Neutrons Down-Under:

Australia's Research Reactor Review

Presented by Allan Murray# to the 4th Meeting of the
International Group on Research Reactors
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Notes

The Australian Nuclear Science and Technology Organisation - ANSTO - was formed in April 1987 to replace the Australian Atomic Energy Commission.

ANSTO's MISSION is to ensure that its research, technology transfer, commercial and training activities in nuclear science and associated technologies will advance Australia's innovation, competitiveness and environmental and health management.

ANSTO will also maintain and further develop its scientific and technological resources and will continue to operate as a national center for science and technology to advance Australia's national and international nuclear policies and interests.

ANSTO has science and technology programs in

- Advanced Materials
- Applications of Nuclear Physics
- Biomedicine and Health
- Environmental Science
- Engineering
- Nuclear Technology
- Radiopharmaceuticals.

ANSTO NUCLEAR TECHNOLOGY PROGRAM

- The Nuclear Technology Program maintains and operates a major neutron source, HIFAR, as a national irradiation and beam facility. HIFAR is a tank type reactor with heavy water moderator and primary coolant within an aluminium tank surrounded by a graphite reflector.
- Thermal neutron flux of 1x1014 n cm-2 s-1
- During 1994, HIFAR operated at an average power of 10 MW(th) for 7,424 hours (83.4% of available time).

currently Counsellor (Nuclear), Embassy of Australia, Washington DC

HIFAR NEUTRON BEAM INSTRUMENTATION

- 2 single crystal diffractometers (medium and high resolution)
- 2 powder diffractometers (medium and high resolution)
- a triple axis spectrometer
- a neutron polarisation instrument (LONGPOL)
- small angle scattering instrument (AUSANS)
- 1,100 person-days of research utilization per year, about two-thirds from projects from Universities

HIFAR IRRADIATION FACILITIES

- 81 irradiation facilities in total: 51 vertical, 30 horizontal
- Isotope production: 1,000 irradiations in in-core rigs and 2,400 irradiations in self-service facilities each year
- About 10 kCi of molybdenum-99 produced for generators each year
- NTD silicon irradiation: 556 irradiations; about 15 tonne Si per year
- NAA of mineral samples: about 350 irradiations

AUSTRALIAN RESEARCH REACTOR REVIEW

Commenced in September 1992, the Review had the following Terms of Reference:

- Whether, on review of the benefits and costs for scientific, commercial, industrial and national interest reasons, Australia has a need for a new reactor.
- A review of the present reactor, HIFAR, to include: an assessment of national and commercial benefits and costs of operations, its likely remaining useful life and its eventual closure and decommissioning.
- If 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.

RESEARCH REACTOR REVIEW: SUBMISSIONS

ANSTO's submissions:

A: Research Reactors: Local and International Experience
B: The Need for a New Research Reactor in Australia
C: The Proposed New Research Reactor for Australia
D: HIFAR: The High Flux Australian Reactor
E: Regulation and Siting Issues for a New Research Reactor
F: Evaluation of the New Research Reactor

Submissions by others included issues of: safety concerns and risks of accidents; routine and accidental radiation releases; health effects; siting and regulation

RESEARCH REACTOR REVIEW: FINDINGS (August 1993)

- Research reactor neutrons are a unique and broadly applicable scientific tool for leading edge investigations in many disciplines.
- HIFAR is an older model reactor not competitive in design, neutron flux or instrumentation with modern reactors.
- HIFAR is efficient and safe, within its design and instrumentation limits. HIFAR operates safely by an adequate margin.
- No evidence presented to establish a realistic outer limit on the remaining life of HIFAR. A PRA is required to assess the remaining life and upgrade possibilities.
- Scientific accomplishments with HIFAR, training, commercial activities and medical radioisotope services were positively viewed.
- ANSTO's proposed specifications for a new reactor would be a suitable basis for the design.
- No conclusion that a reactor would be the best future choice for a neutron source - possibility exists for a spallation source and a small reactor for radioisotopes.
- A multi-purpose reactor cannot be financially self-supporting.

RESEARCH REACTOR REVIEW: RECOMMENDATIONS

- keep HIFAR going
- commission a PRA to ascertain HIFAR's remaining life and refurbishment possibilities
- identify and establish a HLW repository
- accept that neither HIFAR nor a new reactor can be completely commercial
- any decision on a new neutron source must rest primarily on benefits to science and Australia's national interest
- make a decision on a new neutron source in about five years' time (1998).

RESEARCH REACTOR REVIEW: CONDITIONS

Conditions for a positive decision to be made on a new reactor include:

- a HLW site has been identified
- no evidence that spallation technology can economically offer as much or more than a new reactor
- no practical initiation of a cyclotron anywhere worldwide to produce technetium-99m
- good evidence of strong and diverse applications of neutron scattering capability in Australian science
- that the national interest remains a high priority.

Extract from the Report of the Research Reactor Review, August 1993, based upon ANSTO's preferred specifications as submitted to the Review

Table 4.2: Design Proposals for a New Reactor

Requirement	*Specification*	*Reason*	*Comparison with HIFAR*
Flux n $cm^{-2}sec^{-1}$	$3x10^{14}$	Minimum for world-class beam research	10^{14}
	Compact core	Maximises flux with minimum power	
	Heavy water reflector	Thermal source	Heavy water moderator Graphite reflector
	Large reflector region	Minimises flux leakage	
	Cold source Hot source	To allow research not now possible in Australia	HIFAR has neither cold nor hot sources
Beam Facilities	8 beams: 2 cold, 5 thermal, 1 hot Preferably extra 2 beams for thermal and hot neutrons		9 beams, all thermal neutrons 9 experimental positions
	Guide hall	Experimental space Scientists separate from operators	No guide hall
	Tangential beam ports	Superior quality beam	Radial beams - inferior quality
	Optimised biological shield	Maximum radiation protection	
Fuel	Low enriched uranium	Non-proliferation concerns	High enriched uranium