CHAPTER TWO

HIFAR AND THE REPLACEMENT RESEARCH REACTOR PROJECT

2.1 Before turning specifically to the terms of reference, the Committee, in this chapter, traces briefly the history of the research reactor, HIFAR, at Lucas Heights. It sketches its life and the debate that has grown up around its work and its contribution to nuclear research, to Australian society and industry, and to the country's national interest. It looks at the early discussions given to replacing an ageing HIFAR with a more modern facility.

Research reactors

2.2 For more than half a century, research reactors have been important to the development of nuclear science and technology and have contributed to advances in a range of areas such as medicine and industry.

2.3 Close on 650 research reactors have been built to date, of which over 290 are now operating in 58 countries.[1] Altogether over 13,000 reactor-years of cumulative operational experience has been gained during this time. This compares with 8,000 years for power reactors.[2] According to ANSTO, no research reactor, as yet, has had an adverse impact on its community and it is not uncommon for them to be sited on university campuses or in residential areas.[3] In the US, there are 28 university research reactors at 26 universities in 21 states. It should be noted, however, that most university research reactors have a low power output of less than 2 megawatts.

2.4 The number of operating research reactors in industrialised countries peaked in 1975 and has been on the decrease since then. The number of operating reactors in developing countries, however, gradually increased to 1990 but now appears to have levelled off. The International Atomic Energy Agency (IAEA) maintains that this trend does not mean that new research reactors are unnecessary with nine now under construction and seven more planned. Currently, more research reactors are being

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1 Director General, International Atomic Energy Agency (IAEA), submission no. 136. The figures given in this report were taken from more recent information contained in IAEA's *Nuclear Technology Review*, update 2001.

2 See IAEA, International Symposium on Research Reactor Utilization, Safety and Management, Lisbon, 6–10 September 1999, http://www.iaea.org/worldatom/thisweek/preview/1999meet/infsm360.html (12 September 2000).

3 ANSTO, 'HIFAR Reaches 500th operating Program Landmark', News Release, 28 August 1998, http://www.ansto.gov.au/info/press/pr0898.html (17 August 2000); and ANSTO, *ANSTO Questions and Answers on Replacement Research Reactor*, July 2000.

planned, designed and built than at any time in the recent past, with most being of higher power (i.e. approximately 20 megawatts).[4]

2.5 Despite this recent activity in the planning for, and construction of, research reactors, over sixty per cent of those now in operation are 30 years or older and the concern about these ageing facilities is growing. Conditions such as corrosion, irradiation damage effects and reduced component reliability are identified as important areas requiring active in-service inspection programs. Apart from worries associated with the degradation of properties of the materials, there exist problems with outmoded equipment and lack of spare parts.[5] In addition many research reactors have large stocks of spent fuel which contain high enriched uranium. Some people voice serious concerns about the condition of such fuel and the significant safety problem it poses due particularly to corrosion and leakage.[6]

The High Flux Australian Reactor (HIFAR)

2.6 Australia's only nuclear research reactor, HIFAR, is one of the many research reactors operating throughout the world that belongs to this class of ageing reactors. Construction on this reactor commenced in 1956, it first achieved fission power in 1958 and began routine operation in 1960.[7] It is one of six DIDO-class reactors designed in the 1950s and represents the technology of that era.[8]

2.7 At that time in Australia, nuclear power was generally perceived as both safe and cost-effective and there was support for the nuclear weapons programs of the US and the UK. Some sections of the Australian population, including a number of leading scientists, advanced the idea of Australia developing its own nuclear weapons capability; they certainly wanted Australia to keep its options open on this issue. But the main driver in establishing the Atomic Energy Commission (AEC) seemed to have been, as reflected in the legislation, the production and sale of uranium and nuclear energy research.[9] It was envisaged that Australia would become a major producer of

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4 IAEA Annual Report for 1999, http://www.iaea.org/worldatom/Documents/Anrep/Anrep99/ (11 September 2000), p. 65; and Nuclear Engineering International, *World Nuclear Industry Handbook, 2000*, pp. 196–202. See also IAEA, *Nuclear Technology Review*, update 2001 which looks specifically at research reactors.

5 IAEA Annual Report for 1999, http://www.iaea.org/worldatom/Documents/Anrep/Anrep99/ (11 September 2000); N. N. Marinkovic, 'Impressions from the International Symposium on Research Reactor Utilization, Safety and Management', Lisbon, 6–10 September 1999; and International Atomic Energy Agency, 'International Symposium on Research Reactor Utilization, Safety and Management', Lisbon, 6-10 September 1999, http://www.iaea.org/worldatom/thisweek/preview/1999meet/infsm360.html (12 September 2000).

6 Mr Mohamed Elbaradei, Director General, International Atomic Energy Agency, submission no. 136.

7 Department of Industry, Science and Tourism, *Summary Report, A Level 1+ Probablistic Safety Assessment of the High Flux Australian Reactor*, Canberra, January 1998, p. 2.

8 ibid.

