the UK Government announced it would cease the commercial reprocessing of spent fuel at Dounreay and would not enter into any further commercial contract for reprocessing.

4.60 This cancellation prompted ANSTO to contract the French reprocessing company, Cogema, to reprocess HIFAR spent fuel not of United States origin. This waste will eventually be returned to Australia, as long-lived intermediate level waste in a stabilised form suitable for long-term storage. The volume of ANSTO's spent fuel rods to be reprocessed by Cogema would amount to 0.02 per cent of the annual throughput at the La Hague reprocessing plant. According to the EAR, Cogema is well established in reprocessing waste from other countries, has appropriate waste treatment and storage facilities and meets all current French requirements. ANSTO advised the Committee that over 2,000 tons of power reactor fuel is regularly processed at the French plant each year.[25]

4.61 Spent fuel rods from the replacement research reactor would be shipped overseas when between four to eight years old. Separated wastes will be returned to Australia in a stable vitrified form 10-15 years after being reprocessed. ANSTO advised the Committee that Australia's share of radioactive waste arising from reprocessing will be based on the level of radioactivity present in the fuel at the time of reprocessing. The actual level of radioactivity in the waste will continue to decrease in storage until the time the vitrified waste is prepared for shipment to Australia.

4.62 The Committee asked for a copy of the contract between ANSTO and Cogema. ANSTO reiterated the stance taken by the Minister (Senator Minchin) when, on 17 February, he told the Senate that 'the contract will not be tabled in the Senate as it is a commercial contract that is confidential to its signatories'.[26] According to ANSTO, the contract contains considerable proprietary and commercial-in-confidence information. ANSTO stated that the document is different to a document, tabled at the public hearing, entitled 'Contract for the reprocessing of irradiated oxide fuel'. This names Cogema as one of the signatories.

25 ANSTO, *Transcript*, p. 130.

26 ANSTO, *Correspondence*, 24 May 1999, p. 3.

4.63 Australian waste yet to be returned from fuel previously reprocessed at the Dounreay facility in Scotland will be returned in a cement encased form.

4.64 ANSTO advised the Committee that more than a quarter of the spent fuel ever produced has been sent overseas.[27]

Spent fuel from replacement research reactor

4.65 The replacement research reactor will use low enriched uranium fuel. Spent fuel from the reactor will be transferred from the reactor pool to an adjacent storage pool. This procedure will eliminate the need for transfer flasks. Water from the storage pool will be continually circulated through a filtration and ion exchange system to maintain water quality and to remove any radioactivity.[28] The storage pool will need the capability to store ten years arisings. This requirement is based on:

- a minimum cooling time to permit transport of 3 years;
- a minimum practical shipment batch—5 years;
- a buffer of at least one year; and
- a capability to completely unload the reactor core at any time.

4.66 Every five years, ANSTO would ship five years arisings overseas for reprocessing, with the waste being conditioned into a leach-resistant form such as borosilicate glass and eventually returned to Australia for storage and disposal. Based on an annual rate of 40 fuel rods, and a maximum of nine years arisings, this would equate to 360 spent fuel roads.

4.67 Tender specifications include a requirement of bidders to demonstrate a solution for the management of the reactor's spent fuel consistent with ANSTO's waste management strategy. ANSTO advised this requirement will place a responsibility on vendors to demonstrate viable solutions for the 'disposition' of spent fuel arising from their reactor designs.[29] Cogema has indicated that it would be prepared to undertake the reprocessing of low-enriched uranium fuels on a commercial basis.

4.68 ANSTO has estimated that annual waste from spent fuel eventually returned to Australia in the form of borosilicate glass (or possibly synroc) would have a volume of 0.1 cubic metres, giving a total volume of four

27 ANSTO, *Transcript*, p. 130.

28 *DEIS*, op. cit., pp. 10-58, 9.

29 ANSTO, *Correspondence*, 24 May 1999, p. 3.

cubic metres likely to arise during the life of the replacement research reactor, which is estimated to be 40 years.[30]

Other radioactive waste

4.69 HIFAR operations and radioisotope production also produce other radioactive wastes in solid and liquid form which are classified as follows:

- intermediate solid and liquid;
- low level solid; and
- low level liquid—these are treated as emissions.

4.70 Intermediate solid waste is stored in engineered concrete pits in Building 27. One pit is full and the other has additional capacity. About 1.5 cubic metres is produced annually. The volume produced by the replacement research reactor and associated production is comparable with current amounts.

4.71 Low level solid waste is in three categories:

- compactable waste 100, 200-litre drums produced annually;
- sludge from solar-drying wastewater ponds—20 drums annually; and
- non-compactable contaminated items.

4.72 A total of about 150 (200 litre capacity) drums of low level waste is produced annually.

4.73 In 1997, a new facility with a capacity of 6,700 drums was constructed. The Committee understands that this facility can store all present waste and future waste generated until 2010, based on current generation rates. Operation of the replacement research reactor would produce a similar amount of compactable and non-compatible waste to HIFAR. Part of the waste currently stored in solid form is sludge produced by the evaporation of liquid waste. ANSTO is investigating alternative technologies. It expects the investigation to be completed by 1999 and a new liquid waste treatment facility to be operational by 2001.

4.74 Intermediate level liquid waste is produced during the separation of molybdenum-99 from irradiated uranium pellets. The waste is stored in 50 litre flasks for 10-24 months in Building 54. It is then transported to Building 57 for longer term storage in five shielded tanks. About 300 litres

30 *EAR*, op. cit., p. 91.

are produced each year and in April 1996, there were 6,500 litres of this waste in storage.[31]

4.75 The DEIS states that ANSTO is installing equipment to solidify and stabilise this waste. In the SEIS it is stated that the process of solidification had reached the operational stage and it would take three years to solidify the existing inventory. According to the EAR, it is ANSTO's intention to solidify, in synroc, all intermediate level liquid waste from the replacement research reactor and to store it on site until the national storage facility for long-lived intermediate level waste is operational. The EAR states:

> …a high priority must be given to the stabilisation and solidification of intermediate-level liquid waste from the molybdenum-99 production facility. All historic wastes should be stabilised before commissioning of the replacement reactor.[32]

Waste storage and repository

4.76 The Committee shares concerns expressed about the continued storage of a considerable inventory of radioactive waste at LHSTC, including spent fuel rods. There may be some substance in the proposition that waste management is regarded as the key obstacle to the growth and acceptance of nuclear research facilities.

4.77 The question of radioactive waste generation, storage and disposal has been under consideration by various Governments since 1992. In that year, the Minister for Primary Industries and Energy (Hon Simon Crean MP) announced the commencement of an Australia-wide site selection study. This prompted the progressive release, in three stages, of a series of discussion papers. These coincided with and were supplemented by the findings of an extensive inquiry and report by the Senate Select Committee in 1996.

4.78 The Senate Select Committee found that in 1996 there were estimated to be a national total of 960 cubic metres of radioactive waste in Australia requiring storage or disposal, with an annual increase of 50 cubic metres.[33] The Committee indicated that these large quantities must be considered in developing a national strategy to deal with radioactive wastes.

4.79 The Senate Select Committee made three recommendations of immediate relevance to this Report. It recommended that:

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31 *EAR*, op. cit., p. 98.

32 ibid., p. 100.

33 *No time to waste*, op. cit., p. 48.

- a national above ground storage facility be established which has a capacity to take low, intermediate and high level radioactive waste[34];
- the national facility be adequately engineered to withstand all possible climatic conditions, no matter how unlikely[35]; and
- the public, particularly the local community, should be involved in consultation on the construction of a national storage facility and the transport arrangements to any such facility. [36]

4.80 On 6 July 1999, the Minister for Industry Science and Resources (Senator the Hon Nick Minchin) released a report on public comment in response to the Phase 3 discussion paper.[37] The discussion paper identified Billa Kalina as the preferred region. This region is now referred to as the central-north region of South Australia to avoid any confusion with a national contour map with the same title. Within this region, 18 sites have been identified for further investigation. It is expected that the preferred site will be announced in late 1999.

4.81 Once a preferred site is identified, its use as a national radioactive repository will be subject to detailed environmental assessment and further public review. Land at the repository will be used for the below ground burial of all low and short-lived intermediate level radioactive waste. ANSTO would use this facility to dispose of its inventory of these categories of waste (1080 cubic metres), which is a third of the national inventory. The report also indicated that the Government would consider co-locating a store for Australia's long-lived intermediate level radioactive waste with the repository. If the site is considered suitable, similar environmental impact assessments and public review would apply.

4.82 The DISR report mentions that radioactive waste is presently held at more than 50 interim storage sites throughout Australia and is accumulating at the same annual rate as postulated by the Senate Select Committee. In many cases, the waste is held in temporary storage, in buildings neither designed nor located for long term storage. The Committee agrees that disposal and storage at a purpose built national repository, at a remote location, would be preferable to existing arrangements—at Lucas Heights and elsewhere.

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34 ibid., p. 134. Australian research reactors do not and will not produce high level radioactive waste and no waste of this type will be stored in Australia.

35 ibid., p. 137.

36 ibid., p. 167.

37 Department of Industry, Science and Resources, National Radioactive Waste Repository Site Selection Study Phase 3, *Report on Public Comment*, June 1999.

4.83 The NHMRC has developed a code of practice for near-surface disposal based on international recommendations on radioactive waste management. The NHMRC code defines Categories A, B and C wastes as suitable for near-surface disposal. Category S are regarded as long-lived intermediate level wastes.

4.84 The report mentions that Australia holds about 500 cubic metres of long-lived intermediate level radioactive waste (Category S)—less than half of which (205 cubic metres) is generated from the operation of HIFAR and associated radioisotope and radiopharmaceutical production.[38] In Australia, Category S waste consists of sealed sources and waste from radiopharmaceuticals.

4.85 The store would be used by ANSTO for this waste and to store waste returned from overseas. Waste from the decommissioning of HIFAR would also be sent to the repository and store. Overseas reprocessing would produce a volume of about six cubic metres of waste arisings from 30 years of HIFAR operations. No more than 20 cubic metres of cement-encased long-lived radioactive waste would be returned from the reprocessing of the 114 spent fuel rods sent to Dounreay in 1996[39] The site of this store will be considered for collocation with the national near-surface repository. It would remain stored at the site until a deep geological disposal facility or alternative management arrangements are available.

4.86 According to the DISR report, transport of radioactive waste to the facility would be in accordance with standards set out in the National Code of Practice for Safe Transport of Radioactive Substances and relevant State and Territory Regulations to ensure worker and public safety.[40]

4.87 The site will be the size of a football field and surrounded by a buffer zone, bring the total area to just over two square kilometres.

4.88 The Committee notes that further environmental impact assessments will take place following the selection of a suitable site. The Committee also notes that the Phase 3 site selection process has involved considerable public consultation in a manner consistent with the Senate Select Committee's recommendations. These have included community-based meetings, discussions with lessees in the region, community information days and the establishment of a Regional Consultative Committee. The DSIR report commits the Commonwealth to further consultations with

38 ibid., p. 46.

39 ibid., p. 49.

40 ibid., p. 10.

Aboriginal groups. The region is covered by a number of native title claims.

4.89 Details of the cost of the facility are not available. They will be determined following the preparation of designs.[41]

Little Forest Burial Ground

4.90 This area is located within the buffer zone about one kilometre north of LHSTC and contains low level radioactive waste generated by the former Atomic Energy Commission. The wastes are buried in various trenches and covered with at least one metre of soil This burial ground was the subject of a number of submissions to the Committee. The site is routinely monitored. The ANSTO Environmental and Effluent Monitoring Report (1997) states:

> External radiation readings over the trenches are consistent with normal background levels except for one small, localised area near MB16 in the middle of the trenches. Radiation readings around the LFBG site boundary fence are all at background levels, confirming that possible doses to members of the public from external radiation can also be regarded as negligible.[42]

4.91 The Committee notes that whilst risks may be regarded as negligible, there is a public perception that the site poses risks. It is remote from LHSTC and close to major roads. **The Committee considers it imperative that a high priority be given to the exhumation and removal of the waste to the national repository.**

Hazards

4.92 The IAEA has devised an events reporting system entitled the International Nuclear Event Scale (INES) for the prompt reporting of incidents at nuclear plants. Events involving nuclear or radiological safety are classified on a scale of levels from 0 to 7 as follows:

- 0—below scale event deviation—no safety significance;
- 1—anomaly—beyond authorised operating regime;
- 2—incident significant spread of contamination / over-exposure of a worker;

41 ibid., p. 59.

