

LINKAGE INFRASTRUCTURE, EQUIPMENT AND FACILITIES (LIEF)

REVIEW OF ARC LIEF SUPPORT FOR ACCESS TO ISIS

AINSE, LUCAS HEIGHTS RESEARCH LABORATORIES, SYDNEY
9 MARCH 2006

Background

Through the Linkage Infrastructure, Equipment and Facilities scheme, the Australian Research Council provides funding to the Australian Institute of Nuclear Science and Engineering (AINSE) to support the “Access for Australian Researchers to Advanced Neutron Beam Techniques” program. This program enables Australian researchers to access the world’s most intense spallation neutron source, ISIS, at the Rutherford-Appleton Laboratory, UK, in order to undertake studies not possible at Australian facilities, bringing significant benefits in expertise and international engagement for Australia. Access to ISIS is provided for by the payment of an annual membership fee, currently A\$400k per annum. The ARC provides 60%, the remainder being contributed by selected universities, the Australian Nuclear Science and Technology Organisation (ANSTO) and AINSE.

The ARC conducted a review of LIEF support for Australia’s access to ISIS on Thursday 9 March 2006. This entailed a one-day site visit to AINSE by a two-member ARC Panel. Prior to the site visit, AINSE provided the ARC with a submission addressing specific terms of reference (Appendix 1) and providing the following information:

- A strategic plan;
- The publication record (including joint publications) with other participants;
- The numbers of participating postgraduate students, including completion rates and post-doctoral fellows; and
- A list of user grants, including collaborative grants with other participating institutions.

Review Panel

The Review Panel comprised Professor Erich Weigold (Executive Director, Physics, Chemistry and Geosciences, ARC) and Dr Peter Hammond (Senior Lecturer, Department of Physics, The University of Western Australia, and member of LIEF Selection Advisory Committee). Dr Ksenia Sawczak (Senior Project Officer, Humanities and Creative Arts, ARC) provided executive support to the Panel.

Process

The Review Panel considered the submission provided by AINSE prior to the review. The agenda of the one-day review is at Attachment 2.

The following people attended the meeting, representing AINSE and ANSTO:

President of AINSE

Professor John White, The Australian National University

Public Officer and Scientific Secretary of AINSE

Dr Dennis Mather

Chief Investigators

A/Prof Ian Gentle, The University of Queensland

A/Prof Erich Kisi, The University of Newcastle

A/Prof Craig Buckley, Curtin University of Technology & Chair of Specialist Committee

Professor Brendan Kennedy, The University of Sydney

Dr Michael James, ANSTO

Professor Cameron Kepert, The University of Sydney

Professor Greg Hope, Griffith University

Post-doctoral Fellows & Early Career Researchers

Dr Daniel Riley, The University of Newcastle

Dr Jenny Forrester, The University of Newcastle

Dr Darren Gossens, The Australian National University

Postgraduate Students

Mr Adam Perriman, The Australian National University

Mr Mark Pitt, Griffith University

AINSE's Performance against the Review Terms of Reference

1. Evidence of significant benefits to Australia resulting from access to a major facility not otherwise available to Australians, including benefits realised to date by research and research training, the public sector and industry.

In the past five years new neutron and synchrotron methods have made the area of “soft matter” research scientifically assessable in new ways. 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. At the same time, unique instruments currently at ISIS - such as the high-resolution powder diffractometer GEM, the inelastic scattering instruments and the muon facility have opened new areas of science in “hard matter”.

Australia's subscription to ISIS buys entry to the ISIS peer review process. Most recent figures indicate that Australian proposals secure nearly 3% of the available ISIS beam time compared to the 1% that we now pay for. Direct access to the ISIS facility has allowed researchers from Australian universities to undertake research in a number of programs for 2003-2006, including:

- Disordered Material, The Australian National University;
- Solid State Molecular Science, The Australian National University;
- Solid State Inorganic Chemistry, The Australian National University;
- In-Situ Studies of Hydrogen in Metals and Pseudo Metals, Griffith University;
- Neutron Reflectivity Studies of Interfacial Processes, The University of Queensland;
- Structural Studies of Technologically Important Materials, Curtin University of Technology;
- Structural and Dynamical Studies of Magnetic Materials, The University of NSW (ADFA);
- In-Situ Studies of Materials in Simulated Service or Synthesis Environments, The University of Newcastle.