9 The functions and powers of the Commission as stipulated in the *Atomic Energy Act 1953*, place a clear emphasis on activities related to the exploration for, and the mining, treatment, use and sale of uranium and minerals associated with uranium. It was also to construct and operate plant and equipment for the liberation of atomic energy and to carry out research and investigations in connection with matters

uranium and also produce atomic power for industrial purposes.[10] In 1953, Mr Richard Casey, Minister for External Affairs, acknowledged the importance of establishing a single authority, the AEC, to control uranium in the Commonwealth but he also told the Parliament:

> We can now anticipate the orderly development of the sources of atomic energy in Australia. In the ordinary course of events it is probable that we shall not concern ourselves with the development of atomic weapons—at any rate for some appreciable time to come—but we should be most concerned with the development of atomic energy for commercial power.[11]

2.8 During the 1950s and 1960s, Australia retained this interest in developing a nuclear energy program and in 1969, the Government announced that Australia was to build its first nuclear power plant. It believed that nuclear power plants could be an important and economical supplement to Australia's other sources of power in the coming decades.[12] The 1970-71 Budget set aside $2.4 million for work on a power station at Jervis Bay.[13] In June 1970, tenders were called for a 500MW nuclear power station and preliminary work was started on preparing the site. The stated reasons for embarking on this project were to 'gain experience in all phases of tendering, construction and commissioning of a nuclear power station; to encourage the commencement of a nuclear industry in Australia; and as a result to be in a better position to be able to adopt fast breeder reactors when they become available.'[14] Enthusiasm for the project, however, soon waned, in part because of economic considerations, and the plan was eventually abandoned in the early 1970s.[15]

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associated with uranium or atomic energy. One of the stated purposes for undertaking such functions was to ensure the provision of uranium or atomic energy for the defence of the Commonwealth. The *Atomic Energy Act 1953*, assented to 15 April 1953.

10 See Second Reading Speech, Mr Beale, Minister for Supply, *Parliamentary Debates*, vol 221, House of Representatives, 19 March 1953, p. 1392.

11 See Mr Casey, Minister for External Affairs, *Parliamentary Debates*, vol 221, House of Representatives, 26 March 1953, p. 1677.

12 See for example, Senator Cotton for the Minister for National Development, Answer to question, *Senate Debates*, 1 October 1970, p. 1045. Dr Clarence Hardy, *Atomic Anniversary*, Australian Nuclear Association, 18 April 1998, p. 7.

13 *Senate Debates*, 18 August 1970, Budget 1970–71, p. 14.

14 Senator Cotton, answers to questions, *Senate Debates*, 25 August and 15 September 1970, pp. 168 and 537. See also answer to question, 1 October 1970, p. 1045.

15 See *Technology in Australia 1788–1988*, Chapter 11, p. 795 at http://www.austehc.unimelb.edu.au/tia/795.html (13 March 2001); 'Nuclear Energy Prospects in Australia', in *Nuclear Issues Briefing Paper 44*, October 2000; Jim Green, 'Australia's Nuclear History', Section of PhD thesis, Science and Technology Studies, University of Wollongong, Australia, http://www.Uow.edu.au/arts/sts/pgrad/phdthesis/JimGreen/history.html (13 March 2000); Wayne Reynolds, *Australia's Bid for the Atomic Bomb*, Melbourne University Press, 2000. 'Cabinet Deliberations on the Jervis Bay Nuclear Power Station in 1969' and 'Classic stoush the sub-text to nuclear plan', by Bruce Juddery, http://www.pcug.org.au/~mstret/personal/jervisbay.htm (13 March 2001).

2.9 The work undertaken at HIFAR during the last 40 years reflects the shift in attitudes to nuclear power and research. Thus, the focus of its activity, which was originally intended as a materials testing reactor for a nuclear power research program, has changed over time. It is now a multi-purpose research and isotope production reactor. It produces nuclear medicines and industrial isotopes, and is used to carry out research into new materials (such as advanced ceramics and polymers), to analyse samples for the mineral exploration industry and to irradiate silicon for the electronics industry.[16] Its nominal maximum thermal power output is 10 megawatts, compared with an average power plant's 3,000 megawatts. Its total fuel load is 7 kilograms, while a power reactor may hold up to 190 tonnes of fuel.[17]

Review of the Australian Atomic Energy Commission Research Establishment—1979

2.10 HIFAR was barely 20 years old when questions arose about its future and the possibility of replacing it with a new reactor. In 1979 the Minister for National Development requested that the National Energy Research, Development and Demonstration Council undertake a review of the Atomic Energy Commission. Evidence presented to this review advocated a new reactor on the grounds that it would be a valuable means of developing nuclear expertise and would provide an improved capacity to meet the increasing demand for isotope production especially for medical purposes. The review was advised that a new reactor could provide a neutron flux intensity perhaps twice that available from HIFAR at a reactor power of about 25 megawatts.[18]

2.11 The Review Committee, however, was not swayed by these arguments. It did not believe that the potential new avenues of research opened up by a modern reactor could justify the expenditure of up to $40 million. Instead, it concluded that HIFAR should be refurbished. It maintained that at a reasonable cost, a refurbishment program would allow HIFAR to operate safely and efficiently until 1990.[19]

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16 ANSTO, 'HIFAR Reaches 500th operating Program Landmark', News Release, 28 August 1998, http://www.ansto.gov.au/info/press/pr0898.html (17 August 2000).