42 ANSTO, *Environmental and Effluent Monitoring at Lucas Heights Science and Technology Centre 1997*, p. 32.

- 3—serious incident—public exposure at a fraction of prescribed limits;
- 4—accident without significant off-site risk—minor release: public exposure of the order of prescribed limits;
- 5—accident with off-site risk—limited release: likely to require partial implementation of planned countermeasures;
- 6—serious accident—significant release—likely to require full implementation of planned countermeasures; and
- 7—major accident—major release: widespread health and environmental effects.[43]

4.93 Since the introduction of INES in 1992, there have been 46 Level 1 incidents involving HIFAR. The Nuclear Safety Bureau considered this level as not unexpected for a reactor of the age and design of HIFAR.[44]

4.94 The EAR mentions that since 1992, two Level 2 events had been reported by the former Nuclear Safety Bureau. There were no off-site implications.[45]

4.95 The EAR concludes that there are well-established procedures for the reporting and follow-up of incidents with oversight by ARPANSA. A new replacement reactor, once operational and with fully qualified staff, would be expected to lead to a reduction in the number of incidents.[46]

Reference accident

4.96 A number of submissions to the Committee suggested that the parameters established for the reference accident, described in the DEIS, were not a worst case scenario and that, consequently, there was a suggestion that the associated risks to the public had been understated. The lack of a detailed design precludes the ability to undertake a safety analysis.

4.97 ANSTO submitted that the results of the assessments made for the EIS confirm that the Lucas Heights site has no negative features that would render it unsuitable for location of a replacement reactor and that the consequences of the hypothesised most severe credible accident would not require any countermeasures beyond the 1.6 kilometre buffer zone. Thus, no sheltering, evacuation or issue of stable iodine tablets would be needed beyond the buffer zone.

4.98 ANSTO further submitted that these conclusions were also supported by the three independent peer reviews, commissioned by Environment

43 Nuclear Safety Bureau, *Annual Report 1997-98*, (Parliamentary Paper 394 / 1998), p. 8.

44 *EAR*, op. cit., p. 150

45 ibid., p. 149.

46 ibid.

Australia, which were conducted by the International Atomic Energy Agency in Austria, CH2M Hill, and Parkman of the United Kingdom:

> On the basis of the available written information, discussion with key parties as well as the brief site visit, it can be concluded that the site for the proposed reactor has no negative characteristics which would make it unacceptable from a nuclear or radiological safety point of view.[47]
>
> The report concludes that the Risks and Hazards assessment for the EIS has been carried out using currently accepted methodologies and internationally verified computer codes. The Reference Accident has been selected and analysed in detail, and is judged to be appropriate for bounding any fault that can occur on a well designed reactor system.[48]
>
> In Summary, CH2M HILL concludes that radiological impacts of the proposal, as described in the DEIS, are minimal and of no significance to the public. All discharges are well below regulatory limits, as would be expected for a modern pool reactor.[49]

4.99 The EAR concludes that '...the consequences of an accident at a new reactor have been adequately examined as part of the Reference Accident analysis...' noting '...the good public safety record of research reactors and that this supports the assessment that there are low potential risks to the public'.[50]

4.100 The EAR does, however, make a number of recommendations which have been accepted by the Government. These are that:

- the Preliminary Safety Analysis Report (PSAR) must demonstrate that the design of reactor components (eg reactor pool, beam tube penetrations) effectively excludes the failure of these components for earthquakes of lower frequency than the design basis earthquake, to rule out a fast loss of coolant accident as a credible incident. This will need to be demonstrated to the satisfaction of ARPANSA[51]; and
- the assumptions used in deriving the Reference Accident effectively constitute design parameters for the proposed reactor and must be incorporated in the final design to the satisfaction of ARPANSA. In the event of changes, such that the Reference Accident examined may no

47 ANSTO, *Transcript*, p. 39.

48 ibid.

49 ibid.

50 *EAR*, op. cit., p. 151.

51 ibid., p. 125.

longer be valid, agreement to any major design changes must be sought from the Minister for Environment and Heritage prior to design finalisation.

- The PSAR must demonstrate that the design of reactor components (eg reactor pool, beam tube penetrations) effectively excludes the failure of these components from earthquakes of lower frequency than the design basis earthquake, to rule out a fast loss of coolant accident as a credible incident. This will need to be demonstrated to the satisfaction of ARPANSA.[52]

Liability and insurance

4.101 A number of submissions drew attention to residents being unable to obtain commercial insurance against health, property and environmental damage from a serious accident at Lucas Heights. This issue was seen by many local residents as significant.

4.102 ANSTO advised the Committee that in relation to nuclear liability, a Deed of Indemnity was signed on 27 August 1998 between the Commonwealth and ANSTO in which the then-Minister for Industry, Science and Tourism agreed that it was appropriate for the Commonwealth to indemnify ANSTO and ANSTO Officers for nuclear related activities in accordance with the terms and conditions set out in the deed. The Deed provides that:

> the Commonwealth shall indemnify and at all times hereafter keep indemnified ANSTO and ANSTO Officers from and against any loss (including legal costs and expenses), or liability, incurred or suffered by them arising from any proceeding or claim by any person against them for injury to persons or damage to property caused by Ionising Radiation, whether directly or indirectly.[53]

4.103 An ANSTO Officer is defined to include an officer, employee, or agent of an ANSTO Contractor, and an ANSTO Contractor is defined to mean a person or party providing goods or services directly or indirectly to ANSTO.

4.104 ANSTO maintains that this means that any member of the public who has a claim against ANSTO for nuclear-related compensation may pursue that claim in an Australian court secure in the knowledge that any judgement against ANSTO will be met by the Commonwealth.

52 *EAR*, op. cit., p. 125.

53 ANSTO, *Transcript*, p. 38.

4.105 The Commonwealth accepting liability was not seen by many as comforting since delays in the resolution of claims would invariably ensue and the cost of litigation would be prohibitive to most litigants.

4.106 The EAR draws attention to international conventions to cover nuclear third party liability. Other countries provide for operator liability and government indemnity through national legislation. At this stage, Australia does not have specific national legislation covering nuclear liability. ANSTO asserted that the Deed is superior to commercial insurance in a number of key respects, particularly since there is no financial limit to the indemnity. The Committee believes, despite these assurances, that there should be a legislative guarantee of ANSTO's liability to provide the appropriate level of public assurance on this matter and on the wider question of risks associated with the transport of radioactive substances and their disposal or storage.

Preparation of emergency plans

4.107 A number of submissions raised the question of the adequacy of emergency plans and the dissemination of emergency procedures, based on the plans, within Sutherland Shire. The submissions raise public safety issues and the Committee sought clarification of a number of issues from ANSTO.

4.108 Preparation of emergency plans at the for LHSTC is undertaken by the ANSTO Local Liaison Working Party in accordance with NSW emergency and rescue management legislation. The Working Party comprises representatives from:

- bush fire fighting authorities;
- NSW Emergency Services;
- Ambulance Service of NSW;
- Environment Protection Authority;
- NSW Department of Health, and
- Sutherland Shire Council.

4.109 ANSTO advised the Committee that State legislation requires a range of plans, known as 'disaster plans' (DISPLANs), be prepared in readiness for potential emergencies.

4.110 For accidents, incidents or emergencies with on-site consequences only, the emergency planning arrangements for the LHSTC are:

- the Emergency Plan which describes the on-site emergency arrangements for situations that can be handled by ANSTO personnel; and
- the ANSTO Emergency Plan (DISPLAN) provides for the off-site emergency arrangements requiring assistance for any on-site emergencies from NSW agencies. ANSTO personnel provide full technical support to this plan.

Off-site consequences

4.111 ANSTO advised the Committee that accidents, incidents or emergencies with off-site consequences are covered by the following arrangements:

- Sutherland Shire Local Disaster Plan (DISPLAN);
- St George-Sutherland District Disaster Plan (DISPLAN); which will be replaced by the Georges River District Disaster Plan following changes to Police Districts; and
- NSW State Disaster Plan (DISPLAN).

4.112 ANSTO is represented on both the Sutherland Shire and the Georges River Emergency Management Committees.

4.113 Emergency Plans delineate the roles and responsibilities of emergency response organisations, but not detailed actions. These are specified in Standard Operating Procedures for each agency which provide operational details for the emergency response. The SOPs are detailed and describe responses to a wide range of possible incidents.

4.114 Exercises form an integral part of ANSTO's emergency planning and preparedness. Building evacuation drills are conducted on a regular basis and emergency exercises involving emergency services agencies are conducted periodically to test the existing emergency planning arrangements. In February 1997, a bush fire exercise assisted in emergency response during the December 1997 bush fires.

4.115 ANSTO believes it has taken the responsible approach of setting performance criteria for the design of the replacement reactor which are specified to ensure that for a credible accident, there will be no requirement for countermeasures outside the 1.6 kilometre buffer zone.

4.116 The Committee questioned ANSTO about the extent to which emergency plans had been communicated to education authorities and the schools in the area.

4.117 ANSTO advised that regular school briefing sessions are conducted, although it is the responsibility of the NSW Department of Education to

provide the information. ANSTO also places leaflets in letterboxes advising residents of emergency procedures and the existence of emergency plans. These plans will be available in local libraries along with the leaflets. ANSTO added:

> In fact, when every property that is purchased goes to the council, the Sutherland Shire Council provide an advice on the existence of the facility and the emergency procedures. That has been in existence for many years.[54]

4.118 The question of the production of radioisotopes, in close proximity to residential areas was also raised in submissions to the Committee from the local community. ANSTO told the Committee:

> The University of Missouri reactor is in the city. There is a very large reactor closer to the centre of Paris than we are to the centre of Sydney, which has very large-scale radiopharmaceutical production facilities.[55]

4.119 The EAR recommends that:

- The Safety Analysis Report for the reactor must include provision for ongoing monitoring and audit of the frequency and severity of external events to ensure that assessment risks to the replacement reactor remain valid and acceptable, taking into account new developments in the vicinity of the reactor over time.
- Existing emergency plans and arrangements must be updated and subject to independent review at the detailed design stage and prior to the proposed reactor becoming operational This must be completed to the satisfaction of ARPANSA. The independent review of the plans should include opportunities for input by relevant State emergnecy agencies and the general public.
- The emergency management plan must also include a specific plan aimed at facilitating community understanding of credible hazards and risks from the reactor, mitigation measures, emergency arrangements and implications for the community. The plan should consider the best combination of media to achiever the above objectives. The plan must be prepared to the satisfactionof the Minister for the Environment and Heritage, in consultation with the Minister for Industry, Science and Resources and the Minister for Health, prior to the reactor being commissioned.[56]

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54 ANSTO, *Transcript*, p. 991.

55 ibid., p. 990.

56 *EAR*, op. cit., pp. 201–202.

Bushfires

4.120 The planning and coordination of bush fire fighting activities in Sutherland Shire is the responsibility of the Sutherland Bush Fire Management Committee. The Committee comprises members of all local bush fire fighting services, representatives of utilities and service companies, Sutherland Shire Council, ANSTO and other relevant interested groups.

4.121 ANSTO currently receives advice on bush fire management from the NSW Fire Brigades and the NSW Rural Fire Service, which are responsible for bush fire fighting and management within the Lucas Heights Science and Technology Centre and in the 1.6 kilometre buffer zone outside the Centre, respectively. Internal management of fire hazards and initial response to fire fighting within the Centre is the responsibility of ANSTO's Safety Division.

4.122 Current bush fire management at LHSTC involves:

- hazard reduction;
- bush fire preparedness; and
- emergency planning and exercises.

Hazard assessment

4.123 ANSTO advised the Committee that a bush fire hazard assessment has been carried out which:

- examined the existing bush fire hazard at the site of the replacement reactor;
- assessed the likely effect of the reactor facility on bush fire hazard, and the likely impact of bush fires on the construction and operation of the reactor; and
- set out appropriate measures to minimise the risk from bush fire during construction and operation of the reactor facility, including lessons learnt and implications of recent bush fires.

4.124 Agencies responsible for bush fire management and bush fire fighting who were consulted during the assessment included NSW Fire Brigades, Sutherland Rural Fire Service, Department of Bush Fire Services, Sutherland Shire Council, NSW National Parks and Wildlife Service, Commonwealth Department of Defence, ANSTO Safety Division (including Fire Officer), and the ANSTO Buffer Zone Manager.

Site assessment

4.125 The site for the replacement reactor and adjoining terrain to the west and north are flat, with slopes of less than five per cent and comprises open, heathland and woodland. This area is classified as a low to moderate bush fire risk zone. The area south of the site supports woodland vegetation on steeper slopes (15 to 25 per cent), and is therefore considered to be a zone of moderate fire risk. The area to the east of the site is built up and therefore does not constitute a bush fire hazard zone.

4.126 The replacement reactor will be surrounded by a fire protection zone ranging from 50 metres to 150 metres. It would be located 150 metres from the southern boundary, where the higher bush fire hazard exists. ANSTO advised that this distance greatly exceeds the requirements of the Department of Bush Fire Services and those of Sutherland Shire Council (40 metres).

Security and access

4.127 Access to the replacement reactor site would be from New Illawarra Road using the main entrance to the Centre to access either Old Illawarra Road or the main entrance gate to the Centre, depending on the phase of construction. ANSTO advised the Committee that it is likely that construction workers will enter the site through the main entrance, while delivery of bulk materials would be directed to Old Illawarra Road. Delivery of materials and access to the site would be made on approved access routes, determined in consultation with the Roads and Traffic Authority and Sutherland Shire Council.

