The Replacement Research Reactor

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Summary : As a consequences of the government decision in September 1997, ANSTO established a replacement research reactor project to manage the procurement of the replacement reactor through the necessary approval, tendering and contract management stages. This paper provides an update of the status of the project including the completion of the Environmental Impact Statement, Prequalification and Public Works Committee processes. The aims of the project, management organisation, reactor type and expected capabilities are also described.

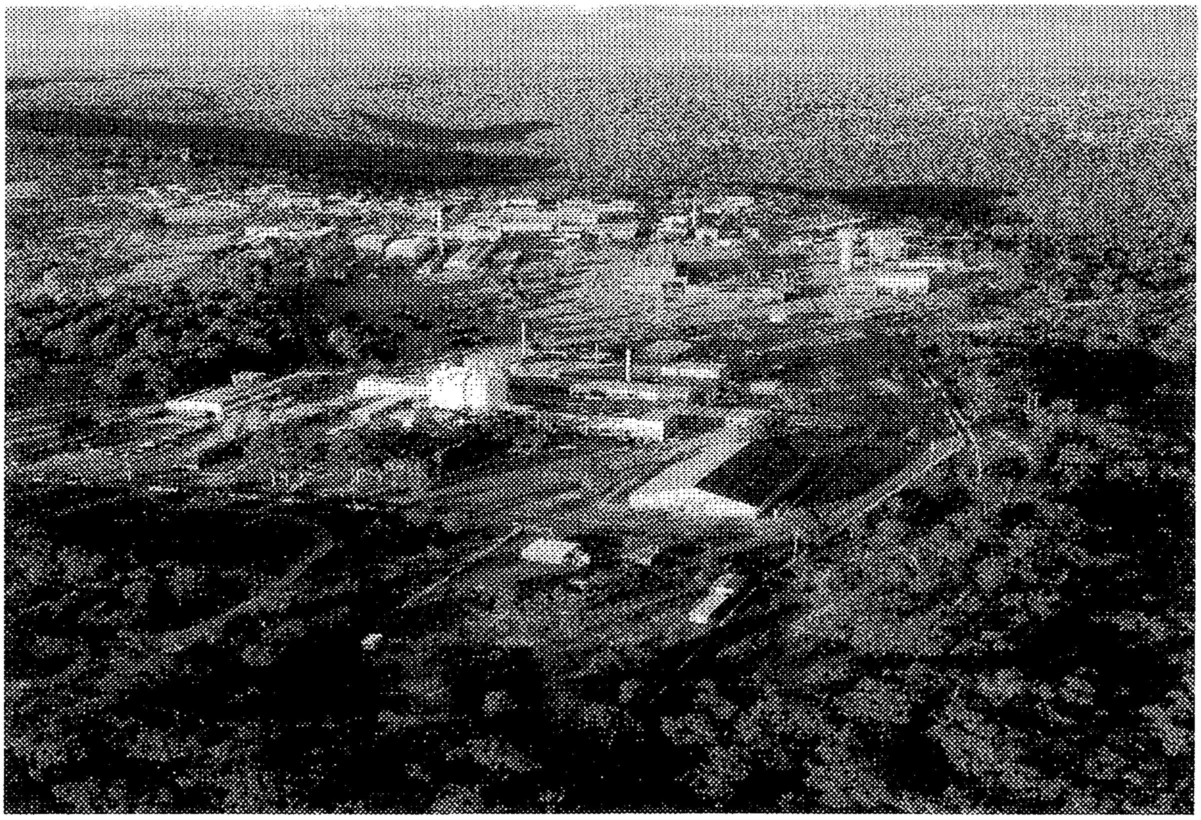
1. INTRODUCTION

On 3 September 1997 the then Minister for Science and Technology announced the proposal to fund ANSTO to construct a replacement research reactor at Lucas Heights. This reactor is to replace the 40 year old, technologically obsolete HIFAR which is expected to reach the end of its operational life around 2005. The Minister stated that the proposal will meet the strictest international nuclear safety standards and its construction would be subject to a stringent environmental assessment process under the Environment Protection (Impact of Proposals) Act 1974, which will be open to public comment (McGauran, Hon. P. 1997 (1)). At the same time, the government announced the intention to establish the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and to provide funding for removing spent fuel from Lucas Heights for reprocessing overseas.