17 ANSTO home page http://www.ansto. gov.au/natfac/hifar.html (17 August 2000); ANSTO, 'HIFAR Reaches 500th operating Program Landmark', News Release, 28 August 1998, http://www.ansto.gov.au/info/press/pr0898.html (17 August 2000) and ANSTO, *ANSTO Questions and Answers on Replacement Research Reactor*, July 2000.

18 The Report does not identify those who argued for a new reactor. The Council, however, received submissions from government departments, organisations which had special interests in the areas of atomic energy, such as the mining industry, electrical utility industry, professional institutions including universities, the Australian Academy of Science, the CSIRO, the National Energy Advisory Committee and the Uranium Advisory Council. Australian Atomic Energy Commission Research Establishment, *Review of Research Activities and Capacity and Proposals for the Future*, Report by the National Energy Research, Development and Demonstration Council, November 1979, Annex C–1.

19 Australian Atomic Energy Commission Research Establishment, *Review of Research Activities and Capacity and Proposals for the Future*, Report by the National Energy Research, Development and Demonstration Council, November 1979, Chapter 10, pp. 8–9.

Report by the Australian Science and Technology Council (ASTEC)—1985

2.12 In 1985, when HIFAR was 25 years old, questions were posed again about its future. At this time, the Australian Science and Technology Council (ASTEC) undertook a review of nuclear science and technology in Australia. It believed that Australia needed to maintain a nuclear reactor for research and the production of radioisotopes. It acknowledged HIFAR's role in scientific research in Australia and the benefits it brought to medicine, industry and environmental studies. [20]

2.13 In particular, the report acknowledged the central role that neutron scattering techniques, carried out at HIFAR, had in advanced research in materials science and concluded it was essential that a neutron beam facility be maintained in Australia. It found:

> Australia has already a small group of internationally recognised experts in this field. This core of expertise should be nurtured, not only because of the scientific excellence of the research, but also because of the potential economic advantages arising from industrial applications of neutron scattering technology.[21]

2.14 The Council stated further that HIFAR produced a range of isotopes for use in medical diagnosis, in industry and in applied research in many fields. It held that the domestic production of radioisotopes should continue and noted in particular the benefits Australian patients derived from the diagnostic techniques of nuclear medicine. It was convinced that a nuclear reactor could not be replaced by a cyclotron for radioisotope production.[22] It contended:

> The absence of a nuclear reactor in Australia would, therefore, preclude the local production of some important isotopes such as technetium-99m, the radioisotope of choice for the majority of medical diagnoses.[23]

2.15 Finally, it noted that the operation of the facility served to maintain a national knowledge of fission technology and supported Australia's eligibility for membership of the International Atomic Energy Agency (IAEA) Board of Governors. It recognised the desirability of Australia maintaining and enhancing its credentials for continued membership of the Board. It believed:

> An aspect of Australia's credentials for its designated seat on the Board, as well as Australia's influence in other international forums related to the

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20 Australian Science and Technology Council, *Nuclear Science and Technology in Australia,* A Report to the Prime Minister by the Australian Science and Technology Council (ASTEC), November 1985, p. 3.

21 ibid, p. 3.

22 ibid, p. 4.

23 ibid, p. 69.

> nuclear fuel cycle, could be weakened if Australia does not maintain and further develop its level of research and development in nuclear science.[24]

2.16 During its review, the Australian Science and Technology Council could find no evidence of deterioration of HIFAR likely to force its closure within the next two decades. It found that replacing HIFAR with a reactor which would produce an equivalent neutron flux was not feasible in the then Australian economic climate. It did suggest, however, that the future needs of scientists engaged in reactor-based applied areas must be taken into account. It concluded that a series of refurbishment programs carried out on HIFAR could ensure its safe and efficient operation into the mid-1990s but that consideration must be given to the future of HIFAR beyond that time.[25] The Council recommended that funds be made available:

> to maintain and upgrade HIFAR so that its continued safe operation can be guaranteed and improvements made to the neutron beam instrumentation; this will ensure a continued Australian capability in neutron beam research and application and radioisotope production.[26]

Legislation establishes the Australian Nuclear Science and Technology Organisation (ANSTO)

2.17 As noted earlier, the reactor's uses have changed over the years. Until the 1970s, fission reactor research was the largest and most important activity at Lucas Heights. Studies centred around the design and construction of nuclear reactor systems with some associated work in safety and regulatory aspects.[27] In the mid 1980s, the Government introduced legislation to reflect the shift in emphasis taking place in nuclear research in Australia. Senator Gareth Evans, then Minister for Resources and Energy, explained to the Senate:

> While moving away from nuclear fuel cycle activities, in line with the Government's policy, which is that Australia not become involved in any stages of the nuclear fuel cycle other than the mining and milling of Uranium and the disposal of waste, the Atomic Energy Commission has continued to apply its substantial expertise to research activities into the uses of radio-isotopes and radiation. However, the Commission's research program has been without firm legislative directions for the future. This new legislation will provide the direction needed to ensure Australia is able to

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24 Australian Science and Technology Council *Nuclear Science and Technology in Australia,* A Report to the Prime Minister by the Australian Science and Technology Council (ASTEC), November 1985, p. 64.