4.128 Temporary internal access roads would be constructed at an early stage to serve construction traffic. These roads would be removed and the area reinstated at the end of the construction period. Where necessary, existing internal access roads will be upgraded.

4.129 The physical protection and nuclear safeguards arrangements currently in place for HIFAR are necessary to meet Australia's national and international obligations.

4.130 The physical protection and nuclear safeguards arrangements to be provided for the replacement reactor would be different from those for HIFAR. The requirements are less onerous than for HIFAR because of the use of low enrichment fuel in the replacement reactor rather than high enriched fuel required in HIFAR. The area around the replacement reactor will be controlled, but the extensive fencing and gate system employed for HIFAR would not be necessary. Access to the reactor building and

neutron guide hall would be controlled through appropriate electronic access systems.

4.131 The existing perimeter security fence surrounding the Centre will remain.

Occupational health and safety

4.132 ANSTO identified two distinct types of occupational risks at LHSTC. First, physical injury resulting from a range of mishaps. ANSTO submitted risk of physical injury places personnel in risk situations similar to laboratory and office workers or workers in light industry.

4.133 Secondly, personnel whose duties involve exposure to radiation. These workers, are subject to additional risks which are controlled by ensuring that all radiation workers have their radiation doses monitored and recorded and that work in radiation areas is undertaken by trained staff and controlled by health physics procedures.

Occupational exposure to radiation

4.134 ANSTO advised the Committee that new radiation regulations were introduced in 1991 and since then no worker has received an annual dose greater than the current limit of 20 mSv per year. Since 1993, no worker has received an annual dose greater than 15 mSv.

4.135 The mean occupational dose for radiation workers at LHSTC has remained constant at approximately one mSv per year. This is about half the average radiation dose in the Sydney region from natural background radiation of 1.8 mSv per year.

4.136 Over the past few years, the ANSTO staff receiving the largest doses were about ten staff involved in the processing and dispatch of radioisotopes. In response to this, the radioisotope dispatch area two improvements have been made to reduce doses. These are:

- the use of state-of-the-art equipment and the development of procedures for minimising the generation of radioactive wastes by waste reduction at source, waste segregation and volume reduction in line with the recommendations of the Waste Management Working Party; and
- the use of improved techniques and procedures for the processing and dispatch of radiopharmaceuticals.

4.137 ANSTO advised that by comparison, the doses to staff operating the reactor are small.

Personal injury claims

4.138 The Committee questioned ANSTO about any claims or litigation from employees as a result of exposure to radiation. ANSTO advised that a search of records, from the establishment of the organisation in 1987, indicates that a claim, amounting to $62,400 was paid. ANSTO advised that the payment was made '...notwithstanding the fact that the level of exposure to radiation or radioactivity by the officer concerned while he worked at ANSTO did not exceed allowable limits.'[57]

4.139 ANSTO paid another claim of $55,000 plus agreed costs arising from stress as a result of an officer being exposed to a low level of radiation. Of two other claims, one was settled in favour of ANSTO and the second was struck out by the Supreme Court of NSW.[58]

COMCARE investigation

4.140 In May 1996, COMCARE conducted an investigation to measure how ANSTO was meeting its obligations under the *Occupational Health and Safety (Commonwealth Employment) Act 1991* and to assist ANSTO in progressing its occupational health and safety performance. ANSTO advised the Committee that the investigation concluded that:

> ANSTO has achieved a remarkable result in all areas of this planned investigation. The qualifications and experience of staff of the Safety Division have enabled ANSTO to develop and implement comprehensive systems to manage all aspects of occupational health and safety.

They concluded:

> Due to the good result, very few recommendations have been made in this report.[59]

Replacement research reactor

4.141 ANSTO advised the Committee that occupational doses resulting from the operation of the replacement reactor will be assessed by ANSTO and the successful vendor and reported in the Preliminary Safety Analysis Report and Final Safety Analysis Report. ANSTO believes there is no technical reason why occupational doses should not be equal to or lower than those from HIFAR, particularly as refuelling operations are simplified with a pool reactor.

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57 ANSTO, *Correspondence*, 24 May 1999, p. 2.

58 ibid.

59 ANSTO, *Transcript*, p. 70.

Committee's Conclusion

4.142 **The storage of radioactive waste at Lucas Heights is of major concern to the local community.**

Committee's Recommendations

4.143 **When moving the expediency motion for the work to proceed, the Minister should provide a guarantee to the House that all recommendations in the Environment Assessment Report will be implemented. This guarantee should include existing commitments and new commitments listed in Appendix A of the Environment Assessment Report.**

4.144 **Provided all recommendations and commitments contained in the Environment Assessment Report are implemented during construction and commissioning and for the expected life of the research reactor, the Committee believes, based on the evidence, that all known risks have been identified and their impact on public safety will be as low as technically possible.**

4.145 **Removal of all radioactive waste from Lucas Heights for disposal or storage at a National Repository must be a high priority and is dependent on the timely provision of the Repository and Store.**

4.146 **In its quarterly and annual reports to Parliament, the Australian Radiation Protection and Nuclear Safety Agency should report on the implementation of all recommendations in the Environment Assessment Report falling within its direct responsibility.**

4.147 **In future, in its Annual Report to Parliament ANSTO should report on compliance and implementation of all recommendations in the Environment Assessment Report, including the commitments listed in Appendix A of the report.**

4.148 **As a matter of urgency, the Minister for Health and ARPANSA should appoint members to positions on committees identified in the Act.**

5

Consultation

The community

5.1 The proposed research reactor will be located in Sutherland Shire which, in the 1996 census, had a population of about 194,000. There has been local, regional and national interest in the proposal. The Draft Environmental Impact Statement (DEIS) assessed the potential impacts of the proposal based on the following hierarchy:

- local community interest of residents in 22 suburbs near Lucas Heights—with a population of 129,000;
- community of interest based on the entire Sydney region—with a population of 3.7 million; and
- national interest—the entire Australian population of 18.3 million.[1]

5.2 A replacement research reactor has been the subject of many inquiries during the past six years. The Research Reactor Review (RRR) was an extensive public consultation process which investigated whether Australia had a need for a replacement research reactor. From the perspective of public consultation, a key requirement of the RRR was the need to take into account the provisions of the *Environment Protection (Impact of Proposals) Act 1974*, particularly in relation to the calling for submissions and the scheduling of public hearings.

5.3 As already mentioned, the RRR conducted public hearings in six mainland States and Canberra, at which more than 380 submissions were received

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1 *DEIS*, op. cit., p. 1-6.

and more than 100 witnesses gave evidence. Some were representatives of the area surrounding Lucas Heights.

5.4 The RRR provided a forum for wide ranging and detailed discussion of all relevant aspects. It was a consultation process in which individuals and organisations from the local community as well as more nationally-focussed interest groups were able to put their points of view.

5.5 The recommendations of the RRR were somewhat ambivalent, leaving the decision to proceed with a replacement project to the Government.

5.6 The Environmental Impact Statement was prepared in accordance with normal practice which is enshrined in relevant Commonwealth statutes and subordinate legislation.

5.7 During the public display of the DEIS, Environment Australia commissioned three independent expert reviews of the DEIS. These were undertaken by:

- the International Atomic Energy Agency—a hazard and risk analysis;
- Parkman Safety Management—a further review of hazards and risks and compliance with best practice; and
- CH2M Hill (Australia)—operational emissions and fuel rods and impacts on the environment.

5.8 Responses to the DEIS were addressed in the Supplementary Environmental Impact Statement (SEIS). The two documents were forwarded to Environment Australia for assessment in accordance with the provisions of the Act. Environment Australia undertook an assessment of the DEIS the SEIS and public comments. The resulting Environment Assessment Report (EAR) was prepared to assist the Minister for the Environment and Heritage in providing advice and recommendations on the proposal to the responsible Minister—the Minister for Industry, Science and Resources. The responsible Minister is required to take advice and recommendations in the EAR into account in further decision making. The EAR contains wide-ranging recommendations. The responsible Minister has indicated that they will be implemented.

5.9 Friends of the Earth submitted that the process of environmental review should involve proponents submitting a finished or semi-finished proposal and modifying the proposal in the light of public comment. The Committee believes there will be further opportunities for public comment from peak environmental groups during ARPANSA's consideration of licence applications from ANSTO.

Extensive public consultation

5.10 ANSTO advised the Committee that extensive public consultation was undertaken during the environmental impact assessment of the proposal. Issues of interest or concern to the local community were identified, appropriate responses were developed and communicated. The exchange of information occurred through meetings, information days, displays at shopping centres, a telephone information line, the Internet, and newsletters.

5.11 Community representatives consulted included:

- Sutherland Shire Council;
- ANSTO-Community Forum;
- People Against a Nuclear Reactor; and
- Health and Environment Committee of Sutherland Shire Council.

5.12 Meetings with these groups were convened to outline the proposal and the EIS process in order to help the participants formulate questions and comments. ANSTO also mounted six mobile displays and information days to provide detailed information on the proposal and to by provide the public with direct contact with the EIS team.

5.13 In addition, ANSTO mounted nine library displays during the public consultation period. The displays were held at local Sutherland Shire Libraries and the Central Libraries of Hurstville, Campbelltown and Wollongong. Each display was approximately of three hours duration and personnel were available to provide information on general or technical issues.

5.14 ANSTO also strengthened the consultation process following the adoption of recommendations of a report prepared by consultants whilst the DEIS was being prepared. These recommendations range from advising local businesses, local community groups and service clubs, to a radio debate.

5.15 ANSTO submitted to the Committee that public consultation, during the EIS process not only exceeded the requirement of the *Environment Protection (Impact of Proposals) Act 1974*, but also included additional initiatives to enhance community opportunities for consultation.

5.16 The DEIS exhibition period extended for a period of 85 days, or three times longer than minimum statutory requirement In addition, submissions were accepted for two weeks after the closure period.

Chronology of community consultation

5.17 The period of community notification of the proposal and opportunities for public comments extended from September 1997 to November 1998.

5.18 Following is the chronology of major milestones of the notification and invitations for community involvement:

- 3 September 1997—proposal is announced by the Minister for Resources;
- 27 September 1997—Minister for the Environment directs that an EIS be prepared;
- October 1 1997—letter to 21 households in Sutherland Shire about the replacement research reactor and spent fuel management;
- 8 November to 6 December 1997—draft guidelines for the content of the DEIS released for public comment;
- February 1998—the proposal, DEIS consultation process, newsletter availability and consultation participation, including details of mobile and library displays, are advertised in St George, Sutherland, Menai and Engadine newspapers and the Sydney Morning Herald, Daily Telegraph and The Australian;
- February 1998—project newsletter is delivered to 21,000 households—describes the proposal and the EIS process;
- February 1998—Internet home page—site with E-mail address is set up by ANSTO. This information medium was designed to include details of the proposal and the EIS process and provided the public the opportunity to send submissions on the proposal via e-mail;
- May 1998—ANSTO Open Day held—following advertising in the media, for industry, academia and the general public;
- June 1998—project newsletter is delivered to 41,000 households. It describes the proposal, the EIS process, summaries community concerns and outlines forthcoming 'consultation' events;
- 17 August 1998—DEIS is released for public comment with a 12 week response period;
- August 1998—third project newsletter is delivered to 41,000 households; outlines arrangements for public consultation on the DEIS;
- October 1998—release of three independent expert technical peer reports commissioned by Environment Australia. The reports were

prepared by the International Atomic Energy Agency, CH2M Hill and Parkman UK. Their purpose was to provide independent technical reviews on different aspects of the proposal and the DEIS.

- 9 November 1998—comments on the DEIS close, although submissions were accepted for three weeks after the official closure.

Commitment to ongoing community consultation

5.19 ANSTO advised the Committee that it is committed to further ongoing community consultation as the proposal is developed through the detailed design, construction and commissioning stages. This consultation process will include the following features:

- the liaison committee will continue to provide community interaction and information exchange;
- the Internet home page will provide updated information on the project;
- further open days and site visits will be available to the public; and
- project updates will be distributed through the community in the form of a newsletter.

Community surveys

5.20 Community surveys in relation to nuclear facilities at Lucas Heights have been conducted over a number of years. The RRR commissioned two qualitative (limited) surveys in response to local suggestions that there was widespread and intense opposition to any replacement research reactor at Lucas Heights. The results raised a number of issues—especially a sense of local mistrust or suspicion of ANSTO.[2] This is the case despite efforts in recent years to ensure openness and public consultation by ANSTO management executive.

5.21 This public perception has been based on an ANSTO culture of secrecy which had its origins in the Australian Atomic Energy Commission (AAEC). The Committee believes this perception could be significantly assuaged by a pro-active openness on the part of ANSTO. Public perceptions may reflect a predisposition, on the part of ANSTO to adopt a 'siege' mentality. If the project proceeds, it will be essential for ANSTO to adopt a frank and open relationship with the local community. This could

2 *Future Reaction*, op. cit., p. 154.

be fostered by conducting more frequent open days. ANSTO has indicated these will occur.

