Input from the Australian Institute of Nuclear Science and Engineering, AINSE, to House of Representatives Industry, Science and Innovation Committee Inquiry into Australia's international research engagement

Terms of Reference

1. The nature and extent of existing international research collaborations.
2. The benefits to Australia from engaging in international research collaborations.
3. The key drivers of international research collaboration at the government, institutional and research levels.
4. The impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these.
5. Principles and strategies for supporting international research engagement.

Introduction

AINSE was founded 50 years ago to support nuclear science and engineering in Australian universities through access to major nuclear research facilities. AINSE continues this role with support for Australian science at the Australian Nuclear Science and Technology Organisation (ANSTO) at Lucas Heights, Sydney and international access.

- In 2001, some New Zealand institutes joined AINSE and this has grown to strong participation as international partners.
- Subsequent to 1994, AINSE and Australian universities, with the Australian Research Council, have provided access to the world's most powerful spallation neutron source ISIS (UK) giving facilities which were not available in Australia and starting European collaborations. This program will continue through existing and new complementarity to home based facilities.

Some aspects of the value of these collaborations are shown below, following the terms of reference.

As well as enabling the ISIS membership, AINSE facilitates access to the instruments at the new OPAL reactor by 40 member universities and other tertiary institutions and provides a focus for cooperation in the nuclear scientific and engineering fields. AINSE also arranges for the training of scientific research workers and the award of scientific research studentships in matters associated with nuclear science and engineering. The research fields are spread widely, ranging from archaeology to climate change to biochemistry and materials.

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AINSE invests $3M pa into the following programs

- Research Awards (RA) – for academic researchers to access ANSTO facilities
- Top-up Scholarships (PGRA) – for doctoral candidates to work on projects using ANSTO facilities
- Research Fellowships (RF) – for postdoctoral researchers to conduct research programs. The aim of the fellowships is to attract young research scientists working internationally.
- Conference support – to support conferences in Australia as well as Australian travel to overseas conferences
- Access to the ISIS international facility

Currently, AINSE supports 150 research awards, 60 PGRAs, 10 research fellows per year. It also supports a number of workshops and conferences per year open to international researchers.

Response to terms of reference

1. ***The nature and extent of existing international research collaborations***.

AINSE facilitates international research collaborations in the following ways

a. **Three NZ universities and GNS Science participate in AINSE Programs** GNS Science is the NZ government-owned research institute focusing on geological resources, environmental and industrial isotopes and natural hazards. The University of Auckland joined AINSE, in 1995; the University of Canterbury and GNS Science in 2005, and the University of Otago in 2007. In 2009 NZ researchers had attracted 15% of AINSE projects, including Research Awards (RA), postgraduate top-up scholarships (PGRA) and research fellowships. AINSE also supports one Research Fellow at the University of Auckland.

Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
All RAs	215	203	185	162	183	206	154	269	125
NZ RAs	5	7	8	6	7	10	8	7	17

Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
All PGRAs	12	11	14	21	11	12	11	15	17
NZ PGRAs			1	0	1	0	0	1	2

b. AINSE **coordinates funding for Australia's membership of the ISIS facility**, the leading pulsed neutron and muon source in the world, located at the UK Rutherford Appleton Laboratory near Oxford. ISIS provides increased capability for experiments which cannot be performed on OPAL, the Australian nuclear reactor, as well as providing a number of techniques which are not available here. The yearly $400K membership fee has been funded

through a series of RIEF and LIEF grants. AINSE's application to the ARC for a five year LIEF grant was successful and it was awarded $1,000,000 over five years, representing 50% of the current ISIS membership fee.

Australia's subscription to ISIS buys entry to the ISIS peer review process, which is openly contested at the highest international level. The quality of Australian proposals measured against international competitors has increased with the level of demand. ISIS applications in 2008 from Australian researchers resulted in 82 days being awarded to 27 proposals from 10 groups. Instrument time was awarded on 12 different ISIS instruments. There were 26 papers published in 2008 in high ranking international journals as a result of this research.

The continuing high quality of the Australian research performed on ISIS ensures that Australian researchers obtain more than 3 times the 1% instrument time that the membership fee would ordinarily buy. In addition, Australian scientists are regularly invited to participate on instrument committees which examine research proposals.

The over-subscription ratio at ISIS instruments, measured in the same way, approaches three across the board, and is up to five for the instruments most frequently requested in Australian proposals. Hence the projects of Australian researchers have achieved sustained excellence when measured in international terms at one of the world's finest neutron beam facilities.