From the point of view of research training, the experience of working at ISIS is an important career step for new Graduate Students or Postdoctoral Fellows. Over the past five years, there have been 13 Postdoctoral Fellows trained through access with the ISIS program. In addition, the number of participating students (PhD and Honours) has been 77. Current doctoral students present at the review outlined a number of benefits, including:

- The confidence to conduct experiments internationally;
- The opportunity to meet other researchers and form networking foundations for future projects.

Working at ISIS also enables the creation of research networks at both academic and graduate student level, leading to significant collaborative programs between Australia, UK and European scientists. An example of a promising researcher in the

area of biological structures at interfaces using neutron scattering and synchrotron techniques is Dr Duncan McGillivray, Rhodes Scholar, 2001, and subsequently Postdoctoral Fellow, John Hopkins University.

Access to ISIS has provided the possibility for research to be undertaken in programs which have potential and actual benefits to Australian health science and industry. Examples of such projects include:

“Lung Surfactants”: A/Prof Ian Gentle, The University of Queensland.

Neutron reflectivity measurements at the ISIS facility have enabled information to be gathered about the structure of ultra-thin films on a surface. Studies have indicated that protein changes its shape at the air/water interface as it is compressed, an observation which has important implications for the development of therapies for Respiratory Distress Syndrome. This is an ailment that afflicts most infants born prematurely. The results of this work were selected by the ISIS facility as a Research Highlight and featured in the 2003 ISIS Annual Report.

“Geopolymer Concrete”: A/Prof Craig Buckley, Curtin University.

This project is a collaborative effort between Curtin University, ANSTO, and industry partners. Geopolymers are materials with useful physical properties, with potential suitability for many applications such as Portland cement replacement, high temperature composites, radioactive waste encapsulation, castable ceramics and others. The aim of experiments undertaken at ISIS is to determine high resolution Total Correlation Functions $T(r)$ from neutron scattering data. These are to be used for gaining more information about how the molecular structure in these amorphous materials is influenced by elemental composition. The use of HRPD and GEM at ISIS are essential for undertaking much of this work, as it involves measurements under extremes of pressure and temperature.

2. The relevance of the facility to national needs and the availability of comparable infrastructure in Australia:

- **The benefits to Australia of continued participation;**
- **The excellence of the researchers and research activity to be supported;**
- **The general performance of the participating groups;**
- **The success of current research programs.**

ISIS instruments are around ten times faster than those currently available at HIFAR. The HRPD (High Resolution Powder Diffractometer) has been particularly important for Australian researchers, as it has unequalled high resolution that allows subtle effects and complex structures to be studied with great accuracy and precision. No other instrument with similar performance is available worldwide.

The “cold neutron” instruments at OPAL should, in the future, be able to accommodate a significant portion of the work done on LOQ, SURF and the thermal instruments at OPAL (ECHIDNA and WOMBAT), should do much of the work currently undertaken by Australians on HRPD, POLARIS and GEM at ISIS. However, the High Resolution Instrument at OPAL will not be able to resolve a fair proportion of the problems currently studied on HRPD at ISIS due to its inferior resolution.

There is currently strong support in the Australian community for a “hot source” to be built at OPAL to support both elastic and inelastic instruments. This support was made apparent at the 2005 Blue Mountains Workshop on “Future Opportunities in Neutron Scattering”. This is unlikely to occur for at least 3 years, amounting to a continued reliance on the use of ISIS inelastic instruments such as TOSCA and GEM. Both Prof Kepert and Prof Kennedy articulated the importance of these instruments in undertaking important experiments for their research, as spallation sources are ideal for liquids and amorphous instruments.

The level and demand for neutron scattering in Australia has grown and diversified since access to ISIS became possible. Over the past 8 years Australian scientists have enjoyed a 68% success rate in time allocation, with a significant drop recorded in the number of days allocated in the 2004-05 period due to extended scheduled shutdowns. However, it is expected that some proposals which did not get through due to reduced facility time will be funded as a priority after resubmission in 2006.

Since the 2003 review, demand for the facility has diversified with four new research groups accessing ISIS: Prof Greg Hope, Dr Paul Meredith, Dr Gary Denis and Prof Allan Pring. In addition, former students have commenced research in their own right: Dr Tomasz Blach and Dr Jenny Forrester. AINSE has also awarded two top up scholarships to doctoral candidates who are conducting research at ISIS: Adam Perriman and Karena Chapman. The overall number of groups accessing the facility has risen from about 6 in 1995 to 23 in 2005.