The purpose of the replacement research reactor is to replace the technologically obsolete HIFAR and to provide the Australian medical and science community and industry with access to a modern, multi-purpose reactor with the performance and facilities necessary to maintain and enhance Australia's nuclear science and technology capabilities across the range of defined needs. The specific objectives of the proposal are to:

- maintain and enhance health care benefits provided to the community and ensure security of supply through the local production of the quantities and the known likely range of diagnostic and therapeutic radiopharmaceuticals needed to satisfy Australia's requirements over the next 40 to 50 years;
- maintain 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;
- provide a neutron beam research facility which would not only meet Australia's own scientific and industrial research needs, but would also be a regional centre of excellence. Research undertaken using this facility will have broad applications to investigations in a wide spectrum of scientific and industrial fields, including the life sciences and medicine, environmental science, chemistry, materials science and engineering science;
- provide research and research training facilities and programs to enhance the educational opportunities available to Australian scientists and engineers;
- provide 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; and
- achieve the construction and operation of the facility in a manner that meets all health, safety, environmental and quality standards. This includes meeting community expectations as well as all legal and regulatory requirements and applicable standards.

To meet these objectives it is proposed to construct and operate a replacement research reactor at the Lucas Heights Science and Technology Centre site in Lucas Heights, located 30 kilometres south-west of Sydney's central business district. The replacement reactor would be located near the existing HIFAR as shown on Figure 1.



To achieve these objectives. ANSTO established the Replacement Research Reactor Project (RRRP) to manage the procurement process. to liaise with users of the facility and to oversee the required approval stages. The project was split into three phases.

2. PHASE 1

Phase 1 is the approvals stage. including the EIS development. the site licence application. the Public Works Committee process. the prequalification of reactor vendors and the development of the tender documents.

2.1 The EIS

The Draft EIS was produced and submitted to Environment Australia on 18 August 1998. There followed a 12 week public exhibition period. during which EA commissioned three independent reviews of the EIS from the IAEA. CH2M Hill and Parkman of the UK. Major conclusions of the technical reviews include:

"*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.*" (International Atomic Energy Agency 1998 (2))

"*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.*" (Parkman Safety Management 1998 (3))

"*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.*" (CH2M HILL 1998 (4))

Nine hundred and thirty-five submissions were received by Environment Australia during and immediately following the 12-week Draft EIS exhibition period. Of these. some 776 submissions were pro-forma submissions. A further 50 submissions were either pro-forma based or repeated issues contained in pro-formas. Substantive submissions included technical submissions from Sutherland Shire Council. from Greenpeace Australia. from the three Peer Review Consultants and from the NSW Government (via the Department of Urban Affairs and Planning). *Figure 2* shows submissions by area and type.

A Supplement to the Draft EIS was produced, taking into account all submissions, and lodged with Environment Australia in January 1999. Environment Australia evaluated the EIS and the Minister for Environment and Heritage gave approval in April 1999 with 29 recommendations, which were accepted by the Minister for Industry, Science and Resources.

2.2 Site Licence Application

Before any work can commence on the site, it is necessary to obtain a Facility Licence, Site Authorisation from the CEO of the Australian Radiation Protection and Nuclear Safety Agency. This licence application was based on a detailed characterisation of the features of the proposed site and an evaluation of a reference accident, as a bounding case to all credible accidents with a pool type reactor. The application was submitted in April 1999 and a response is expected shortly.

2.3 Parliamentary Public Works Committee

All major government funded capital programs are required to gain the approval of the Public Works Committee (PWC). The ANSTO project was referred to the PWC in February and public hearings were held in May. The report from the PWC was tabled in parliament in late August (5). The report concluded that, *"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"*. On that basis, "The Committee recommends the construction of a replacement research reactor at Lucas Heights at an estimated cost of $286.4 million at 1997 prices".

2.4 Prequalification

As part of the tendering process, a prequalification of reactor vendors took place in 1998. This was designed to prequalify experienced reactor vendors with capabilities in delivering an integrated pool type reactor facility. As a result of this process, four reactor vendors were prequalified. These were:

- AECL from Canada
- INVAP from Argentina
- Siemens from Germany
- Technicatome from France.

These companies will take part in the main tendering stage.

2.5 Tender Documentation

The specification of the requirements for the replacement reactor was an iterative process involving extensive discussions with reactor users and study of the capabilities of reactors overseas. A Beam Facilities Consultative Group was formed involving major neutron beam users to identify their requirements. Discussions were also held with medical and industrial radioisotope users and other industrial users to understand their product needs now and in the future. This resulted in a set of requirements for beams and irradiation facilities.

Staff from ANSTO and a range of consultants, both from Australia and overseas, worked to translate these requirements in specifications that could become part of the tender documents.

The process has been designed to provide transparency and probity throughout and the Australian Government Solicitor has performed probity audits at all significant stages.

