



ANSTO's Future Plans for Nuclear Science & Technology

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SUMMARY. There are four key themes in ANSTO's future plans for nuclear science and technology (S&T):

- 1) How ANSTO plans for the future—within its established 'core business areas' (CBAs), following a rigorous process, and incorporating extensive interaction with organisations around Australia and overseas.
- 2) The replacement research reactor (RRR)—a Major National Research Facility and the cornerstone of ANSTO's future activities.
- 3) Business—A number of business development initiatives have been launched by ANSTO over the past year, under the banner of "Good science is good business at ANSTO".
- 4) National Research Priorities—ANSTO is contributing to the national research priorities that the Prime Minister announced last December. In particular, it is pursuing new plans in the security and forensics area within the 'Safeguarding Australia' national research priority.

1. The Planning Process

ANSTO undertakes its activities within the framework of its strategic plan, vision and mission and the organisation is currently mid way through a strategic plan that began in 2000 and goes to 2004-2005. To fulfil its vision and mission, ANSTO has set a number of strategic goals focussing on timely delivery of scientific advice to government and other stakeholders; fulfilling Australia's national and international nuclear obligations; advancing Australia's interests through international nuclear science and technology and its applications; enhancing and improving core nuclear science and technology based facilities to produce research, products and services at the highest possible standard; and contributing to new knowledge in relevant research areas and improving business performance. Of course, in all ANSTO operations, ANSTO's first core values are safety and quality.

ANSTO's strategic goals are structured into six core business areas (CBAs). The CBAs are:

- International strategic relevance of nuclear science and technology
- Core nuclear facilities operation and development
- Nuclear science for environment and sustainability
- Treatment and management of man-made and naturally occurring radioactive substances
- Sustainability and international competitiveness of industry
- Organisational development and support.

All activities at ANSTO, including research, business or support services, are carried out within one of these CBAs, and therefore only those proposals that fit under one of these areas are considered. The activities are undertaken as projects and typically run for three years. This length of time enables researchers to conduct well-founded and well-structured research, and to disseminate and where possible implement findings. For projects where further work would be of demonstrable value, either scientifically or through to commercial returns; projects may be restructured to focus on new goals and thus continue. As a number of new projects begin and end each year, ANSTO is constantly evolving and refocussing on current developments in the application of nuclear S&T, as well as the expectations of government, community and the market.

Ideas for new projects are initiated from a wide variety of sources and are proposed by individual researchers, research teams, ANSTO management and board, and other stakeholders. As described, it can often build on, or be a refocussing of, previous work. For example, the work on synroc from 1979 has led to on-going research and considerable know-how in the areas of ceramics and nanotechnology - areas in which ANSTO is now internationally recognised. New ideas may reflect new priorities in government or the wider community. For example, the national research priorities are driving ANSTO's new, stronger focus on forensics and security. Similarly, opportunities may be identified from using ANSTO facilities and expertise to enter emerging science areas and so on.

The proposer of a project, (the 'project champion') will initially workshop the idea to produce a project definition. Such workshoping will often involve people and collaborators from within ANSTO, around Australia and overseas. The project champion documents what the project is about, its background, objectives, expected outputs and outcomes, scope and stakeholder drivers. He or she looks at the required resources and related factors. He or she also has to show how it relates to ANSTO's core business areas as well as ANSTO's mandate and mission. This is an interactive process. It may be appropriate to hold off starting a project until a later year, perhaps when resources become available, the scientific argument is more persuasive or the project is refocussed to better match ANSTO's mandate.

2. Collaboration

A consistent element in all ANSTO projects is collaboration. ANSTO's partners in collaboration span industry and universities, as well as other R&D science and technology organisations such as CSIRO, the Defence Science and Technology Organisation (DSTO), Geoscience Australia and Cooperative Research Centres (CRCs). In order to appeal to collaborators across the board from private industry to publicly funded agencies, ANSTO believes that it is vital to have various models of collaboration from which to choose the best match to the requirements of all parties. Considerations in collaborative research include not just the facilities, expertise and resources to do the science but also issues arising from IP ownership and potential commercial return. When looking at future research opportunities, ANSTO asks, "Who are the best three organisations in this area in Australia, or in the world?" They are the ones the Organisation wants to work with.

Such models include (but are not limited to) the AINSE model of collaboration with universities; the Bragg Institute; individual 'umbrella' agreements such as memoranda of understanding; user groups (for example those involving beamline facilities); external programs; funding schemes (ranging from those run by the Australian Research Council to International Atomic Energy Agency programs); adjunct staff positions at universities; and co-location, such as at the ANSTO Technology Park.