The performance of the participating groups can be measured by the success of current research programs, with a significant number of publications, PhD and Honours theses completed, and funding for research proposals (Appendix 3 of AINSE submission contains a full list). A number of Australian researchers have also received important awards. Examples include Prof Allan Pring: awarded the John Sanders Medal by the Australian Microscopy Society for his work on the minerals in 2004, and the Sir Joseph Verco Medal by the Royal Society of South Australia in 2005.

The decision to award to Australia the 2005 International Conference on Neutron Scattering, held in Sydney in November, provides evidence of Australia’s scientific contribution to the use of neutrons. This conference was attended by 700 participants from all parts of the world.

3. The effectiveness of the cooperative arrangements between institutions, including access and resource sharing and the extent of current usage:

• Evidence of collaborative arrangements including research grants and publications

There have been a number of collaborative arrangements, with access to ISIS being central to the success and continuation of such projects.

Example: A/Prof Ian Gentle (The University of Queensland) and Prof Geoffrey Ashwell (Cranfield University, UK) on aspects of molecular electronics. This has resulted in a number of publications and, most recently, an ARC Discovery Project Grant.

In addition, four different senior investigators from Australia have been invited as members of the ISIS specialist review panel, further enhancing personal and scientific contacts developed through access to ISIS.

Collaborative programs resulting from ISIS interactions also provide some indication of important international research networks that have developed.

Example: As a result of Australian pioneer work in the world's best liquid surface reflectometer (SURF), Dr Michael James from ANSTO was seconded to ISIS for 6 months to act as instrument scientist with UK colleagues for the newly developed instrument. He has subsequently returned to ANSTO where he is developing Australia's first neutron reflectometer, which will be complementary to that at ISIS.

Current cooperative arrangements between AINSE and the Rutherford-Appleton Laboratory (ISIS) work well, with Australian scientific proposals sent directly to the ISIS reviewing panels from Australia. The complementarity of the ISIS and HIFAR instruments have rendered a second reviewing process in Australia unnecessary.

4. The commitment of the lead and collaborating institutions, including clear evidence of the extent of financial and other support, consistent with relevant research management plans.

AINSE has a strong track record of sound collaborative arrangements between ANSTO and Australian universities. The contributions from universities towards the ISIS access program have all been agreed in the past by the Deputy Vice-Chancellors (Research) of the participating universities as an additional sum to that provided by the universities for access to ANSTO facilities. This process is intended to continue in the proposal for the next five-year period of the LIEF grant being sought in association with the submission presented by AINSE.

The contributions to AINSE, both from universities and ANSTO, have been planned into budgets and a new Memorandum of Understanding between AINSE and ANSTO, valid until the operation of the instruments for the Replacement Research Reactor, has just been signed between the two organisations.

5. The financial relationship between AINSE and individual collaborating institutions.

Since taking over the leadership of access to ISIS in 1997, AINSE has had consistent support from the collaborating institutions, with levels of support ranging from \$5,000 to \$30,000. The number of collaborating universities has increased from 7, and in 2007 there will be 9. ANSTO has contributed \$25,000 per annum up to and including 2006.

AINSE has maintained a subscription of \$400,000 per annum to ISIS, with contributions from collaborating institutions representing about 40% of this subscription. The remainder comes from the ARC LIEF grant.

6. The relationship between the strategic plans of AINSE and individual collaborating institutions.

AINSE has set the following goals as part of its strategic plan 2003-2008:

- By the end of 2008 members will have access to major nuclear and related research facilities in Australia and overseas through AINSE;
- By the end of 2008 the research performance of AINSE's scientific outcomes will have increased substantially;
- By the end of 2008 all universities in Australasia, some sections of CSIRO, many major museums, many non-teaching hospitals and a significant proportion of the scientific institutions in Australasia will be members of AINSE;
- By the end of 2008 AINSE will have expanded its existing set of excellent scientific networks.

This demonstrates a commitment to advancing research, education and training in the field of nuclear science, engineering and related fields within Australasia by being the key link between universities, ANSTO, other member organisations and major nuclear science and associated facilities.

Review Panel Questions

Publications

Q: The Publications List in the AINSE submission did not clearly indicate which involved international or ISIS collaboration.

A: All listed publications involved ISIS. Those marked by # indicate close collaboration.

System of application to ISIS

Q: Do proposals go through AINSE first or straight to ISIS?

A: All proposals go directly to ISIS. However, scientists need to first indicate in writing that this experiment cannot be conducted in Australia. ISIS utilises a web-page system that involves little documentation.