Another way of expressing Australian performance is that, while the subscription corresponds to about 1% of the ISIS operating budget, Australian science secured 1.75% of the facility on average in 1994-8. The most recent figures indicate that Australian proposals secure nearly 3% of the available ISIS beam time.

A summary of allocation of instrument time at ISIS over the past ten years:

YEAR	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
DAYS ALLOCATED	35	58	37	74	77	96	54	55	48	32	82

c. AINSE provides **international conference support** in two ways – by providing seed funding, underwriting or organisational support for international conferences and training schools or by supporting Australian students to attend international conferences.

AINSE has underwritten and organised the international conference of the International Association of Radiation Research (Brisbane, 2003) and the International Conference on Neutron Scattering (Sydney, 2005). A mark of Australia's scientific contribution to using neutrons was the decision to award to Australia this 2005 International Conference on Neutron Scattering (ICNS2005). The conference was particularly successful, attracting 737 registered delegates from 38 countries and providing a showcase for Australian scientists and the OPAL Research Reactor.

AINSE has also supported workshops (eg ITER Forum, Sydney 2007) and training schools both in Australia and overseas. For example, AINSE has supported student involvement in the AONSA (Asia Oceania Neutron Scattering Association) training schools (Korea, 2007 and Lucas Heights 2009).

AINSE established a policy in 2004 to support students wishing to present their research at an off-shore international meeting. A maximum subsidy of $900 is provided. In 2009, AINSE supported 13 students in this way.

2. ***The benefits to Australia from engaging in international research collaborations***.

An overall strategy for Australia to participate in essential "cutting edge" science beyond our national resources was elaborated in 1990:

> *'…It is therefore imperative that Australian scientists be permitted to increase their overseas access if the existing momentum of Australian neutron scattering research is to be maintained and if Australian scientists are to remain abreast of their overseas colleagues'*

Small Country – Big Science, ASTEC report to the Prime Minister, 1990.

The success of this submission was based upon the need to grow new areas of science and the training of a new generation of students and postdoctoral fellows in those areas. For the ISIS access, areas of scientific and technological strength in Australia, (for example colloid and surface chemistry, biology) were connected to European counterparts.

We see three key benefits from access to international facilities such as ISIS for Australian science and technology:

(i) Creativity - In the past ten years new neutron and synchrotron methods have made the area of "soft matter" research scientifically assessable in new ways. Through the ISIS subscription, Australians have participated, *and in some cases led these advances***.** This area, at the interface between physics, chemistry and biology, embraces polymer and biological macromolecular research, surfaces and interfaces and the design of new materials of commercial importance.

(ii) Contestability - Access for both hard and soft matter science has placed Australian researchers in direct competition with the best international groups. This aspect of "contestability" is of continuing value to test the quality of Australian programs in new areas as well as create new international linkages.

(iii) Complementarity - The OPAL research reactor at Lucas Heights is becoming a facility of international quality. The number of Australian groups using neutrons will grow if international trends are followed. AINSE has implemented a "tenure track" Research Fellowship scheme to promote this. The situation with respect to international participation at other neutron sources is very similar to what we will have here. It is

foreseen that international exchanges of access can further help Australian programs and the large investment overseas is still producing instruments complementary to what we have in Australia. The best strategy to manage this useful but inevitable phenomenon is to ensure that what is developed and built in Australia is the best of its kind. This, with our strong international links, developed through "suitcase science", should be kept so that we benefit from major investments elsewhere using their complementary instrumentation, possibly in exchange for their access here.

An important aspect of networking at ISIS is the age distribution of the scientists using this facility, shown in the Figure below, which peaks at age 30. There is thus a high probability for young researchers meeting up and eventually collaborating with other young researchers from the international scientific community. When this fact is coupled with the wide spread of the science done at the ISIS facility it can be seen that cross fertilisation between physics, chemistry, geology, biology, engineering and materials science readily occurs in the use of this facility. With around 1600 visitors per year a unique quality to the research training is added.