5.22 ANSTO commissioned a survey of residents in Sutherland Shire in 1997 which indicates a majority of respondents support a replacement research reactor.[3]

5.23 The EAR recommended that:

> ANSTO must develop a specific program for ongoing community consultation and dissemination of information during the design, construction and commissioning phase of the reactor, to the satisfaction of the Minister for Environment and Heritage.[4]

5.24 In relation to a Community Right to Know Charter, the EAR recommended that:

- a high priority must be given by ANSTO to finalising a Community Right to Know Charter between ANSTO and the community;
- this Charter, as a minimum, must establish principles for information exchange, the obligations of parties in providing and using information, timely mechanisms for dispute resolution, and a process of periodic review and update;
- the use of a recognised mediator to facilitate completion of the Charter should be considered; and
- if the Charter has not been agreed within 12 months of the date of these recommendations, the outstanding issues of dispute should be referred to the Minister for the Environment and Heritage for resolution, in consultation with the Minister for Industry, Science and Resources and the Minister for Health.[5]

Local Government

5.25 Sutherland Shire Council has been consulted on the project. Support for the replacement research reactor by the Council has waxed and waned over recent years. The Mayor of Sutherland Shire told the Committee:

> The Council at the moment is supporting the reactor, subject to the spent fuel issue being handled.[6]

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3 *EAR*, op. cit., p. 143.

4 ibid., p.146.

5 ibid.

6 Councillor Schreiber, *Transcript*, p. 321.

5.26 He also told the Committee:

> We get a lot of benefits in the Shire from people who work at ANSTO. It is the second largest employer within the Shire and a lot of benefits come back into the Shire with regard to jobs and security.[7]

Committee's Recommendation

5.27 **There is an urgent need for an agreement on the Community Right to Know Charter. Steps toward its development identified in the Environment Assessment Report should be undertaken as soon as possible to enable the public to be better informed about the further development of the project.**

7 ibid., 323.

6

Non-radiological environmental impacts

Site impacts

6.1 Construction of the replacement reactor is expected to take about three years. The Australian Nuclear Science and Technology Organisation (ANSTO) advised that the construction period is feasible but is considered to be relatively short for a facility with an operational life of at least 40 years.

6.2 Construction will directly affect an area of four hectares within the Lucas Heights Science and Technology Centre (LHSTC). ANSTO believes the overall environmental impact of the construction of the reactor facility will be relatively minor. Construction will result in direct, short-term, localised and small scale impacts to soils, air quality, flora and fauna, traffic and transport, infrastructure and services, noise and landscape.

6.3 The Environment Assessment Report (EAR) recommended that prior to the commencement of construction, a Construction Environmental Management Plan (EMP) must be prepared to the satisfaction of the Minister for the Environment and Heritage.[1] The EMP would need to address all commitments and undertakings made by ANSTO in the Draft Environmental Impact Statement (DEIS) and Supplementary Environmental Impact Statement (SEIS) for environmental management during construction. In general terms, these embrace the following broad categories:

- geology, soils and water;
- air quality;

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1 *EAR*, op. cit., pp. 197-98.

- other waste;
- flora and fauna;
- traffic and transport;
- infrastructure and services;
- social and economic impacts;
- land contamination;
- noise;
- visual and landscape;
- cultural heritage;
- decommissioning; and
- cumulative impacts of ecologically sustainable development.

6.4 In addition, the EAR recommended that an Erosion and Sedimentation Control Plan must be prepared as part of the EMP. Measures proposed to be implemented must be referred to the NSW Environment Protection Authority (EPA) and the NSW Department of Land and Water Conservation for comment prior to their adoption in the EMP. The Plan shall conform with the principles and objectives of the following NSW EPA handbooks:

- Managing Urban Stormwater: Treatment Techniques 1997;
- Managing Urban Stormwater: Soils and Construction 1998; and
- Managing Urban Stormwater: Source Control (draft release 1998). [2]

6.5 ANSTO advised that management initiatives will restrict any impact on surface and groundwater quality and on general waste management. A small area of soil contaminated with hydrocarbons would require on-site remediation.

6.6 The EAR made a number of recommendations in relation to groundwater, runoff and on-site remediation both during and after construction[3], namely that:

- monitoring of water quality must continue into the operational phase until sufficient data have been collected to indicate that the site, and stormwater run-off, has stabilised;

2 ibid., p. 197.

3 ibid., p. 199.

- a Stormwater Control Plan must be developed during the design stage to ensure that the site system is constructed to current best practice and in accordance with NSW EPA guidelines. The plan will also consider options for containment of one-off larger volume spills, such as fire fighting foams. The plan must be prepared to the satisfaction of the Department of the Environment and Heritage;
- a Remedial Action Plan must be developed, as part of the EMP, in accordance with NSW EPA guidelines for the treatment of hydrocarbon-impacted soil. Any requirements for off-site disposal of contaminated soils must be to the satisfaction of the NSW EPA[4];
- the EMP must include a comprehensive monitoring program to ensure that run-off and discharges from the construction site meet nutrient, sediment and other surface water quality criteria for protection of the environment. At least 12 months baseline data must be collected prior to construction works commencing. The program will include measures to be implemented should acceptability criteria be exceeded;
- a program of groundwater monitoring must commence at least twelve months prior to construction commencing. This program will be detailed in the EMP. Prior to construction commencing, an independent report reviewing the results of the program and requirements for further monitoring during construction and operation of the reactor must be prepared. This report must be submitted to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the Department of the Environment and Heritage for agreement[5]; and
- an Air Quality Management Plan must be prepared, as part of the EMP, in consultation with the NSW EPA and the NSW Department of Land and Water Conservation. A primary objective of the Plan will be to ensure that particulate levels at the nearest residence are below 50μg m^{-3} (PM10) during construction works.[6]

Construction impacts

Visual

6.7 Visual impacts associated with construction involve a temporary reduction in visual quality associated with vegetation clearance, night

4 *EAR*, op. cit., p. 198.

5 ibid.

6 ibid.

lighting, the presence of construction plant and machinery, and the addition of temporary workshops, fencing, and other human features. However, only a relatively small area of low-lying vegetation would be removed, and vegetation surrounding LHSTC would continue to screen the site and these activities from most of the viewing locations described previously.

6.8 ANSTO advised that motorists on New Illawarra Road and Heathcote Road may catch glimpses of construction activities, following vegetation clearance. A substantial amount of vegetation would remain between the construction site and the roads. Overall, ANSTO considers that the visual impacts of construction on neighbouring residential areas would be minimal.

6.9 Normal construction hours are likely to be 7.00 am to 6.00 pm Monday to Friday and 7.00 am to 1.00 pm Saturdays. However, construction activities may be required outside these hours on occasion. In these instances, night lighting may be erected to facilitate night time construction. Such works undertaken during night time hours would be for limited periods. Limited night lighting is currently used throughout LHSTC to illuminate carparks, walkways and emergency exits. Additional lighting would only be required at the site of the replacement reactor. Much of the night lighting would be shielded by existing structures and vegetation. Visual impacts of night lighting during construction would therefore be minor.

6.10 The main visual impact of the replacement reactor would be the addition of built structures. The reactor building and discharge stack would be visible to some Engadine residents. From most views, however, these features would represent only a minor addition to the existing appearance of the Centre.

6.11 ANSTO advised that a number of features of the site would reduce its visual impact, namely:

- the height and scale of the replacement reactor building and discharge stacks would be consistent with existing structures at LHSTC; and
- from areas north-east of the site, such as Barden Ridge, the facility would largely be screened by intervening buildings, leaving existing views essentially unchanged.

Noise

6.12 The overall construction period for the replacement reactor will be three years with noisiest activities, associated with bulk excavation, planned to be completed in four months. Depending on the method of construction adopted, a concrete batching plant may be installed on site for a period of

about three months. None of these noise-generating activities would be conducted outside of daytime hours.

6.13 ANSTO assured the Committee that construction of the replacement reactor would not involve blasting or pile driving. Air blast overpressures or groundborne vibrations resulting from these particular activities would not be generated during the construction period.

6.14 Other construction activities such as rock breaking and the use of heavy construction equipment would very likely cause some groundborne vibrations. These would be localised and temporary, and would have a negligible impact on HIFAR (approximately 200 metres to the east) or on people working within the Centre or residing nearby.

6.15 The remainder of the construction period would be dedicated to activities such as building fit-out, installation of hydraulic and mechanical services and other low-noise generating activities. Some of these activities may be undertaken outside of daytime hours.

6.16 ANSTO advised that noise during construction is unlikely be discernible at the nearest house. Management of construction noise levels will however, involve:

- minimising the period of bulk excavation works as much as practicable and ensuring that no noisy activity takes place outside of normal construction hours;
- siting noisy plant as far as possible from noise sensitive locations within the Lucas Heights Science and Technology Centre; and
- wherever possible, selecting quiet-running construction plant and equipment, and maintaining them regularly.

6.17 The EAR recommended that a Noise Management Control Plan must be prepared, as part of the EMP, with the objective of ensuring that noise impacts to the public are minimised. The Plan must be prepared to meet NSW EPA requirements. ANSTO has given an undertaken management measures will be incorporated into the EMP. The Committee believes they should be strictly adhered to.[7]

6.18 The replacement reactor will be located within a reactor building, which would also act to shield surrounding areas from noise. Noise from the replacement reactor would be less than from HIFAR because it and most of its support systems would be contained within the reactor building whereas at present only HIFAR itself is contained within a dome

7 *EAR*, op. cit., p. 198.

structure. It is expected that noise from operation of the replacement reactor would not be discernible.

Construction traffic

6.19 Traffic generated by construction of the replacement reactor will result in a minor increase in daily traffic movements on New Illawarra Road for the duration of the construction period of approximately three years.

6.20 The increase in traffic is anticipated to peak at approximately 110 additional traffic movements per day. These movements represent less than one per cent of existing total daily traffic movements on New Illawarra Road and accordingly would not generate a noticeable increase in traffic noise. According to ANSTO, heavy trucks are already a significant component of local traffic movements.

6.21 The EAR recommends that ANSTO must consult with the NSW Roads and Traffic Authority to determine if upgrading of the intersection between New Illawarra Road and the LHSTC entrance is needed, in particular extension of the southbound deceleration lane. Any works required will be completed prior to construction commencing and at ANSTO's expense.[8]

Heritage

6.22 An assessment of Aboriginal archaeology was undertaken in accordance with National Parks and Wildlife Service standards and guidelines. The site of the replacement reactor, a disturbed area of less than four hectares, was surveyed in parallel transects. A range of information sources were also consulted or reviewed, including discussions with local Aboriginal community representatives.

6.23 The following agencies were contacted:

- Australian Heritage Commission;
- National Council of Engineering Heritage (Institution of Engineers, Australia);
- The National Trust of Australia;
- NSW Heritage Office; and
- Sutherland Shire Council.

8 ibid., p. 198.

6.24 In addition, items of non-Aboriginal heritage were searched for during the Aboriginal archaeological field survey.

6.25 The site of the replacement reactor has been heavily disturbed, with evidence of vegetation clearing, some earthworks and some quarrying activities. The exception is a portion of land in the north-eastern sector that has been subject to earthworks and pipe laying activities, but is still vegetated.

6.26 Excavation of rock shelter sites at Bardens Creek and Mill Creek, north of the Centre, indicates that Aboriginal occupation in this area may have begun 2,000 to 3,000 years ago and lasted until 400 to 500 years ago.

6.27 Archaeological studies undertaken indicate that no Aboriginal relics, sites or potential sites were identified within the actual site of the replacement reactor. Four rock shelters with earth floors and the potential for archaeological deposits have been identified in the area of the buffer zone to the south and south-west of the site.

6.28 The closest potential archaeological deposit (PAD 1) is in a shelter approximately 30 metres south of the proposed fence line of the site, facing south over the Melinga Molong Gully. The shelter is 6.7 metres long, 3.5 metres deep and 2.4 metres high. The EAR recommends that appropriate works must be installed to protect the identified Aboriginal shelter site (PAD 1) from construction water run-off and sediment. Provision will be made in the EMP for liaison between the proposed ANSTO EMP Environmental Officer and the NSW National Parks and Wildlife Service concerning environmental management in the vicinity of the site, if required.[9]

6.29 The Committee was advised that as at 14 April 1998, no native title claims had been received by the National Native Title Tribunal covering either the site of the replacement reactor or the buffer zone.

6.30 No non-Aboriginal cultural or heritage items were identified within the site of the replacement reactor. The replacement reactor would also not affect the cultural heritage significance of the Holsworthy Military Area or Heathcote National Park.

6.31 ANSTO believes the replacement reactor facilities would not appreciably alter the high quality aesthetics of the landscape and visual character of the bushland surrounding LHSTC. The buildings will be accommodated at the periphery of an existing complex of buildings. Areas of undisturbed bushland within the 1.6 kilometre buffer zone also contribute to the quality of the natural environment and these areas of bushland will

9 ibid.

continue to be managed by ANSTO to retain the landscape and visual character.