Arrangements with ISIS

Q: What is the nature of the current agreement with ISIS?

A: ISIS has extended its existing agreement. This agreement will have to be reconsidered when OPAL opens.

OPAL

Q: What considerations will need to be taken into account with the opening of OPAL?

A: AINSE will have to reconsider its agreement with ISIS, with the possibility of a reciprocal agreement and broader interaction between Australia and UK. The question of which facility to use for conducting experiments will be particularly critical. There is an expectation of further growth in programs currently being conducted, and an acknowledgement of the need for scientists to have access to the best facilities, regardless of where they are located. The differentiation of new users will become finer when OPAL becomes fully operational. There was a suggestion that OPAL be open to international competition. It was agreed that the possibility of trade should be raised at a later point.

Review Panel Recommendations

The Review Panel strongly recommends continued support through the LIEF funding arrangement for Australian access to ISIS until the date of the next review (2009). At that time significant changes in the national and worldwide scientific landscape for neutron scattering experiments will have occurred, namely:

- The OPAL facility at ANSTO will have become operational with many detection systems of similar performance characteristics that currently exist at ISIS;
- A major detection system development is currently under construction at ISIS at a cost of A\$295 million (the Second Target Station) which will provide significant detection system advances compared with current ISIS apparatus, and is planned to be operational in October 2008;
- Two new neutron sources are being constructed in the USA and Japan, each costing in the order of A\$1 billion;
- The Australian Synchrotron will have become operational providing some overlap and complementarity with studies achievable with neutron scattering.

Given these developments, the Review Panel recommends that bi-lateral “zero-cost” arrangements be explored with ISIS and other facilities, in which international access to OPAL is enabled via competitive peer review of research proposals, in exchange for similar access to international facilities, with a view to the termination of the subscription payment to ISIS.

Terms of Reference

1. Evidence of significant benefits to Australia arising from access to a major facility not otherwise available to Australians:
 - Including benefits realised to date by research and research training, the public sector and industry.

2. The relevance of the facility to national needs and the availability of comparable infrastructure in Australia:
 - In particular, the benefits of continued participation;
 - The excellence of the researchers and the research activity to be supported;
 - The general performance of the participating groups; and
 - The success of current research programs.

3. The effectiveness of the cooperative arrangements between institutions, including access and resource sharing and the extent of current usage:
 - Evidence of collaborative arrangements including research grants and publications.

4. The commitment of the lead and collaborating institutions, including clear evidence of the extent of financial and other support, consistent with relevant research management plans.

5. The financial relationship between AINSE and individual collaborating institutions.

6. The relationship between the strategic plans of AINSE and individual collaborating institutions.

Agenda for review of ARC LIEF support for access to ISIS

AINSE

Building 5, Lucas Heights Research Laboratories

Thursday, 9 March 2006

09.45	Review Panel assemble. Review Panel members: <ul style="list-style-type: none"> • Prof Erich Weigold • Dr Peter Hammond
10.00	Review Panel meets with Chief Investigators to review agenda.
10.15	Presentations by Chief Investigators : <ul style="list-style-type: none"> • Overview by Prof John White, The Australian National University & President AINSE • A/Prof Ian Gentle, The University of Queensland • A/Prof Erich Kisi, The University of Newcastle • A/Prof Craig Buckley, Curtin University & Chair of Specialist Committee • Prof Brendan Kennedy, The University of Sydney
11.30	Review Panel discussion with Research Group Leaders, Postdoctoral Fellows, Early Career Researchers and PhD Students. Research Group Leaders: <ul style="list-style-type: none"> • Dr Michael James, ANSTO • Prof Cameron Kepert, The University of Sydney • Prof Greg Hope, Griffith University Post doctoral Fellows & Early Career Researchers: <ul style="list-style-type: none"> • Dr Daniel Riley, The University of Newcastle • Dr Jenny Forrester, The University of Newcastle • Dr Darren Gossens, The Australian National University PhD Students <ul style="list-style-type: none"> • Mr Paul Saines, The University of Sydney • Mr Adam Perriman, The Australian National University
12.15	Review Panel discussion with members of senior management
12.45	Lunch
13.45	Review Panel discussion (Review Panel members only)
14.15	Review Panel discussion with Chief Investigators. During this session the Chief Investigators will have the opportunity to respond to issues that remain unclear to the Review Panel.
15.45	Depart