The tender documents were finalised after the completion of the approval stages, taking into account the findings and recommendations from the Minister for Environment and Heritage and the PWC.

3. PHASES 2 AND 3

Phase 2 of the project relates to the tender issue, evaluation and award of the contract. It is expected that this process will take approximately 10 months.

Phase 3 is the design, construction and commissioning of the reactor. The contract will be let as a turn-key contract so that the successful tenderer will be required to deliver against the specifications and ANSTO will manage the contract against the agreed milestones. The commissioning process, after fuel loading, will be performed by ANSTO with assistance from the Contractor, as this requires a separate licensing authorisation.

Following successful commissioning there will be a requirement to operate both reactors for a period long enough to allow transfer of the isotope production to the replacement reactor. Following this, HIFAR will be shut down and eventually decommissioned.

During phases 2 and 3, there will be a separate project to develop and eventually install a suite of neutron beam instruments in both the Reactor Hall and the Neutron Guide Hall.

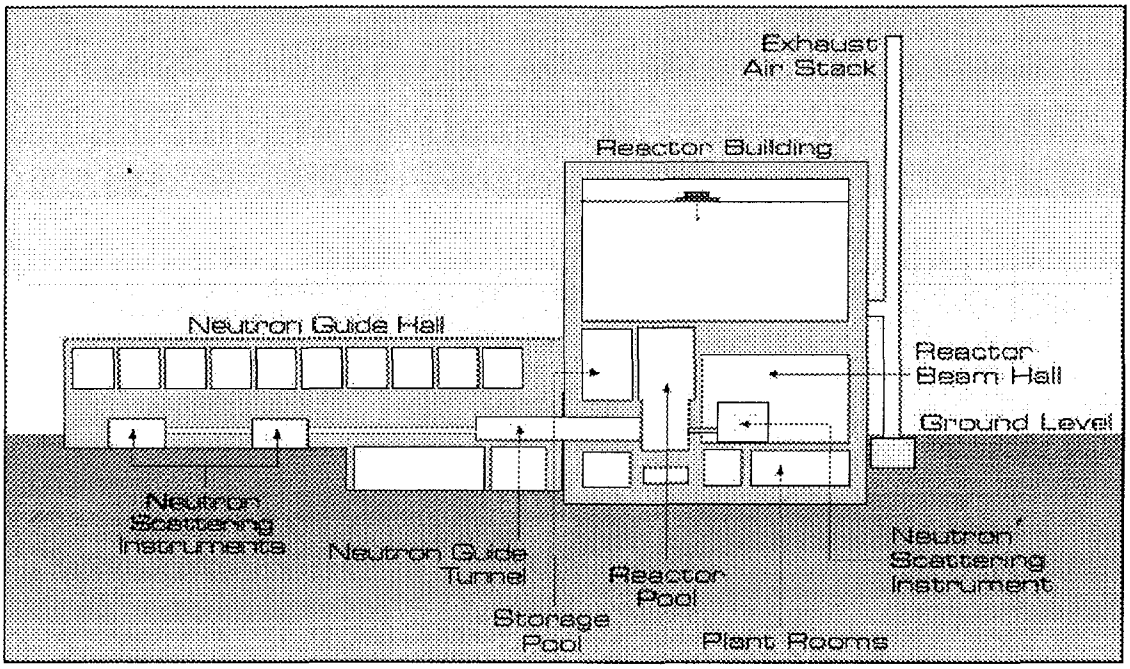


Figure 3 Typical vertical section of reactor building and neutron guide hall

4. TYPE AND CAPABILITIES OF THE REPLACEMENT REACTOR

The reactor will be a pool reactor, in contrast to HIFAR which is a tank type reactor. This maximises the inherent safety features, since the core is contained in a large pool of water and operations with fuel are more accessible and visible. Some comparisons between the reactors are shown in Table 1.

	HIFAR	RR
Type	tank	pool
Power	10-15 MW	Up to 20MW
Core	Loose array	Compact
Fuel	High enriched	Low enriched
Coolant	Heavy water	Light water
Reflector	Heavy water	Probably heavy water
Neutron beams	Thermal	Thermal, cold and provision for hot
Peak neutron flux ($ncm^{-2}s^{-1}$)	1×10^{14}	3×10^{14}
Guide hall	No	Yes

The main uses for the reactor are in neutron beam research, radioisotope production and irradiation services.