6.32 The EAR recommended that ANSTO must review the Lucas Heights Buffer Zone Plan of Management (1986), in consultation with relevant stakeholders, to ensure measures required for the protection of the environment during the construction and operation of the proposed replacement reactor are implemented, and to ensure that the biological and conservation values of the buffer zone are maintained. The revised plan must be prepared to the satisfaction of the Department of the Environment and Heritage.[10]

Property values

6.33 ANSTO submitted that the effect of the project on land values was considered in a cost benefit analysis of a new research reactor, undertaken by Coopers Lybrand in 1993. This analysis concluded:

> It is not possible to identify a definitive impact, either positive or negative, on house prices in the suburbs surrounding the Lucas Heights Science and Technology Centre, nor is it possible to separate potential impacts arising from either the Lucas Heights Waste Management Centre or the existence of a reactor.[11]

6.34 ANSTO submitted that an analysis of properties in surrounding postcode area of 2232 (Kirrawee), 2233 (Engadine) and 2234 (Menai) undertaken using The Sydney Morning Herald, Thursday, 27 November 1997 revealed that since 1987, property prices in these surrounding postcodes experienced substantial growth rates of 18.0, 12.2, and 15.0 per cent respectively. According to ANSTO, over the last decade, property prices in these suburbs have all experienced a strong average annual growth rate of 8.8, 9.1 and 14.1 per cent. Over the past decade, of all areas in Sydney, the area of Menai consisting of Bangor, Barden Ridge and Menai—properties closest to Lucas Heights have, on average, experienced the highest growth rate in property values of surrounding areas.

Construction workforce

6.35 ANSTO estimated that during construction, the onsite workforce will vary from 40 to 100 with an expected peak employment of 150 for a 12 month period. In addition, it is estimated that off-site employment will range

10 ibid., p. 199.

11 ANSTO, *Transcript*, p. 73

between 20-50 and will involve fabrication. The multiplier effect is expected to lead to further job opportunities.

Staff

6.36 ANSTO do not expect the number of staff to increase when the replacement research reactor becomes operational in 2005. The number of visiting scientists is expected to double.

7

Australian industry and local planning

Australian industry

7.1 The tender documents will require Australian industry involvement in the project. Accordingly, the focus will be on involvement in areas where Australian industries maintain capabilities, or can develop new skills and expertise.

Short term Australian industry involvement

7.2 The Australian Nuclear Science and Technology Organisation (ANSTO) envisages that Australian involvement in the project will be of short term and long term duration. In the short term, Australian firms, acting in conjunction with the prime contractor, would be able to develop competencies in nuclear grade systems and equipment. It must be recognised, however, that there is no reactor technology within Australia which can be drawn upon. For this reason, Australian firms interested in taking part in the reactor construction would need to join with the vendors in order to maximise Australian involvement.

7.3 ANSTO is facilitating the establishment of linkages between Australian firms and potential vendor companies by employing a two-stage tender process. The first stage of this process involved the pre-qualification of tenderers. Australian firms are being given the opportunity to interact with the four pre-qualified vendors which have passed the pre-qualification phase to maximise their potential involvement.

7.4 ANSTO has informed the pre-qualified vendors of the Australian firms interested in taking part in the project. ANSTO has also provided contact details of the pre-qualified reactor vendors. The reactor vendors and

Australian industry will continue to be briefed by ANSTO to keep them informed and to keep them updated on the avenues available to them.

Continuing opportunities for Australian industry

7.5 ANSTO has identified a number of the longer-term opportunities for Australian involvement in the project. Upon completion, it is envisaged that ANSTO will operate and maintain the facility. It is anticipated that whilst operational and core maintenance activities will be undertaken by ANSTO staff, a need for a continuing Australian industry involvement will remain. ANSTO anticipates that the high level of involvement by Australian industry in the design and construction of the facility will ensure a high level of expertise within Australian industry to support the maintenance function. ANSTO expects that Australian industry will be in a prime position to deliver support services to the research reactor due to proximity and the quick response time they will be able to provide.

Instrumentation

7.6 ANSTO advised the Committee that the provision of world-class neutron scattering instruments to meet the requirements of the Australian scientific and industrial research communities will require the specialist skills of innovative high-technology companies in Australia. The program of instrument construction will occur in two main stages.

7.7 The first stage will be concurrent with the construction of the replacement research reactor, and the second will extend to a five-year period after the reactor is commissioned.

7.8 The extended construction program will encourage industry investment in the necessary specialist skills and capabilities. The construction of neutron scattering instruments for the replacement research reactor will offer a significant incentive to high-technology industries to develop and/or enhance specialist skills and form a solid basis for expansion into related areas of advanced scientific instrument design and development.

Employment

7.9 Over the past year, ANSTO has employed on average approximately 780 persons, of whom 2.5 per cent are employed on a part time basis. Approximately 50 per cent of ANSTO's employees reside in the Sutherland Shire. Another 15 per cent reside in the northern part of the Illawarra.

Employment—operational

7.10 As stated earlier in the Report, no change is expected to the number of personnel employed by ANSTO at the Lucas Heights Science and Technology Centre (LHSTC) when the replacement research reactor commences operation in 2005. The number of visiting scientists is expected to double.

Local planning

7.11 The LHSTC and the buffer zone are located in Sutherland Shire. Planning, at the local level, is controlled by the Council through statutory planning instruments. ANSTO maintained that construction of the replacement research reactor on land owned by ANSTO—the Commonwealth, would not be subject to local planning controls. The type of development which the Council believes to be appropriate is, however, indicated in local land use and environmental planning.

Sutherland Shire Local Environmental Plan, 1993

7.12 ANSTO advised the Committee that the relevant local planning instrument for the LHSTC is the Sutherland Local Environmental Plan 1993. The LHSTC is zoned 5(a)—Special Uses (Research and Technology) under the provisions of Sutherland Local Environmental Plan, 1993 as amended by Sutherland Local Environmental Plan No. 50.

7.13 The function of a 'Special Uses' zone is to provide for community services and facilities without adversely affecting residential areas. The term is generally applied to land set aside for community and Government uses.

7.14 The following zonings apply to the balance of the land within the buffer zone:

- Special Uses 5(f)—Waste Recycling—applies to part of the area of the Lucas Heights Waste Management Centre;
- Future Recreation 6(d)—applies to part of the area of the Lucas Heights Waste Management Centre east of Heathcote Road;
- Special Uses 5(a)—Military Uses—applies to the area of the Holsworthy Military Area west and south of Heathcote Road;
- Special Uses 5(c) - Arterial Road—applies to New Illawarra and Heathcote Roads;

- Environment Protection 7(a)—Waterways—applies to the Woronora River; and
- Environment Protection 7(b)—Bushland—applies to the remaining areas of the buffer zone.

7.15 The above zonings control the range of uses that may be permitted by Council, or in some cases identify uses that are prohibited.

7.16 ANSTO is exempt from application of State or Territory laws where those laws relate to the use of land, environmental consequences of the activities of ANSTO, radioactive materials and dangerous goods, or certain types of licensing.[1]

7.17 ANSTO advised the Committee that it is, however, committed to following NSW regulatory requirements where there is no Commonwealth legislation such as the *Clean Air Act 1961*, and *Clean Waters Act 1970* (and consequential subordinate legislation). This legislation covers discharge of airborne emissions and discharges of pollutants to waterways. ANSTO assured the Committee that it would continue to comply, as appropriate, with these and other relevant State statutory requirements during the construction and operation of the reactor.

Future land uses

7.18 In 1996, a mediation was conducted by the Office of Environmental Mediation and Inquiry about the future use of three areas of land at Lucas Heights currently owned or leased and occupied by Waste Service NSW. The mediation resulted in a decision to proceed with the following broad proposals on land situated either wholly or partly within the buffer zone or its immediate environs:

- to develop a sporting and recreational facility at the closed municipal waste disposal site, known as Lucas Heights No.1, situated approximately two kilometres north-east of the Centre;
- to extend the life of the Lucas Heights Waste Management Centre and incorporate an 'enclosed biowaste processing facility', an outdoor green waste facility, an outdoor green waste processing and composting operation, and to plan for its future use as a site for passive recreation; and

1 Pursuant to Section 7A of the *Australian Nuclear Science and Technology Organisation Act 1987*.

- to establish a conservation area north of the Waste Management Centre, on land previously earmarked for the West Menai urban release area.

7.19 Release of the land for recreational use is proposed to occur in six stages between 2000 and 2025. Most of the proposed recreational areas will first be overtopped with more waste and landscaped to suit the particular recreational use. Approval for these uses on that part of the land owned by ANSTO will rest with ANSTO and will take account of ANSTO's safety criteria.

7.20 The mediation had further consequences—in 1997, Sutherland Local Environmental Plan No. 50 was gazetted, amending the zonings previously applying under the 1993 plan to reflect the outcomes of the mediation.

Impacts on planning and future land uses

7.21 ANSTO advised the Committee that construction and operation of the replacement research reactor will not alter the current metropolitan, regional or local planning framework or directions set out in the various strategic planning documents. ANSTO assured the Committee that planning undertaken at these various levels has taken account of the operation of HIFAR. There is little evidence in any of the documents that metropolitan and regional planning is significantly influenced by HIFAR. ANSTO believes this situation is not expected to change as a consequence of proceeding with the replacement research reactor.

Urban development

7.22 ANSTO advised the Committee that by the time the replacement reactor is commissioned in 2005, a further 1,000 dwellings are expected to be built within the Urban Development Program areas at Menai.

7.23 The major growth in population expected in Sutherland Shire—approximately 11,000 additional dwellings by 2011, would occur in the older, established areas. With the deletion of West Menai from the Urban Development Program, no significant urban development opportunities exist at the fringe of the buffer zone. Nevertheless, ANSTO advised the Committee that some small-scale residential development in isolated locations within the Menai area could be expected and some of these may be located on land currently zoned for future urban development. As such sites are likely to continue to be developed at the same low densities currently existing in the surrounding areas, existing population densities would be maintained.

7.24 ANSTO anticipates that the replacement reactor would not affect the land use and development patterns that have emerged beyond the 1.6 kilometre buffer zone in the surrounding residential areas of Menai, Barden Ridge, North Engadine and Engadine.

Siting —impact on buffer zone

7.25 Siting the replacement research reactor immediately to the west of HIFAR will not require any adjustment to the existing buffer zone. Areas to the west are in the Holsworthy Military Area which is owned by the Commonwealth. ANSTO advised that a small parcel of land currently in the ownership of Waste Service NSW would potentially be affected. Based on current and proposed future land uses no land use restrictions would need to be applied to that land.

7.26 The range of activities presently conducted in the buffer zone would not vary as a consequence of the commissioning of the replacement reactor. Land use restrictions administered by ANSTO within the buffer zone would continue to apply. Land uses would continue to be restricted to commercial, research and technological uses associated with the LHSTC, low employment generating land uses such as the Waste Management Centre and associated facilities as well as a relatively narrow range of passive and structured recreational activities consistent with those already conducted within the zone.

8

Project management and cost

Project phases

8.1 The project will be completed in three phases:

- Phase 1—all activities required prior to the formal tendering process for the turnkey contract;
- Phase 2—the tendering process; and
- Phase 3—execution of the turnkey contract—the design, construction and commissioning.

Overall management

8.2 The Australian Nuclear Science and Technology Organisation (ANSTO) Board is responsible for the proper and efficient performance of the functions of the organisation and reports to the Minister for Industry, Science and Resources. The Executive Director of ANSTO has overall management responsibilities. For this project, the Executive Director will be the approving authority but it will be necessary for the Minister to authorise the commencement of the contract.

Management strategy

8.3 The ANSTO Board will have the technical and financial responsibility for the project. The Project Manager will be responsible for the prime carriage of the project for ANSTO and will provide progress reports to the Steering

Committee, composed of members of ANSTO senior management. The Steering Committee will report to the Executive Director.

8.4 The Steering Committee will be responsible for advising on and reviewing all activities in Phase 1 and 2. Consultants will be used for specific tasks related to environmental assessment, the reactor contract and specifications and fulfilling the project audit requirements, including the preparation of the risk management plan.

Government facilitation group

8.5 A committee, with representation from relevant and appropriate departments and agencies, has been established under the chairmanship of a senior officer from the Department of Industry, Science and Resources. This group is responsible for ensuring that departments and agencies are informed of progress in the project and have the opportunity to raise any emerging issues.

Project manager

8.6 An project manager has been engaged by ANSTO. The project manager is supported by a core project management team which will work in conjunction with the ANSTO functional organisation and other specialist contracted parties to effectively support the project throughout all phases.