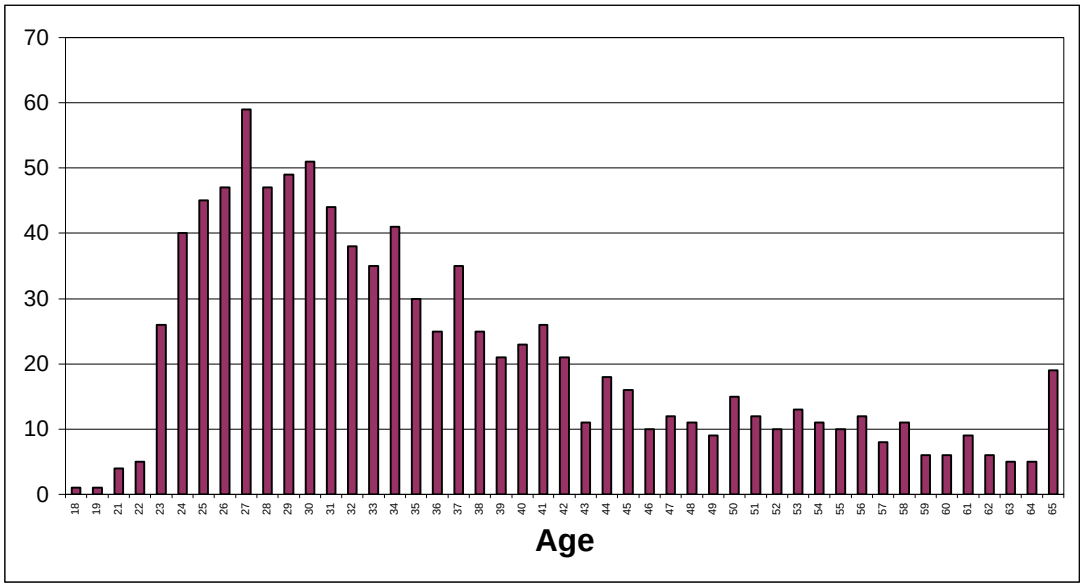

Figure - Age distribution of the users of ISIS

Drawing on the above comments, the four key benefits of continued access to the ISIS facility are:

- Access to complementary infrastructure;
- Access to the ISIS contestability processes and international collaborations through participation there;
- Access to new developments in neutron technology and instrument design through participation; and
- Formation of enduring collaborations.

3. **The key drivers of international research collaboration at the government, institutional and researcher levels**.

- *Access to facilities not available in the home country*
  This driver remains strong for Australian and NZ scientists and was a key aspect of the initial "Small country - big science (1990)" proposal.
- *International collaboration through new techniques and science culture of the collaborating country as a means of enriching and refreshing Australian and NZ science.*
  The investment in ISIS during the 1990s helped to create strong groups in **soft matter and hard matter** science in Australia which, themselves, have justified the world ranking facilities built at the OPAL reactor since 2002.

- *Scientific and technological knowledge transfer through the contacts made in 'user oriented' large international facilities.*
  The instrument designs at the OPAL reactor have benefited greatly from the strong personal contacts created internationally over the previous ten years and the goodwill of international institutes to offer expertise and technology.

4. **The impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these**.

A significant impediment to Australians in contributing to international collaborations is the funding required for access, travel and accommodation. The international access is, however, of potential strategic importance to the interests of Australia.

The Australian government through the Access to Major Research Facilities (AMRF) Fund (administered by ANSTO) has provided travel and subsistence funding to allow the international contacts, started by "Small country - Big science", to grow modestly. There is strong oversubscription for this fund but great opportunity for stronger international collaboration – especially in the Asia Pacific region. This is frustrated by shortage of funds in that program, so that there is no guarantee that funding will be allocated to successful applications. A second frustration is that the timetable for the application system is often out of sync with Australian Funding programs.

Australian access by international researchers and students here is sometimes hindered by delays in obtaining appropriate visas and, particularly for families, by the high relative costs charged here for medical assistance and for public school attendance.

5. Principles and strategies for supporting international research engagement.

The AINSE model has worked well for 50 years in providing access for Australian researchers to large facilities at ANSTO and it is increasingly proving its worth in facilitating international research engagement. The AINSE view is that continued access to large international research facilities is essential to Australian science, but that this access has to be properly and consistently funded

For example, Australian participation in ISIS was the result of an ad hoc decision in the early 90s and the funding for this has not been continuous or secure. Access to the facility through ARC grant systems (RIEF and LIEF) has largely worked well although there has been a consistent trend to require universities to contribute a larger proportion of the membership fee. Funding for travel and accommodation is also vital. The Access to Major Facilities Fund often has insufficient funding to cover all the required travel. It is disappointing when a researcher wins time on an instrument at ISIS but is unable to utilise it because there are no travel funds. This situation is exacerbated by the AMRF funding cycle being out of phase with the decisions of ISIS governing access to the facility.

It is **recommended** that a travel-funding scheme be devised so that, when time on international facilities is won by Australian scientists, adequate travel funds can automatically be made available to ensure that maximum benefit can be gained from time gained competitively on the facility.

Involvement at the executive level in organisations such as AONSA is also critical for Australian researchers to remain engaged in international collaborations. However there is no mechanism to provide on-going support for such commitments.

It is **recommended** that consideration be given to funding Australian participation in these international organisations.

Bruce King
President