25 ibid, pp. 23, 69.

26 ibid, p. 4.

27 Australian Atomic Energy Commission Research Establishment, *Review of Research Activities and Capacity and Proposals for the Future*, Report by the National Energy Research, Development and Demonstration Council, November 1979, p. A–4.

> take full advantage of the many benefits…to be derived from the peaceful application of nuclear science and technology.[28]

2.18 Under the *Australian Nuclear Science and Technology Organisation Act 1987*, the Australian Nuclear Science and Technology Organisation (ANSTO) replaced the Australian Atomic Energy Commission. This meant that ANSTO became a body corporate and took over all the existing staff, liabilities and financial estimates of the Australian Atomic Energy Commission including HIFAR.

2.19 It now had the primary responsibility to undertake research and development in relation to nuclear science and nuclear technology, the production and use of radioisotopes, and the use of isotopic techniques and nuclear radiation for medicine, science, industry, commerce and agriculture.[29] Senator Evans told the Senate that the creation of ANSTO was more than a superficial change of name for the Australian Atomic Energy Commission. He stated:

> The Government recognises that nuclear technology, when applied to areas such as medicine, science, industry and agriculture, can make an important contribution to the social and economic well-being of Australia and accordingly these are the areas in which ANSTO will focus its activities. The Atomic Energy Commission has already made a major contribution to the development of nuclear medicine in Australia and currently supplies more than 50 hospitals with a wide range of radio-pharmaceuticals. The medical radio-isotopes supplied represent a total of about 100,000 patient doses per year.[30]

The Australian Science and Technology Council—1992

2.20 As each year passed and HIFAR increasingly began to show its age, despite refurbishment and upgrades, the case for further delay in determining its future weakened and the decision about a replacement reactor assumed greater priority.

2.21 In 1992, the Australian Science and Technology Council (ASTEC) identified HIFAR as one of seven major national facilities for likely development or replacement.[31] It stated:

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28 Second Reading Speech, Australian Nuclear Science and Technology Organisation Bill 1985; Australian Nuclear Science and Technology Organisation (Transition Provisions) Bill 1985; Atomic Energy Amendment Bill 1985, *Senate Debates*, 6 November 1986, p. 1618.

29 *Australian Nuclear Science and Technology Organisation Act 1987*, Part 11, section 5.

30 Second Reading Speech, Australian Nuclear Science and Technology Organisation Bill 1985; Australian Nuclear Science and Technology Organisation (Transition Provisions) Bill 1985; Atomic Energy Amendment Bill 1985, *Senate Debates*, 6 November 1986, p. 1618. See also Mr Barry Jones, House of Representatives, *Debates*, 19 February 1987, p. 406.

31 The Prime Minister commissioned ASTEC to conduct a study of major national research facilities, costing over $5 million each, which were likely to require Government decisions on their funding over the next ten years. Foreword, Australian Science and Technology Council, *Major National Research Facilities, A National Program*, A report to the Prime Minister by the Australian Science and Technology Council, March 1992, Canberra, pp. xiii, 22.

> A high flux Research Reactor, to replace HIFAR will maintain and further enhance Australia's position of leadership in the use of neutron beams for research into advanced materials (for the electronics and other high-technology industries), the production of radioisotopes for at least 300 000 medical procedures annually in Australian hospitals, the training of postgraduate students in advanced research techniques and the continuation of industrial-scale irradiation of silicon for marketing to the international electronics industry. The installation of a more powerful high-flux reactor will ensure continuation of Australia's influential position in the international nuclear community and ability to participate in nuclear non-proliferation initiatives and activities.[32]

2.22 The Committee notes, however, that the Council recommended that the future development of major national facilities in Australia should be recognised as a national program, be reviewed at four-yearly intervals and be closely linked with national priority in research and technology. The Council pointed out that it had not employed peer review, on-site visits and other steps necessary for a full evaluation of proposals and suggested that it would be essential for this to be carried out rigorously before final decisions were taken.[33]

The Research Reactor Review—1993 (the McKinnon Review)

2.23 A year later, in 1993, a review was conducted under the chairmanship of Professor Ken McKinnon to evaluate the benefits and costs of a new research reactor. It was to address the following terms of reference:

> 1. Whether, on review of the benefits and costs for scientific, commercial, industrial and national interest reasons, Australia has a need for a new nuclear research reactor.
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> 2. A review of the present reactor HIFAR, to include an assessment of the national and commercial benefits and costs of HIFAR operations,