The Bragg Institute was launched a year ago as a specific vehicle for "ANSTO in partnership" with universities, other R&D and science and technology organisations and with industry. Through the Bragg Institute ANSTO is establishing a joint Centre for Structural Biology and Chemistry at the University of Sydney. It will offer high-level fellowships and a joint lectureship in chemistry, among other joint activities. The Bragg Institute also has joint postdoctoral arrangements with Curtin University of Technology and the University of NSW, and staff-visit agreements with Bio21 in Victoria. The Institute has a strong emphasis on international relationships, to ensure Australia attracts the

world's leading scientists to use the replacement research reactor and perhaps join the ANSTO team. It aims to bring together neutron scattering and x-ray scientists and users, to maximise the benefits of the superb facilities that Australia will have in this area in the next few years, with the replacement reactor and the synchrotron. The work undertaken at the Bragg Institute is relevant to diverse areas, including plastics, minerals, welds, pharmaceutical products, electronic materials, biology, catalysts and magnets.

ANSTO also collaborates extensively internationally. This keeps Australia involved and aware in international thinking as to the future of nuclear science and technology, and enables ANSTO to participate in that future. ANSTO works multilaterally, especially with the International Atomic Energy Agency, but also with global programs, such as the Intergovernmental Panel on Climate Change. Regionally, ANSTO works with the IAEA Regional Cooperative Agreement and the Forum for Nuclear Cooperation in Asia. Countries in the Asia Pacific region are making great strides in the nuclear area, and it is important to Australia's strategic interests that we have an understanding of their values and goals in nuclear science. The contacts, networks and colleagues established by collaborative research in these areas is invaluable in ensuring that understanding, as well as allowing Australia an opportunity to be a champion in the region for high standards of safety and environmental protection and promoting the peaceful uses of nuclear S&T.

ANSTO also works bilaterally. Relations with the US, particularly with the Departments of Energy and State, help keep Australia informed and involved in developments. The following illustrates the diversity of the Organisation's collaboration with the European Union (EU):

- Last year ANSTO counted 30 research projects involving organisations in the EU.
- ANSTO is actively involved in consortia seeking funding from the EU's Sixth Framework Program for research (FP6), which is funded to 17 and a half billion euros over five years.
- ANSTO has strong relationships with EU Joint Research Centres (JRCs), particularly the transuranium JRC in Karlsruhe, and with the French Atomic Energy Commission (CEA).

3. Facilities

ANSTO's future plans for nuclear science and technology are very strongly influenced by its facilities, and even more so now by the replacement research reactor, which will be online in 2005/06. The replacement reactor will be a world-class neutron source.

Eight neutron beam instruments are planned for the replacement reactor: four diffractometers, two spectrometers, a small-angle neutron scattering beamline and a reflectometer. The selection of these instruments followed an extensive consultation process. The Beam Instruments Advisory Group determined the scope for

the instruments through a series of workshops that were held for each instrument or area, (for example biological sciences). The workshops were open to any organisation in Australia and overseas, and ANSTO particularly sought involvement of individuals from North America, Europe and Japan, so it could capture developments internationally. The Australian Neutron Beam Users Group also provides input on future instrumentation, and to the development of the new instruments. The aim in this high level of consultation is to build a world-class centre with a unique range of capabilities.

The replacement reactor is, in fact, capable of supporting 17 instruments. The additional instruments would be housed in a second beam hall. Some potential additional instruments have already been identified. The Bragg Institute's website <http://www.ansto.gov.au/ansto/bragg/index.html> carries more information about them. While these instruments form part of ANSTO's future plans, they do not yet feature in any ANSTO budget, and the Organisation anticipates needing alternative funds to supplement possible government funds to enable these instruments to be developed, operated and maintained. As the Australian Government recently established a taskforce to examine research infrastructure in Australia, ANSTO is using that opportunity to bring the issue of additional beamlines to the attention of that taskforce.

ANSTO has already established projects to take advantage of the capabilities of the replacement reactor. Around the world, research is under way on a new generation of radioisotopes. Because of its higher flux, the replacement reactor has the potential to produce a much wider range of therapeutic radioisotopes than HIFAR can. Therefore ANSTO Radiopharmaceuticals has launched a project to identify and develop a methodology and commercial production processes for new diagnostic and therapeutic radioisotopes.

The replacement reactor's cold neutron source will open up completely new opportunities for research in nanotechnology, biology and a wide range of material science applications. Another new feature will be the residual stress capability that will allow the study of welds, engines, composite materials and so on.

As well as opening up new research areas, the replacement reactor will also enable ANSTO to satisfy ever-growing demand for its products and services. Last year radiopharmaceutical sales rose by 7 per cent. The replacement reactor will vastly increase ANSTO's radioisotope production capacity by four times the current capacity enabling us to meet growing domestic needs and create export opportunities. Neutron transmutation doped silicon sales rose by 22 per cent last year. The replacement reactor will give us four times the capacity to produce phosphorus-doped silicon for the semiconductor industry.

4. Business development

To meet increases in demand for ANSTO's products and services as well as the new opportunities that will be

provided by the RRR, ANSTO has been sharpening its focus on business development. ANSTO's business development team will play a key role in bringing ANSTO's future nuclear science and technology to market. ANSTO's new director of business development, Rob Muir, has returned home after a 20-year career in the US at the forefront of technology commercialisation and venture capital. As well as the "good science is good business at ANSTO" tagline, Rob has launched the ANSTO Business Lab, an environment for learning and the evaluation, management and commercialisation of intellectual property and technologies.