Request for tender

8.7 ANSTO advised that it believes the preparation of the Request for Tender (RFT) documentation will provide a high degree of transparency for the tenderers in relation to their obligations under the prime contract. Details of the process are summarised as follows:

- Invitation to Tender;
- Summary of Requirements;
- Conditions of Tender;
- Tender Data Deliverables;
  - ⇒ General
  - ⇒ Business
  - ⇒ Engineering
  - ⇒ Integrated Logistics Support

- ⇒ Software Engineering and Integration
- ⇒ Test and Evaluation

- Draft Conditions of Contract;
  - ⇒ General Conditions
  - ⇒ Special Considerations
  - ⇒ Contract Data Deliverables

    Business

    Engineering

    Integrated Logistics Support

    Software Engineering and Integration

    Test and Evaluation

    General Requirements
  - ⇒ Statement of Work.

Project management plans

8.8 A Project Management Plan and sub-plans have been prepared and will be progressively reviewed and updated. The plans address the following items:

- Performance Management;
- Core Team Composition;
- Core Team Relationship with the functional ANSTO Organisation;
- Project Scheduling;
- Configuration Management and Data Control;
- Work Breakdown Structure;
- Cost Reporting;
- Cost Control and Variance Analysis;
- Project Resourcing; and
- Progress Meetings.

8.9 Further sub-plans will be added as the project moves through subsequent stages of its life cycle.

8.10 The Project Management Plan also addresses compliance with the following key Audit Functions, namely:

- Financial Audit;
- Performance / Efficiency Audit;
- Regulatory Audit;
- Quality Audit;
- Occupational Health and Safety Audit;
- Australian Tax Office Audit; and
- Emergency Plan Audit.

8.11 ANSTO's project management activities are being undertaken under close financial control and reporting by the Project Manager. ANSTO has developed a Project Work Breakdown Structure against which defined tasks, budget and schedule are monitored on a regular basis.

Preparation of tender specifications

8.12 The Committee sought to identify personnel responsible for preparing the tender specifications. The Committee was advised that:

> The specifications for the facility have been developed after consultation with the Australian community. From the point of view of the reactor specifications, they are quite clearly known; they are available in public documentation. The detailed specifications with regard to code, et cetera, which is the sort of thing which is being defined now as to exactly which code is required, is being done by people within ANSTO and with the use of external consultants from the UK and Sinclair Knight Mertz. So we have a team of people, including our own people, external overseas consultants and civil engineering groups in Australia who are developing those specifications.[1]

Reactor vendors

8.13 The Committee established that four reactor vendors have been selected following prequalification. ANSTO is working closely with the four vendors by issuing draft documentation to ensure comments are received for consideration before the final Request for Tender is issued.

1 ANSTO, *Transcript*, p. 143.

8.14 Tenders will be evaluated for compliance, using a two envelope system. The first part of the tender will be the technical and commercial offers, and the second part the financial offers. The latter will remain unopened.

8.15 A rigorous evaluation will take place for up to three weeks. This will be followed by a period of 56 days during which intense clarification sessions with each of the vendors will take place. At the end of February, it is planned to have agreement with each of the vendors in terms of technical and performance attributes of their specifications and of commercial conditions. At this point, the vendors will be asked to resubmit any repricing they consider necessary as a result of their interchanges with ANSTO. The Committee was advised that when repriced schedules are submitted, they will be in exactly the same form as the original schedules submitted in December. A further financial analysis and risk evaluation will be undertaken.

8.16 At the public hearing, ANSTO described the process thus far:

> ...The point we have reached at the moment is that we have four pre-qualified reactor vendors. We intend to issue the request for tender on 22 July. We are in the process of preparing the RFT documentation. We have issued draft RFT documentation for review and comment by the reactor vendors, seeking their views, which we have undertaken to review but not to incorporate to any extent if we do not feel that anything they have come back with should be incorporated[2].

8.17 ANSTO believes that the process will encourage the four reactor vendors to compete intensely against each other. The objective is to obtain the best technical offer with commercial compliance.

8.18 The tender evaluation and tender selection processes will be separate. The tender evaluation committee will provide iterative and final evaluation reports to the tender selection committee. The tender selection committee will comprise representatives from ANSTO, the Department of Finance and Administration and the Department of Industry Science and Resources.

Basis of selection

8.19 ANSTO advised the Committee that the objectives in the process of selecting the prime contractor are to:

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2 ANSTO, *Transcript*, p. 141.

- choose the most experienced and best resourced prime contractor capable of delivering the project outcomes with the minimum of technical, commercial, contractual and schedule risk;
- adopt a proven design tailored to meet ANSTO's requirements;
- choose a prime contractor with the proven ability to successfully manage the integration of all components of the project; and
- meet or reduce the project cost budget and the schedule objectives.

Collusive tendering

8.20 The Committee sought to establish mechanisms which will be applied to deter collusive tendering amongst the tenderers. It was told:

> There is intense competition. We have recently been in contact with each one of these reactor vendors. There is intense competition between the four reactor vendors. …[I]t is my view, having been through a number of large projects that they [the tenderers] are all working very hard to win, individually, this project. This is a prestige project for them. With the process that we are going through, using the two-envelope system, we are not considering price; we are leaving price aside and simple driving until we get to the point where we have four reactor vendors, four tenderers, who have offers that we consider—initially by our own evaluation and then in clarification with them—meet our requirements in terms of the technical and performance criteria...[3]

8.21 The Committee questioned ANSTO about the experience of Sinclair Mertz Knight to review the costing. ANSTO advised that Sinclair Mertz Knight are collaborating with AEA Technologies in the UK. This organisation has built reactors in the past and operates extensively in the nuclear arena.

Risk management

8.22 ANSTO's project management team will submit the prime contractor to a rigorous risk identification, assessment and mitigation program. The prime contractor will be required to develop a preliminary Risk Management Plan as a tender deliverable in order to demonstrate an acceptable approach in the development and maintenance of an effective risk management process in the contract. This plan will be further developed as a contract deliverable to be reviewed, actioned and updated

3 ibid., p. 143.

throughout the period of the contract, in relation to technical, commercial and schedule risk.

Independent auditor

8.23 The Committee sought to establish if the process will be monitored by an independent person to ensure compliance with agreed principles and processes. This, the Committee believes, would ensure that procedures followed are transparent and equitable. It would further ensure that opportunities would not be provided for unsuccessful tenderers to challenge the processes in the courts as was the case with The Australian Advanced Air Traffic System (TAAATS) project[4]. The project was delivered using the turnkey method of project delivery.

8.24 The Committee was assured that:

> ...it is basically a tender selection process which runs through the total process but importantly points to the fact that the Australian Government Solicitor will undertake audits of both the process and of the adherence to the process. We will also use the Australian National Audit Office to undertake performance audits through the whole process of getting to contract.[5]

8.25 Further confidence in the transparency of the process was expressed by ANSTO in the following terms:

> In summary, the process that we are using is thorough and rigorous. It has been planned in detail, is subject to external audit through all of the phases, that is, through the formal phase of the pre-qualification of the reactor vendors, the request for tender development, the tender evaluation and the pre-contract negotiations leading up to contract award. The external audit process include our own internal risk assessment which is being done externally—we are having somebody come in to externally audit our own operations...the Australian Government Solicitor will audit the process and the implementation of that process and the Australian National Audit Office will undertake a performance audit through the whole process.[6]

4 See Committee's Seventh Report of 1993, *Construction of Air Traffic Control Centres at Brisbane and Melbourne*, (Parliamentary Paper 264/1993)

5 ANSTO, *Transcript*, p. 140.

6 ibid, p. 141.

Prime contractor

8.26 The project will be undertaken on a lump-sum turnkey basis, with the prime contractor being responsible for the delivery of ANSTO's required performance outcomes. The contract will be specific in terms of the prime contractor's obligations to meet ANSTO's performance requirements within budget and schedule.

Contract payments

8.27 Contract payments will only be made for satisfactory performance against pre-determined contract events and milestones. The ANSTO project management team will work in close consultation with the prime contractor and, where necessary, with the regulator to ensure that the contract is progressed in accordance with the contract schedule.

Cost

ANSTO advice

8.28 ANSTO advised that the estimated cost of the project is $286.4 million in January 1997 Australian dollars. The capital cost of a replacement reactor was derived from a market survey of potential reactor vendors in 1992.

8.29 This base figure was then refined through discussion with a number of experts and adjusted to meet the specific requirements of the project and to accord with Department of Finance and Administration criteria. This resulted in the capital cost of $286.4 million in 1997 dollars.

8.30 This cost estimate includes the cost of the reactor facility, the neutron scattering instruments, interfacing with existing site services, transition costs and an allowance for contingencies. The methodology was verified and cost estimates were endorsed by the Department of Finance and Administration.

8.31 ANSTO advised the Committee that the cost estimate is compatible with the cost of construction of recent reactors (for example, in Egypt), with published information from vendors (for example, in Canada) and was confirmed as appropriate in discussions with potential vendors during 1998. The cost estimate is, therefore, believed to be the most realistic estimate obtainable prior to issue of a request for tender. About 50 per cent of the total cost is domestically derived.

Operating and maintenance costs

8.32 ANSTO advised that operating and maintenance costs would be approximately $12 million per year (1997 dollars). The Committee sought further information regarding the breakdown of this annual recurrent expenditure. ANSTO advised the Committee:

> The $12 million which we have identified covers all reactor operations and associated safety. It includes maintenance, and upgrading on a regular basis which minimises the need for one-off large expenditures. It covers waste management and it includes the cost of fresh fuel and the management of spent fuel—including shipping, reprocessing and return of intermediate level waste to Australia in qualified storage containers.[7]

Contract variations

8.33 For many years, the Committee has been conscious of the potential of contract variations to inflate project costs beyond initial estimates. For this reason, the Committee asked ANSTO if there was provision in the cost estimate for contract variations as distinct from rises and falls which may be associated with exchange rate variations and the building or consumer price indices. ANSTO assured the Committee that:

> There will not be variations afterwards.[8]

8.34 This was subsequently reaffirmed:

> The contract will detail what is to be delivered, and contract variations are not to be considered.[9]

8.35 The Committee also questioned ANSTO if it is obliged to choose the lowest tender from the competing bids. ANSTO advised that it would not necessarily accept the lowest tender—selection will be on the basis of the best tender which meets requirements. However, it would need to be consistent with available funds.

Cost—public concerns

8.36 A number of submissions from individuals and organisations expressed considerable unease about the validity of the cost estimate and sought to delay the project until more specific costs were available. It was asserted that a more realistic cost for the proposed work would be in the order of

7 ibid., p. 980.
8 ibid., p. 155.
9 ibid., p. 980.

$600 million. The Committee shares these concerns. Bearing in mind considerable unease in the community about cost over-runs, especially in relation to major Defence equipment acquisitions, the Committee sought categorical assurances from ANSTO that the basis of the costing is sound and that there would be no cost over-runs, apart from those legitimately associated with exchange rates and consumer price indices.

8.37 The Committee therefore asked ANSTO about measures which will be implemented to avoid the type of cost over-runs associated with the Collins Class submarine project. ANSTO told the Committee:

> I just contrast the ANZAC ship project with that of the Collins class submarine and leave it at that. We use proper processes. The processes we are going through in getting to the point where we get that commercial and technical view is extremely important, and we do not go any further until we get to that point.[10]

8.38 ANSTO advised the Committee:

> ...facilities have come on-line in Egypt in the last year. There is a reactor under construction in Thailand. There are two under construction in Canada and a third in final design. We know what those costs are. Some of those costings have been provided to us. We can, I think with reasonable confidence, say that for the kind of money we are talking about we will get the sort of facility with the sought of delivery that we expect. People talk about $600 million. They do not always understand. There is a facility being built in Germany at the moment where someone might say that the cost is about $500 million or $600 million, but the facility is building an awful lot of the infrastructure that already exists at the Lucas Heights site. They are not just building a reactor; they are building a hospital for patient care so they can do nuclear medicine things on site et cetera. That is included in those cost estimates. We do have a very good idea of what current facilities that have either been built or are under design and construction have been costed for.[11]

8.39 ANSTO reiterated these points at the final hearing in Canberra on 14 May in the following terms:

> The costs were based on estimates provided by a range of reactor vendors. Given that 50 per cent of the content—essentially civil

10 ibid., p. 155.

11 ibid., p. 148.

> engineering works—will be Australian, the appropriate Australian construction indices were used for the assessment of the cost of this component. The resulting estimates and the derivation of them were reviewed by a consortium with civil and nuclear expertise. The resulting projected costs align well with the published cost for recently completed facilities and those for which construction is imminent overseas.[12]

8.40 When questioned about the relevance or applicability of international comparisons, ANSTO advised the Committee:

> The Egyptian facility, without its irradiation rigs and without its beam facilities and without all of the goodies, was $US100-odd million. We know what the cost differential is for all of the rigs and beams and everything else that goes in. The Canadian neutron source, which is under detailed design, has about $90 million for what they call CANDU equipment in it. The estimate for that facility is $398 million and that facility has $98 million of special infrastructure that is associated for them to be able to test the CANDU reactors. These two comparisons show you that the costings are in line with international comparisons.[13]

Cost cap

8.41 The question of placing a cost cap on the project was considered by Liverpool City Council as potentially reducing the scope of the project. When questioned about this concern, Professor John White, representing the Australian Academy of Science, submitted:

> ...I think that it is a fair comment as a general comment, but that means that ANSTO has to be sure, and indeed kept on the track, of specifying what are the key things which are not negotiable. Of course safety is one of the key things which is not negotiable; but other performance factors are not negotiable too. So I think the way in which this committee finally recommends will probably have to touch on that sort of point.[14]

Cost of decommissioning

8.42 The Committee, as well as a number of organisations and individuals, pointed to the need to include the cost of decommissioning HIFAR.