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32 ibid, pp. 22–3. The seven major national research facilities were: the Australian Telescope Upgrade; a High-flux Research Reactor; the Marine Geoscience Research Vessel; the Mining Materials Research Facility; the Tropical Marine Research Network; the Very High-speed Research Data Network and the Synchrotron Research Facility. ASTEC also identified eight proposals of high merit which should be considered at the next review. On 30 April 1992, Senator Gareth Evans, representing the Minister for Science and Technology, drew attention to the ASTEC Report and the seven major national research facilities named in it. He noted ASTEC's recommendation that 'a further process of rigorous evaluation will be necessary before any decision can be made to proceed with any of these.' In particular he mentioned the High-flux Research Reactor. Ministerial Statement, *Senate Debates*, 30 April 1992, p. 1920. In 1995, the Government announced that seven Major National Research Facilities would be established including the upgrade of Australia's telescope and the Synchrotron Research Program. The High Flux Research Reactor was not among the seven named facilities. Senator Peter Cook, Minister for Industry, Science and Technology, News Release, 6 December 1995, http://www.dist.gov.au/events/innovative/body_r1.html (14 March 2001).

33 Australian Science and Technology Council, *Major National Research Facilities, A National Program*, A report to the Prime Minister by the Australian Science and Technology Council, March 1992, Canberra, pp. xi, 22.

its likely remaining useful life and its eventual closure and decommissioning.

3. If the finding on 1. above is that Australia has a need for a new nuclear research reactor, the Review will 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.

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.[34]

2.24 This Review found that although HIFAR may have been a leading research facility in its youth, it had not kept pace with advances in science and technology. HIFAR's neutron flux of 10^{14} neutrons per square centimetre per second at the neutron beam face at the edge of the reactor core may have been world class thirty years ago but by now was at the low end of the scale for reactors endeavouring to undertake advanced scientific programs.[35]

2.25 The Review identified the limitations placed on HIFAR by its 1950s design and instrumentation. For instance, the beams produced in HIFAR are radial rather than tangential so they do not easily filter out unwanted neutrons. They contain a mixture of fast, epithermal and thermal neutrons, and gamma rays, whose presence interferes with desirable beam characteristics and reduces the quality of the beam and the quality of the signal obtained by the detectors in the instruments.[36]

2.26 Because HIFAR has no 'cold' or 'hot' neutron source, its research capability is also limited. During the review, beam users argued strongly that 'cutting edge' research required the use of cold neutrons, making a cold source essential.[37]

2.27 Putting to one side HIFAR's struggle to keep at the forefront of advances in nuclear science and technology, the ageing reactor also presented safety considerations. In turning to the need to have a nuclear research facility able to meet safety standards and modern day research requirements, ANSTO pointed out that prudent reactor managers, 'while anxious to get the maximum life out of plants, would prefer to replace them while there is still a good safety margin'.

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34 K.R. McKinnon et al., *Future Reaction: Report of the Research Reactor Review*, August 1993, p. xii.

35 ibid, p. 29.

36 ibid, p. 30.

37 ibid, pp. 31, 38.

2.28 Although the Review accepted that HIFAR could not compete in design, neutron flux or instrumentation with modern reactors, it, nonetheless, found that there was not a pressing need to make a final decision on the fate of the reactor. It suggested that a technical Probabilistic Risk Assessment (PRA) was desirable to assess its remaining life potential. It stated:

> A better understanding of the potential to extend the life of HIFAR (so-called remaining life potential) and any associated costs would be enhanced by actual testing of components and by a probability risk assessment. (PRA)…a PRA would also assist in defining refurbishment needs and in providing reassurance about safety systems.[38]

2.29 The Review found that HIFAR's remaining life was likely to extend beyond a decade, but concluded that the time was approaching when a decision about its decommissioning would have to be made.[39]

2.30 In turning to emerging and developing technologies, the Review considered developments in science and technology that offered an attractive alternative to a nuclear reactor. At this time cyclotrons and spallation sources showed promise of being able to substitute for a nuclear reactor while avoiding the problems of waste created by such a reactor. The Review was clearly impressed by the potential of these alternative methods to produce isotopes and as a neutron source but decided that the uncertainty about existing and prospective developments was sufficient to make it prudent to delay any final decisions.

2.31 In assessing the scientific benefits to be derived from a new reactor, the Review found:

> A nuclear reactor devoted solely to research, or even a reactor with mixed scientific, production of isotopes, industrial irradiation and neutron activation analysis roles cannot be financially self-supporting.
>
> Unless a reactor, whether the current HIFAR reactor, or any prospective new one, is considered sufficiently important for scientific purposes and in the national interest, to justify continuing government financing for its capital and a majority of its running costs, it would not be viable.
>
> The scientific effort based on the current reactor cannot alone carry the case for a new reactor. At present, even allowing a reasonable value for the scientific effort and adding in commercial revenue possibilities, the case for a new reactor is left crucially dependent on the value attributed to the national interest.[40]

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38 K.R. McKinnon et al., *Future Reaction: Report of the Research Reactor Review*, August 1993, p. 32.

39 ibid, p. xiii.

40 ibid, p. xiii.