ANSTO is also breaking new ground in providing a new incentive environment for its scientists and researchers, who are eligible to participate in potential commercial returns from ventures. This is being managed through the ANSTO Technology Innovation Awards program. In addition, a Technology Forum will involve staff from across the Organisation and which will help to further build the commercialisation culture in the organisation.

ANSTO's future plans for business development require:

- 1) Raising Australia's global scientific profile
- 2) Further development of the ANSTO Business Lab
 - Changing the focus from 'C for commercialisation', to 'C for customer',
 - Pursuing 'Investment-Ready Opportunities' built around ANSTO's three 'crown jewels' (mining, materials and radiopharmaceuticals) and partnerships, and
 - Building Australian templates for the successful transfer of technology from public-sector organisations such as ANSTO to the private sector
- 3) Creating additional sources of funding for research, collaboration, and global technology transfer.

In order to plan for these goals, ANSTO recognises the need to understand how the organisation is currently seen by the stakeholders and potential customers. Therefore it is undertaking a survey of its stakeholders, across staff, the community, business and government. This survey aims to identify stakeholder knowledge of ANSTO, attitudes to the Organisation and the resulting behaviour, as well as identifying stakeholder needs and issues, and the best way of communicating ANSTO's solutions to those needs and issues. Clearly, it is not only a matter of how ANSTO communicates what it does - this research may also influence ANSTO's decisions about what it does.

5. National Research Priorities

The initiatives regarding business development are one way in which ANSTO is seeking to maximise the value of its research and capabilities. Another way is through its involvement in the national research priorities. The Prime Minister announced the following four national

research priorities last December:

- An environmentally sustainable Australia
- Promoting and maintaining good health;
- Frontier technologies for building and transforming Australian industries
- Safeguarding Australia

While 'Safeguarding Australia' is suggestive of the physical security of nuclear and radioactive materials, the priority goals in this area address a broader range of research themes including:

1. Critical infrastructure
2. Protecting Australia from invasive diseases and pests
3. Protecting Australia from terrorism and crime
4. Transformational defence technologies

ANSTO has been looking for the past year at how it might best increase its research activity in this area, and where it might be able to provide nuclear-based services and technologies to other organisations.

ANSTO's capabilities in materials and engineering science are particularly relevant to other organisations. ANSTO, CSIRO and DSTO have held a number of workshops during the past year, and among items for discussion has been the role that ANSTO's materials testing capabilities, such as lifetime assessment services and welding technologies, could play a role in the critical infrastructure priority goal. ANSTO also has know-how and services that might be applicable in the defence technologies priority goal. The Organisation's capabilities in computer aided design of new components and for performing simulated testing on existing structures is relevant, as is its extensive ceramics processing facilities.

All of these capabilities have been built up over a number of years, in some cases such as materials testing services, they were built up to help keep HIFAR functioning effectively and safely.

ANSTO has a track record in research in recent years, to support IAEA work on safeguards, that is applicable to the "preventing terrorism and crime" priority goal. Current research addresses:

1. detectors
2. environmental monitoring for the detection of clandestine nuclear activities
3. nuclear forensics
4. the use of nuclear and technologically advanced techniques for classical forensic science research.

Last year a working group of the Prime Minister's Science, Engineering and Innovation Council investigated the contribution that science, engineering and technology could make to security. Further work was then undertaken in the Department of Prime Minister and Cabinet. ANSTO has been involved throughout these processes and has made significant contributions. The Organisation is currently working with CSIRO, DSTO, Geosciences Australia and other organisations and is participating in counter terrorism

forums to enable us to identify research opportunities. ANSTO is also developing close ties with radiation health services and HAZMAT divisions throughout Australia. For example, it can advise emergency response organisations on the detection, response and clean-up of radioactive incidents. ANSTO's linkages in this field also spread internationally. For instance, it has also been in discussions through the year on a proposed EU FP6 project on illicit trafficking detection.

6. Conclusion

In conclusion, there are a number of exciting future plans under way at ANSTO with a clear focus on the scientific and commercial benefits the replacement reactor will bring. The new infrastructure that is being developed will make an enormous difference to the work that ANSTO can undertake, and that others can undertake using the Organisation's facilities. In its preparations, ANSTO is concentrating on building client bases and on strengthening its relations with users, particularly with leading research institutes from around the world. It is also building linkages with other research performing organisations around Australia. It has in place a project management system that enables it to adapt to change so as the future unfolds, ANSTO will have the flexibility to respond. It is putting a great effort into building business linkages, to ensure the nation gains the maximum economic benefit from ANSTO's work.

All in all, the future looks bright for nuclear science and technology in Australia.

Table
The eight neutron beam instruments planned for the replacement research reactor

- Diffractometers:
 - High-resolution powder
 - High-intensity powder
 - Residual-stress
- Quasi-Laue
- Small-angle neutron scattering
- Spectrometers:
 - Polarisation analysis
 - 3-axis
- Reflectometer

Illustration (see next page)

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Illustration

The initial eight instruments for the replacement reactor