12 ibid., p. 980.

13 ibid., p. 147.

14 Prof. White, *Transcript* , p. 428.

ANSTO advised that estimates of the cost of decommissioning HIFAR were undertaken and were based on a number of scenarios. The preferred scenario involves turning the reactor off and removing the fuel elements and the heavy water. The facility would then be placed on a care and maintenance basis for 30 years. This period is to allow the irradiation of metallic and other structures to decay. Under this scenario the net value of the likely cost would be extremely low.[15]

8.43 In a separate paper prepared by ANSTO to address questions raised in submissions, the Committee was advised that HIFAR would be decommissioned independently of the replacement research reactor project. Hence, the costing of the decommissioning of HIFAR has been identified as a separate project.

8.44 ANSTO confirmed that an options study for the decommissioning, an overall decommissioning plan and a comprehensive stage 1 decommissioning plan, which would include costs and time schedules, would need to be completed at least a year before HIFAR is shut down.

8.45 ANSTO advised the Committee that funds for the decommissioning will not be required until 2035.

> ...The money does not need to be expended until then. Security and those sorts of issues are covered by our existing security people...There is no additional expenditure that will be sought from Government until about 2035.[16]

Impact on national science budget

8.46 A number of organisations commented about the possible effect of the cost of funding construction on the Government's science budget. It was felt that were the proposal to proceed, it would be at the expense of other research and development funding. Friends of the Earth believe neutron science to be of non-critical importance and does not warrant the expenditure of $300 million. The funds would be better directed to other research and development projects. Furthermore, if neutron science were important, the requirement for neutrons could be better filled by spallation sources rather than by a reactor, it was claimed. This has already been addressed in Chapter 2 of the Report.

15 ANSTO, *Transcript*, p. 149.

16 ibid., p. 150.

Cost of additional facilities

8.47 A number of submissions suggested that the replacement research reactor would require additional funds to provide 'add ons' such as instrumentation. ANSTO advised that the suite of beam instruments to be installed was formulated in consultation with the Australian scientific and industrial research community and with selected input from overseas specialists. The cost of these facilities is consistent with similar facilities at overseas neutron sources. In addition, selected state of the art instruments from HIFAR will be directly transferred to the replacement research reactor. Importantly, the Committee notes the assurance from ANSTO that additional investment will be made as part of the project and is included in the costing.

Project Schedules

Schedules

8.48 ANSTO has adopted a three level planning approach for the conduct of its management activities:

- Level 1 Project Master Schedule (comprising Key Dates and Milestones);
- Level 2 Consolidated Schedule (comprising an integration of sub-programs);
- Level 3 Sub-Programs, including:
  - ⇒ Environmental Assessment
  - ⇒ Safety and Licensing
  - ⇒ Pre-qualification of Reactor Vendors
  - ⇒ Development and Issue of the Request for Tender
  - ⇒ Tender Evaluation and Prime Contractor Selection.

Milestone	Date
Government Decision	3 September 1997
Environmental Impact Statement Outcome	March 1999
Facility Licence – Site Authorisation by ARPANSA	April 1999
PWC Outcome	June 1999
Request for Tender Issued	July 1999
Tenders Close	December 1999
Tender Evaluation Completed	April 2000
Select Preferred Tenderer	May 2000
Pre-Contract Negotiations	May – July 2000
Contract Award	July 2000
Detailed Design including Systems Requirement Reviews and System Critical Design Reviews	July 2000 – May 2002
Construction Authorisation by ARPANSA including Preliminary Safety Analysis Report	April 2002
Construction Commencement	May 2002
Low Power Reactor Commissioning	March 2005
High Power Reactor Commissioning	June 2005
Operation Authorisation by ARPANSA including Final Safety Report	September 2005
Replacement Reactor Full Operations	December 2005
Permanent Shutdown of HIFAR	December 2005

Revenue

8.49 There are two types of revenue generated by ANSTO, direct revenue to ANSTO as a result of sales of products such as radioisotopes and services, and enhanced revenues accruing to industry as a result of the contributions made by ANSTO to their operations.

8.50 ANSTO advised there has been widespread diffusion of nuclear-related technology to the general scientific and industrial communities with significant benefits to the Australian economy. Most has required neutron-based analysis to develop the product or process. Without a replacement reactor, the diffusion process would be substantially slowed and the benefits limited.

8.51 Access Economics recently estimated some of these expected benefits. The study indicated that the current benefit from HIFAR is at least $50 million annually to the process industries. Investigating the impact of selected recent research projects in mining and other specified industries, Access Economics identified the greatest impact has been to the mining sector with an estimated annual gross economic benefit of a further $100 million or more. The identified impacts on industry sectors other than mining

from the selected research projects were each in the order of $25 million annually.

Committee's Conclusions

8.52 **The estimated cost is based on international precedents and national construction. There will be no scope for design variations during construction which could lead to cost increases.**

8.53 **A high level management structure will be established to oversight the project with representation from key departments—including the Department of Finance and Administration.**

Committee's Recommendations

8.54 **The Committee recommends provision of the reactor should not be at the expense of other Government science funding.**

8.55 **The Committee recommends the construction of a replacement research reactor at Lucas Heights at an estimated cost of $286.4 million at 1997 prices.**

Hon Judi Moylan MP
Chair

12 August 1999

Appendix A—Witnesses

Wednesday, 5 May 1999

CAMERON, Dr Ronald, Director, Safety Division, Australian Nuclear Science and Technology Organisation

CHIN, Mr Philip Andrew, Environmental Management Planner, Liverpool City Council

GARNETT, Professor Helen, Chief Executive, Australian Nuclear Science and Technology Organisation

HORLOCK, Mr Ken, Director, Nuclear Technology, Australian Nuclear Science and Technology Organisation

LOY, Dr John, Chief Executive Officer, Australian Radiation Protection and Nuclear Safety Agency

McNAB, Mr Don, Acting Director, Regulatory Branch, Australian Radiation Protection and Nuclear Safety Agency

PARSONS, Mr Norman Anthony (Private capacity)

PRICEMAN, Mr Michael, Convenor, Nuclear Study Group, Sutherland Shire Environment Centre

ROLLAND, Mr John, Director, Government and Public Affairs Division, Australian Nuclear Science and Technology Organisation

SCHREIBER, Councillor Kevin, Mayor, Sutherland Shire Council

SEABORNE, Mr Garry, Project Manager, Australian Nuclear Science and Technology Organisation

WHITE, Professor John, Secretary, Science Policy, Australian Academy of Science

Thursday, 6 May 1999

GREEN, Dr Jim (Private capacity)

HALLAM, Mr John Richard, Nuclear Campaigner, Friends of the Earth

HARDY, Dr Clarence, President, Australian Nuclear Association Inc.

JACKSON, Mr Erwin, Australian Project Coordinator, Greenpeace Australia

McSORLEY, Ms Jean Sarah, Adviser, Campaign for a Nuclear Free Future

RANKIN, Ms Genevieve, Convenor, People Against a Nuclear Reactor Inc.

SCHNELBÖGL, Mr Hans-Peter, Private Citizen

SWEENEY, Mr David, Uranium Campaigner, Australian Conservation Foundation

WILSON, Mrs Hazel, Private Citizen

Friday, 14 May 1999

CAMERON, Dr Ronald, Director, Safety Division, Australian Nuclear Science and Technology Organisation

GARNETT, Professor Helen, Chief Executive, Australian Nuclear Science and Technology Organisation

HORLOCK, Mr Ken, Director, Nuclear Technology, Australian Nuclear Science and Technology Organisation

SEABORNE, Mr Garry, Project Manager, Australian Nuclear Science and Technology Organisation

B

Appendix B—Submissions and Correspondence

Submissions

(in alphabetical order)—

Australian Academy of Science

Australian Academy of Technological Science and Engineering

Australian Conservation Foundation

Australian Industry Group

Australian Institute of Nuclear Science and Engineering

Australian Mineral Industries Research Association Limited

Australian Nuclear Association

Australian Nuclear Science and Technology Organisation (ANSTO)

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

Australian Research Council

Australian and New Zealand Society of Nuclear Medicine Inc.

Campaign for a Nuclear-Free Future

CSIRO

Department of Defence

Department of Foreign Affairs and Trade and Australian Safeguards and Non-Proliferation Office

Environment Centre NT Inc.

Mr J. R. Fredsall and Mr N. A. Parsons
Friends of the Earth, Sydney
Friends of the Earth, Southern Tablelands, NSW
Ms Joy Goodsell
Dr Jim Green
Greenpeace Australia, Sydney
Mr John Hill MP, Member for Kaurna, Parliament of South Australia
Mr Ian Hore-Laey
Mr Anthony Howe
Kupa Pitit Kungka Tjuta Aboriginal Corporation
Liverpool City Council
Lucas Heights Community School
Nuclear Engineering Panel, Institution of Engineers Australia, Sydney Division
Mr Martin Oliver
Mr Hans-Peter Schnelbögl
People Against a Nuclear Reactor
Professor J.W.V. Storey, School of Physics, University of New South Wales
Sutherland Shire Council
Sutherland Shire Environment Centre
Ms Danna Vale MP
Mrs Hazel Wilson OAM

Additional submissions/correspondence

(in alphabetical order)—

Zacharay Barclay
Kristy Barry
Nanda Biandara
Margaret Bradford
Sonja Bradford
S. Broady
Allan Dean
Tricia Flanagan
Catherine Franks
Edith Franks
Kevin Garland

Lily Gatt
Zeny Giles
Marion Giles
Ursula Heilman
Matt Heys
Katherine Holland
Annemarie Hopcroft
Tom Kingston
Hugh Maccallum
Geoff Marks
K. McPodden
Andrena McSweeney
Susan Morley
Owen Pascoe
Heather Paterson
Julie Power
M. Psaltis
Francine Roberts
Charles Saxton
Tom Sevil
Wallace J. Shelley
Eamon Suffolk
Joel Teasdale
Kim Tregoning
J. P. van der Zahn

C

Appendix C—Conclusion and recommendations—Environment Assessment Report

PROPOSED REPLACMENT NUCLEAR RESEARCH REACTOR AT LUCAS HEIGHTS

Department of Environment and Heritage

(Footnotes refer to Sections in the Environment Assessment Report)

CONCLUSION AND RECOMMENDATIONS

The Department considers that the requirements of the *Environment Protection (Impact of Proposals) Act 1974* have been met in regard to the proposal by ANSTO to construct and operate a replacement nuclear research reactor at the Lucas Heights Science and Technology Centre. In particular, environmental impacts of the proposal have been identified and examined as far as practicable.

The Department's assessment concludes that there are no environmental reasons, including on safety, health, hazard or risk grounds, to prevent construction of the proposed reactor at Lucas Heights. This conclusion is subject to implementation of the recommendations below. The sections in this report at which the recommendations have been made are given as footnotes for reference purposes.

ANSTO commitments and undertakings

1. The construction and operation of the proposed reactor at the Lucas Heights Science and Technology Centre (LHSTC) must be in accordance with the undertakings and commitments provided by the Australian Nuclear Science and Technology Organisation (ANSTO) in the Final Environmental Impact Statement *(Replacement Nuclear Research Reactor, 1997/98,* Volumes 1, 2 and 3), and as summarised in Appendix A to this report. If there is conflict between the ANSTO undertakings and the recommendations below, the recommendations will take precedence.