2.32 The problem of the accumulation of nuclear waste and finding a solution to its disposal was also considered. The Review stated:

> …if the waste management problem can be solved, in future a demonstrably outstanding national scientific capability and performance, in association with a high assessment of the benefit to the national interest, and combined with enhanced revenue possibilities, would justify a decision to build a new reactor.[41]

2.33 It added bluntly, however, that:

> it would be utterly wrong to decide on a new reactor before progress is made on identification of a high level waste repository site.[42]

2.34 The Review was disappointed that it could not reach a definite decision on Australia's need for a new research reactor. It stated:

> …despite its desire to present a decisive response to the Terms of Reference, the Review has been forced to the conclusion that an immediate yes or no decision is not the best policy option.[43]

2.35 The Review made the following recommendations:

- keep HIFAR going;
- commission a Probabilistic Risk Assessment to ascertain HIFAR's remaining life and refurbishment possibilities;[44]
- 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

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41 K.R. McKinnon et al., *Future Reaction: Report of the Research Reactor Review,* August 1993, p. xiii.

42 ibid, pp. xiii–xiv.

43 ibid, p. xiv.

44 An A Level 1+ Probabilistic Safety Assessment of the High Flux Australian Reactor was begun in 1996. The report was published in January 1998.

- 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.[45]

2.36 The Review identified a number of conditions that should exist at the end of five years that would make it appropriate to decide on a new reactor. These were:

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

- there is no evidence that spallation technology can economically offer as much as 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.[46]

2.37 The Review concluded that if these conditions were met and a positive decision made then 'the most suitable site would need to be identified'.

2.38 It noted, however, that:

> If any one of these onerous requirements is not met, either a negative decision, or a decision to delay further, would be indicated.[47]

2.39 The Committee notes that this Review was the most recent, independent and thorough examination of the various issues concerned with a new research reactor. It therefore considers that the McKinnon Review and its recommendations must be the starting point for any subsequent consideration of whether or not Australia needs a new reactor.

2.40 To this stage, the Committee believes that the Government and ANSTO have either chosen to ignore the McKinnon Review or only paid lip service to its findings and recommendations. Rather than taking a balanced approach to the Review, they have fixed on parts favourable to the decision to build a new reactor while disregarding other important findings and recommendations.

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45 K.R. McKinnon et al., *Future Reaction: Report of the Research Reactor Review*, August 1993, p. xiv.

46 ibid, p. xv.

47 ibid, p. xv.

2.41 In particular, the Committee draws attention to an important but neglected finding of the Review:

> In the light of developments, even though as indicated in the Report there are areas where studies are incomplete, it seems no longer appropriate that a second stage should follow immediately upon this Report. A different organisational framework would require a different approach to the next stages. The Review should now be wound up and if, at some later stage, a new reactor is envisaged, it should be assessed by a new panel possibly operating within the *Environmental Protection (Impact of Proposals) Act 1974.*[48]

2.42 The McKinnon Review also commented on the logistics and siting of any proposed new reactor. It stated:

> If a decision were to be made to construct a new reactor, it would not necessarily best be placed at Lucas Heights. An appropriate site would best be decided after exhaustive search, taking into account community views.
>
> Apart from Lucas Heights, for which there were both strong proponents and strong opponents, Kalgoorlie has advanced claims as a future site for a new reactor. Any siting decision should be based on criteria similar to those developed by the National Resources Information Centre with an additional range of economic and scientific criteria.[49]

Decision to replace HIFAR

2.43 Within five years of the McKinnon Review, the matter was again under review with attention clearly focused on HIFAR's age. In June 1997, the Executive Director of ANSTO, Professor Helen Garnett accepted that HIFAR was very close to its 'use by' date. She stated, 'unless something is done soon to either refurbish it or replace it, we'll run out of neutrons early next century'.[50]

2.44 Addressing specifically the safety issue, the Nuclear Safety Bureau (NSB) observed that HIFAR was designed before nuclear safety philosophy and standards were formalised. It stated:

> Modern safety standards reflect the accumulated experience of the nuclear industry over its fifty-year history. The NSB expects plant operating in the next century to reflect modern standards and practices. Although considerable upgrading of safety systems has been achieved throughout HIFAR's operating life, and the reactor is presently considered to be safe,

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48 K.R. McKinnon et al., *Future Reaction: Report of the Research Reactor Review,* August 1993, p. 4.

49 ibid, p. xxiv. The National Resources Information Centre was established in 1988 to expand and complement the existing facilities and expertise of the Bureau of Mineral Resources and Bureau of Rural Resources. See answer to question on notice, House of Representatives, *Hansard,* 23 November 1988, p. 3147.

50 Transcript, 'Lateline', 10 June 1997.

> there is a growing gap between the design of existing plant safety systems and current safety standards and expectations, due to the age of the plant and its design.