4.1 Neutron Beams

The reactor will have a separate guide hall to allow experimenters access to the beam guides without needing access to the reactor area. Figure 3 shows a schematic of the type of design possible and Figure 4 shows a possible arrangement for the instruments in the guide hall. HIFAR has only thermal neutron beams but the replacement will allow thermal and cold neutron beams and have provision for a hot source. This significantly widens the type of research possible and allows research into polymers and biological molecules.

Eight neutron beam instruments are planned for the replacement reactor when it is commissioned in 2005. ANSTO expects to add more within 5 years. These instruments comprise diffractometers, small angle scattering instruments, reflectometers, spectrometers and neutron radiography.

4.2 Irradiation facilities

The two main applications of radioisotopes are in production of nuclear medicine and in industrial services. A steady increase in demand for nuclear medicine is predicted. The Commonwealth Department of Health and Aged Care has estimated growth at around 14% per year over the next 10 years. The replacement reactor will provide a

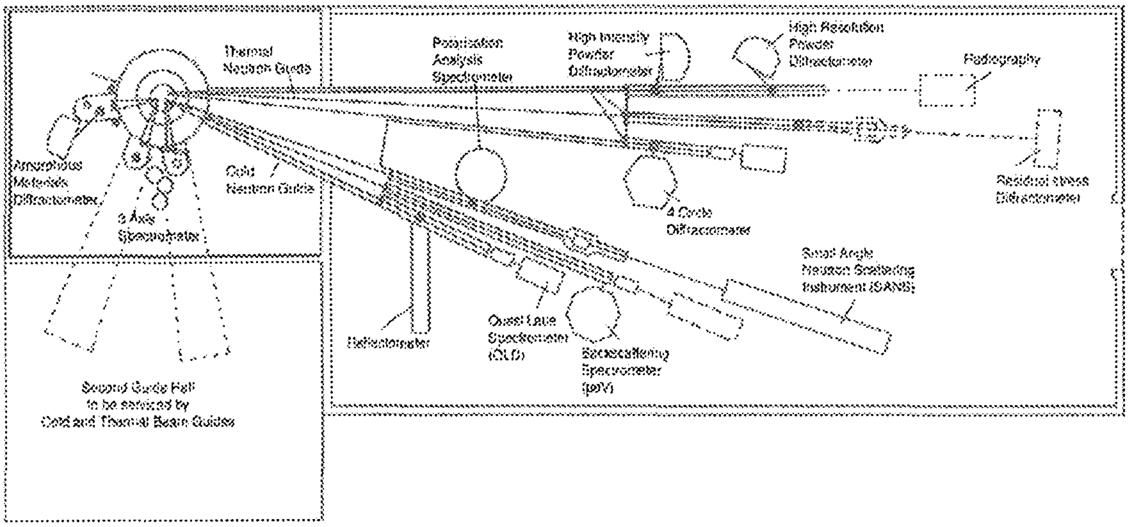


Figure 4 Typical arrangement of neutron beams in the guide hall

significantly larger volume for irradiations, including the capability to expand molybdenum production by a factor of up to four over current production. Additional benefits would also be derived from the development of new radiopharmaceuticals, including the emerging therapeutics, and drug delivery systems. New radiopharmaceuticals designed to provide a greater understanding of, and improvements to, the diagnosis of neurological disease and cancers are being produced.

Industrial isotopes are widely used in, for example, measuring flow rates in power stations, monitoring sewage and pollution movements offshore, measuring wear in engines and groundwater flow detection. In addition, they are used in radiography and sterilisation . Neutron activation analysis is also growing as a non-destructive technique for measuring trace element concentrations of a wide range of industrial, geological, biological and environmental samples. The replacement reactor will provide greater capacity for production of such isotopes.

5. CONCLUSIONS

The replacement reactor offers a greatly enhanced capability for a wide range of applications of neutron beams and irradiation facilities. The pool type reactor will have many inherent safety features such that there will be no need for any intervention, even in the event of a severe accident, outside the buffer zone.

The project has received approval from the Minister for Environment and Heritage and from the Public Works Committee. It has now entered phase 2.

6. REFERENCES

1. McGauran, Hon P (1997) *Nuclear Reactor Replaced*, Media release, Minister for Science and Technology, September 1997
2. IAEA, *Review of the Draft Environmental Impact Statement for the Replacement Research Reactor*, September, 1998
3. Parkman Safety Management, *ANSTO Replacement Nuclear Research Reactor EIS: Peer Review of Hazards and Risks*, September 1998
4. CH2M Hill, *Report to Environment Australia: Replacement Reactor Draft EIS Technical Review*, September 1998
5. Parliamentary Standing Committee on Public Works, *Report on the Replacement Nuclear Research Reactor, Lucas Heights, NSW*, August 1999.