Construction environmental management plan

2. ANSTO must prepare a construction environmental management plan (EMP), to the satisfaction of the Minister for the Environment and Heritage, prior to construction commencing. The EMP will address all commitments and undertakings made by the proponent for environmental management during construction, and as summarised in Appendix A to this report. The following, associated recommendations must also be addressed:

   - an Erosion and Sedimentation Control Plan must be prepared as part of the EMP. Measures proposed to be implemented must be referred to the NSW Environment Protection Authority (EPA) and the NSW Department of Land and Water Conservation for comment prior to their adoption in the EMP. The Plan shall conform with the principles and objectives of the following NSW EPA handbooks:
     - ⇒ - Managing Urban Stormwater: Treatment Techniques *1997;*
     - ⇒ - Managing Urban Stormwater: Soils and Construction *1998;* and
     - ⇒ - Managing Urban Stormwater: Source Control (draft release *1998)*[2]
   - a Remedial Action Plan must be developed, as part of the EMP, in accordance with NSW EPA guidelines for the treatment of hydrocarbon-impacted soil. Any requirements for off-site disposal of contaminated soils must be to the satisfaction of the NSW EPA;[3]
   - an Air Quality Management Plan must be prepared, as part of the EMP, in consultation with the NSW EPA and the NSW Department of Land and Water Conservation. A primary objective of the Plan will be to ensure that particulate levels at the nearest residence are below 50 μg m^{-3} (PM10) during construction works;[4]
   - appropriate works must be installed to protect the identified Aboriginal shelter site (PAD 1) from construction water run-off and sediment. Provision will be made in the EMP for liaison between the proposed ANSTO ENT Environmental Officer and the NSW National Parks and Wildlife Service concerning environmental management in the vicinity of the site, if required;[5]
   - a Noise Management Control Plan must be prepared, as part of the EMP, with the objective of ensuring that noise impacts to the public are minimised. The Plan must be prepared to meet NSW EPA requirements;[6]

[2] Section 6.1
[3] Section 6.2
[4] Section 6.3
[5] Section 6.6
[6] Section 6.8

- the EMP must include a comprehensive monitoring program to ensure that run-off and discharges from the construction site meet nutrient, sediment and other surface water quality criteria for protection of the environment. At least 12 months baseline data must be collected prior to construction works commencing. The program will include measures to be implemented should acceptability criteria be exceeded;[7] and
- a program of groundwater monitoring must commence at least twelve months prior to construction commencing. This program will be detailed in the EMP. Prior to construction commencing, an independent report reviewing the results of the program and requirements for further monitoring during construction and operation of the reactor must be prepared (see also Recommendation 11 below). This report must be submitted to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the Department of the Environment and Heritage for agreement.[8]

Other construction issues

3. ANSTO must consult with the NSW Roads and Traffic Authority to determine if upgrading of the intersection between New Illawarra Road and the LHSTC entrance is needed, in particular extension of the southbound deceleration lane. Any works required will be completed prior to construction commencing and at ANSTO's expense.[9]

Operational impacts (non-radiological)

4. Monitoring of water quality must continue into the operational phase until sufficient data have been collected to indicate that the site, and stormwater run-off, has stabilised.[10]

5. A Stormwater Control Plan must be developed during the design stage to ensure that the site system is constructed to current best practice and in accordance with NSW EPA guidelines. The plan will also consider options for containment of one-off larger volume spills, such as fire fighting foams. The plan must be prepared to the satisfaction of the Department of the Environment and Heritage.[11]

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[7] Section 6.3
[8] Section 6.3
[9] Section 6.7
[10] Section 10.1
[11] Section 10.1

6. ANSTO must review the *Lucas Heights Buffer Zone Plan of Management* (1986), in consultation with relevant stakeholders, to ensure measures required for the protection of the environment during the construction and operation of the proposed replacement reactor are implemented, and to ensure that the biological and conservation values of the buffer zone are maintained. The revised plan must be prepared to the satisfaction of the Department of the Environment and Heritage.[12]

Site emissions and monitoring

7. Radioactive gaseous emissions discharged via stacks from buildings associated with radiopharmaceutical production (primarily Buildings 23 and 54) must not increase above existing levels regardless of any future production increases. This requirement should be recognised by ARPANSA as part of its licensing of emissions from radiopharmaceutical facilities at the LHSTC. The objective of this approach is to ensure implementation of existing and emergent technologies to further contain or reduce such emissions.[13]

8. ANSTO, in consultation with ARPANSA, should re-examine the issue of coordination and timing of processes which give rise to gaseous emissions from stacks with a view to minimising the impacts of radioactive gaseous discharges, to the extent practicable.[14]

9. A review of the method of molybdenum-99 production process must be undertaken by ANSTO, in consultation with ARPANSA, to investigate means whereby the isotope can be produced and isolated with decreased releases of subsidiary radioactive waste products. This should be completed to the satisfaction of ARPANSA.[15]

10. A high priority must be given to the review and licensing of radioactive waste discharges to sewer by ANSTO. As part of this, ANSTO should be required to undertake further assessment and analysis to ensure that all possible exposure pathways and future events at the Cronulla Sewage Treatment Plant are taken into account. Monitoring and assessment of individual discharges within the LHSTC is also desirable, to enable understanding of the various sources and their relative contributions. This assessment must be prepared to the satisfaction of ARPANSA and prior to reactor operations commencing.[16]

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[12] Section 6.5
[13] Section 7.4
[14] Section 7.4
[15] Section 7.4
[16] Section 7.5

11. As part of the groundwater monitoring program (see Recommendation 2 above), ANSTO or its contractors must establish bores at appropriate locations in the LHSTC and the buffer zone to ensure coverage of contaminants from the site overall and aquifer flows downstream of the proposed reactor. The locations and monitoring regimes must be agreed with ARPANSA.[17]

12. ANSTO must consult with ARPANSA with a view to establishing a radiological site characterisation, or 'footprint', for the reactor site and LHSTC / buffer zone in general. The objective of this characterisation is to provide a fundamental basis for ongoing radiological monitoring programs and the detection of radiological trends over time. The current radiological monitoring should be reviewed on the basis of the site characterisation. The characterisation and monitoring review must be completed prior to commissioning of the proposed reactor.[18]

Hazards and risks

13. The Preliminary Safety Analysis Report (PSAR), to be prepared at the detailed design stage, must be subject to independent peer review. to the satisfaction of ARPANSA.[19]

14. The assumptions used in deriving the Reference Accident effectively constitute design parameters for the proposed reactor and must be incorporated in the final design to the satisfaction of ARPANSA. In the event of changes, such that the Reference Accident examined may no longer be valid, agreement to any major design changes must be sought from the Minister for the Environment and Heritage prior to design finalisation.[20]

15. The PSAR must demonstrate that the design of reactor components (e.g. reactor pool, beam tube penetrations) effectively excludes the failure of these components for earthquakes of lower frequency than the design basis earthquake, to rule out a fast loss of coolant accident as a credible incident. This will need to be demonstrated to the satisfaction of ARPANSA.[21]

16. The consequences resulting from loss of off-site electricity for water supply and fire fighting purposes must be examined as part of the PSAR. If risks are significant, on-site power provisions for water pumps should be provided to the satisfaction of ARPANSA.[22]

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[17] Section 12.2
[18] Section 12.2
[19] Section 8.3
[20] Section 8.3
[21] Section 8.3
[22] Section 8.4

17. The safety implications of an inter-linked store for spent fuel elements must be assessed in detail in the PSAR, to the satisfaction of ARPANSA.[23]

18. The final design of the reactor should include a fixed and possibly automatic fire suppression system within the containment building, to the satisfaction of ARPANSA. The PSAR should also examine the need for a drencher system for the cooling towers.[24]

19. The risk of a common mode failure involving both HIFAR and the replacement reactor during the commissioning period, and resourcing requirements to ensure adequate infrastructure and staffing safety, must be addressed as part of the PSAR to the satisfaction of the ARPANSA. The results of the PSAR analysis should also be reflected in emergency plans.[25]

20. In the event of dual operation occurring for a longer period than six months, ANSTO must obtain separate approval and authorisation from ARPANSA. This authorisation should specify safety, infrastructure and occupational requirements to ensure that doses are minimised during any extended commissioning period.[26]

21. The Safety Analysis Report for the reactor must include provision for ongoing monitoring and audit of the frequency and severity of external events to ensure that assessed risks to the replacement reactor remain valid and acceptable, taking into account new developments in the vicinity of the reactor over time.[27]

Emergency management plan

22. Existing emergency plans and arrangements must be updated and subject to independent review at the detailed design stage and prior to the proposed reactor becoming operational. This must be completed to the satisfaction of ARPANSA. The independent review of the plans should include opportunities for input by relevant State emergency agencies and the general public.[28]

23. The emergency management plan must also include a specific plan aimed at facilitating community understanding of credible hazards and risks from the reactor, mitigation measures, emergency arrangements and implications for

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[23] Section 8.4
[24] Section 8.6
[25] Section 8.4
[26] Section 8.4
[27] Section 9.4
[28] Section 8.6

the community. The plan should consider the best combination of media to achieve the above objectives. The plan must be prepared to the satisfaction of the Minister for the Environment and Heritage, in consultation with the Minister for Industry, Science and Resources and the Minister for Health, prior to the reactor being commissioned.[29]

Community consultation

24. ANSTO must develop a specific program for ongoing community consultation and dissemination of information during the design, construction and commissioning phases of the reactor, to the satisfaction of the Minister for the Environment and Heritage.[30]

25. A high priority must be given by ANSTO to finalising a 'Community Right to Know Charter' between ANSTO and the community. This charter, as a minimum, must establish principles for information exchange, the obligations of parties in providing and using information, timely mechanisms for dispute resolution, and a process for periodic review and update. The use of a recognised mediator to facilitate completion of the charter should be considered. If a charter has not been agreed within 12 months of the date of these recommendations, the outstanding issues of dispute should be referred to the Minister for the Environment and Heritage for resolution, in consultation with the Minister for Industry, Science and Resources and the Minister for Heaith.[31]

Nuclear wastes

26. Reactor construction should not be authorised until arrangements for the management of spent fuel rods from the replacement reactor have been demonstrated to the satisfaction of ARPANSA and the Minister for the Environment and Heritage.[32]

27. The Industry, Science and Resources and Health Portfolios should give timely consideration to strategies for the long term and eventual permanent disposal of Australia's long-term intermediate-level nuclear wastes, and associated issues.[33]

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[29] Section 8.6
[30] Section 8.5
[31] Section 8.5
[32] Section 13.6
[33] Section 13.2.

ANSTO environmental management system

28. ANSTO must continue, as a high priority, to review and upgrade its environmental management systems (EMS) to achieve ISO 14000 standards. The EMS should be certified by a suitably accredited independent body and be in place prior to the replacement reactor being conunissioned.[34]

Compliance with commitments and recommendations

29. ANSTO must report to the Minister for the Environment and Heritage on measures taken, or to be taken, to implement the above recommendations, including the undertakings and commitments referred to at Recommendation 1. This is to be done by way of an initial written report to the Minister prior to construction commencing and thereafter at six monthly intervals until all recommendations have been addressed to the satisfaction of the Minister for the Environment and Heritage. These reports must be made publicly available by ANSTO, following their acceptance by the Minister.

Environment Assessment Branch

February 1999

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[34] Section 12.3

MEDIA RELEASE
SENATOR NICK MINCHIN

Minister for Industry Science and Resources

3 May 1999 99/109

Government advises ANSTO of environmental requirements for Replacement Research Reactor

The Minister for Industry, Science and Resources, Senator Nick Minchin, today announced he had accepted the Minister for the Environment's recommendations on the replacement nuclear research reactor at Lucas Heights.

"As Science Minister it is my responsibility to ensure that all recommendations relevant to my portfolio are taken into account. As such, I have written to the ANSTO Board's Chairman asking that ANSTO implement appropriate plans to give effect to the recommendations.

"The implementation of these recommendations will ensure the replacement reactor at Lucas Heights is built and operated in accordance with best international practice."

The recommendations cover the construction and operation of the replacement reactor, management of wastes, monitoring and containment of site emissions at Lucas Heights, management of hazards and risks, emergency management plans, and community consultation.

ANSTO must report on measures taken to implement the recommendations, starting prior to construction commencing and thereafter every six months, until all recommendations have been satisfactorily addressed.'

Like all large scale public works, the replacement reactor has been referred to the Parliamentary Public Works Committee. This Committee is currently considering the proposal for the replacement reactor and is expected to report by the end of June.

The Government announced on 3 September 1997 that it had decided to construct a replacement research reactor at Lucas Heights at an estimated cost of $286 million.

"The current HIFAR reactor provides support and significant benefits for a wide range of private and public sector activities in Australia; however it was built 41 years ago and is approaching the end of its service life.

"The replacement reactor will produce similar benefits to those produced by HIFAR, and contribute to scientific and technological advances across a wide range of disciplines, and provide radio isotope and radiation services for the benefit of the medical, industry, agricultural and resources sectors," Senator Minchin said.

The replacement reactor project is strongly supported by institutions and professional organisations such as the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, the Institution of Engineers (Australia), the Australian Medical Association and the two nuclear medicine societies, the Federation of Australian Scientific and Technological Societies and the Australian Institute of Nuclear Science and Engineering.

ANSTO's site unions, the Australian Manufacturing Workers Union, the Community Public Sector Union and the Australian Professional Engineers, Scientists and Managers Association, also strongly support the project. A spokesman for the joint unions recently told the Senate Economics Reference Committee inquiry into the replacement reactor:

'The union members at ANSTO have not altered their view that the replacement of the HIFAR reactor with a successor of modem design will be beneficial to Australia."

"I expect the request for tender will be issued later this year to the four vendors who were pre-qualified," Senator Minchin said. "The successful vendor should be announced around twelve months after this date and the replacement reactor should be commissioned by the end of 2005."

Legislation to establish the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) was passed last year and the new body is now operational. ARPANSA will be responsible for nuclear regulatory issues relating to the replacement reactor project.

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