2.45 The Bureau concluded that 'the length of time and extent to which it would accept this current situation is finite'.[51] It believed that a significant refurbishment and upgrading program would be required in order to maintain satisfactory standards of safety if HIFAR were to operate for a significant period beyond 2003.[52]

2.46 The long running speculation about the fate of the near 40-year old HIFAR and the likelihood of a replacement research reactor was brought to a close with the announcement on 3 September 1997 of the Commonwealth Government's decision to construct and operate a new research reactor at Lucas Heights.[53]

2.47 **The Committee notes that this decision was taken six years after the ASTEC report on major national facilities and five years after the McKinnon Review and without heeding their advice for further investigation. In other words, since 1992, there has been no comprehensive and independent study to establish funding priorities for Australia's major national scientific facilities and no full and thorough public inquiry into the need for a new reactor or the most suitable location for such a facility.**

2.48 The announcement regarding the proposed research reactor sparked public debate. Some from the scientific community welcomed the news. The Australian Academy of Science endorsed the Government's intention to build a new research reactor arguing that such a facility was 'essential for developing national capacities in nuclear medicine and materials technology as well as for maintaining a number of critical research competencies'.[54]

2.49 There were others, however, who fiercely opposed the proposal. The Australian Conservation Foundation (ACF), for example, denounced the decision as 'pre-emptive, unnecessary and ill-advised'.[55] The Mayor of Sutherland Shire, Councillor Kevin Schreiber, told reporters that local residents were outraged by the Government's plan. He maintained that the decision had been made without any community consultation and with no solution yet found for the highly radioactive waste that exists on the Lucas Heights site and waste yet to be produced.[56] Another member of the Council, Councillor Genevieve Rankin stated:

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51 Report Prepared by the Australian Nuclear Safety Bureau, *Convention on Nuclear Safety: Australian National Report,* Commonwealth of Australia, n.d., p. 5.

52 ibid, p. 5.

53 ANSTO, Application for a Facility Licence, Site Authorisation for the ANSTO Replacement Research Reactor Facility, April 1999.

54 Australian Academy of Science, Media Release, 'Research Reactor a Must', 4 September 1997.

55 Australian Conservation Foundation, Media Release, 3 September 1997.

56 *Engadine District News,* 9 September 1997, p. 3 and *Sydney Morning Herald,* 4 September 1997, p. 4.

> The decision to build another nuclear reactor has been approved by Federal Cabinet behind closed doors, with no input from the Australian community and no consultation with local people.[57]

2.50 The Committee believes that the failure by the Government to hold a full public inquiry on the need for a new reactor as recommended by the McKinnon Review prior to making the decision for the facility has meant that the various issues identified in that detailed and intensive review have never been adequately and independently assessed.

The Replacement Research Reactor Project

The scope of the project

2.51 The project for replacing HIFAR with a new reactor consists of the design, construction and commissioning of a replacement research facility. It is to be a multi-purpose pool reactor using low enriched uranium fuel. It will have neutron beam and irradiation facilities for isotope production and silicon and other irradiations.

2.52 The replacement reactor is to be located on Commonwealth-owned land within the Lucas Heights Science and Technology Centre (LHSTC). This centre is situated in the local government area of Sutherland Shire, approximately 30 kilometres south-west of Sydney's central business district. It is to be built on a site adjacent to the current reactor and will use existing infrastructure at the LHSTC to support its operation.[58] HIFAR is to be shut down six months after its replacement is commissioned.[59] A 1.6 kilometre buffer zone, within which there is no residential development, currently exists around the present reactor. This buffer zone is to remain.[60]

2.53 A containment building that will also include the primary cooling circuit and most of the auxiliary plant will house the reactor. The reactor pool is to be about six metres deep and of thick-walled reinforced concrete construction. The reactor core will sit towards the bottom of the pool. A service pool, contiguous with the reactor

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57 *Sydney Morning Herald*, 8 September 1997, p. 15.

58 Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 5.

59 INVAP Website 'Prequalification in the ANSTO Replacement Research Reactor', December 1998, http://www.invap.community.ar/pre-ansto.html (31 August 2000); ANSTO, News Release, 3 May 1999; Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 4.

60 Overview of the Proposed Replacement Nuclear Research Reactor, http://www.ansto.gov.au.ansto/RRR/eis_overview.html (18 August 2000); and Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 4; Senator the Hon. Robert Hill, Media Release, 30 March 1999.

pool, will handle irradiated materials and provide for the interim storage of spent fuel.[61]

2.54 The new reactor is to have a power rating of 20 megawatts and will produce a maximum neutron flux more than four times greater than the existing reactor. ANSTO claims that this will enable research into new nuclear medicines, and new materials such as plastics, polymers, lightweight substances and those important to nano-technology.[62]

2.55 The detailed design and engineering specifications for the reactor will not be known until the final design is well underway.[63]

2.56 ANSTO proposes to commence construction work in 2002, with the reactor to be operational in 2005. A major step forward for this project was taken on 22 September 1999, when ANSTO was granted a licence from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to prepare the site for the replacement reactor at Lucas Heights. This stage involves those activities needed to bring the site into a state of readiness so that construction of the proposed reactor might commence. Activities include the necessary clearing and grading of the site and preparing access roads, fencing and erecting support buildings. ANSTO will need to obtain a separate licence from ARPANSA before it can proceed to the next stage of the project to construct the replacement reactor.[64]

Inquiries into the Government's decision to build a new research reactor

2.57 Since the Government announced its decision to build the new research reactor, there have been two parliamentary inquiries into the proposal. On 2 October 1997, the Senate referred to the Senate Economics References Committee for examination and report the matter of whether a new reactor should be built to replace HIFAR at Lucas Heights or elsewhere in Australia. In its inquiry the Committee was to make particular reference to:

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61 Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 5.

62 Overview of the Proposed Replacement Nuclear Research Reactor, http://www.ansto.gov.au.ansto/RRR/eis_overview.html (18 August 2000); ANSTO, News Release, 30 March 1999, 'Contract Signed for Australia's History-Making Replacement Research Reactor'; INVAP Homepage, http://2000.51.6.19/press/0713firma-ansto-e.htm (17 August 2000); ANSTO, Media Release, 13 July 2000.

63 Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 7.

64 Environment Australia, *Environment Assessment Report: Proposed Replacement Nuclear Research Reactor at Lucas Heights*, February 1999, (printed March 1999), p. 5; and Facility Licence, 22 September 1999; ARPANSA, 'Issue of a Licence to the Australian Nuclear Science and Technology Organisation to Prepare a Site for a Replacement Research Reactor Facility', Statement by the CEO of ARPANSA, 22 September 1999.

(a) the suitability of building a new reactor in a densely populated suburban area of Sydney and the impact on the environment of the Sutherland Shire community of a new reactor on the Lucas Heights site;

(b) the availability of alternative technologies to generate neutrons for medical, scientific, mining, industrial and other uses;

(c) the safety, cost, viability and effectiveness of alternative technologies such as cyclotrons and spallation sources compared with the long-term commissioning, operation and decommissioning of a new reactor; and

(d) whether the issues raised by the 1993 Research Reactor Review have been satisfactorily addressed in the context of the decision to proceed with a new reactor at Lucas Heights.[65]

2.58 The majority report of the Senate Economics References Committee, which was tabled in September 1999, was not fully convinced that a thorough and proper investigation of the need for a new reactor had taken place. It found that the issues raised by the McKinnon Review had not been satisfactorily addressed. It proposed, among other things, that a full public inquiry, similar to and recommended by the McKinnon Review in 1993, be conducted into the Government's decision. This inquiry would consider matters such as a solution to the final disposal of nuclear waste from Lucas Heights, alternative sites to Lucas Heights, and the benefits of spending on other scientific and medical areas of research rather than the reactor.[66]

2.59 On 17 February 1999, the House of Representatives referred to the Parliamentary Standing Committee on Public Works for consideration and report the proposal for a replacement reactor. [67]

2.60 In brief, the Public Works Committee found that HIFAR was obsolete and would need to be permanently decommissioned. It believed that the new reactor would meet national interest considerations, research and development requirements and the need to sustain the local production of radioisotopes.

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65 Terms of Reference, Senate Economics References Committee, *A New Reactor at Lucas Heights,* September 1999, p. v.

66 Senate Economics References Committee, *A New Reactor at Lucas Heights,* September 1999, pp. xvii–xx.

67 Parliamentary Standing Committee on Public Works, *Proposed Replacement Nuclear Research Reactor, Lucas Heights, NSW,* 12 August 1999. The Parliamentary Standing Committee on Public Works is established under the *Public Works Committee Act 1969*. Under the Act, a public work, the estimated cost of which exceeds $6,000,000, shall not be commenced unless it has been referred to the Committee and before a report of the Committee concerning the work has been presented to both Houses of the Parliament. There are a number of exemptions to this general provision. The Committee in considering and reporting on the work shall have regard to matters such as the stated purpose of the work and its suitability for that purpose; the necessity for, or the advisability of, carrying out the work; the most effective use that can be made, in the carrying out of the work, of the moneys to be expended on the work; and the present and prospective public value of the work. See *Public Works Committee Act, 1969,* Clauses 17(3), 18(8).

2.61 The Government disagreed with the findings of the Senate Economics References Committee's majority report and proceeded with plans to construct the new reactor by putting in train a tendering process. On 6 June 2000, the Government announced that an Argentinian company, INVAP S.E., had been chosen as the successful tenderer for the replacement reactor at Lucas Heights.[68]

2.62 ANSTO was to begin pre-contract negotiations with INVAP to be followed by detailed design and site works.[69] This announcement added fuel to the public debate about the need for a new reactor and the Government's nuclear waste management strategy. A number of community groups and individuals rejected the arguments about the benefits derived from a nuclear research reactor and they cast doubt on the credentials of the successful tenderer.

2.63 Against this background of on-going controversy which had been heightened by the awarding of the contract to INVAP, the Senate resolved to establish this Select Committee of Inquiry.

2.64 The Committee appreciates that this inquiry traverses well-worked ground in re-examining the case for a new reactor. Although it considers evidence taken by the Senate Economics References Committee and the Parliamentary Standing Committee on Public Works, it takes careful note of new evidence brought before it.

2.65 As explained in the previous chapter, this report follows closely the terms of reference and is divided into three broad parts, dealing with the need for a new reactor; the tendering process and the contract; and nuclear waste disposal and public health and safety.

68 'Replacement Research Reactor', ANSTO homepage, http://www.ansto.gov.au/info.cnrr000.html (18 August 2000).

69 Senator Nick Minchin, Minister for Industry, Science and Resources, Media Release, 6 June 2000.