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2011 Strategic Roadmap for Australian Research Infrastructure

A response from The Australian Plasma Fusion Research Facility and the Plasma Research Laboratory at the Australian National University

Dear Julia,

The Plasma Research Laboratory at the Australian National University is home to the Australian Plasma Fusion Research Facility which was awarded \$7M for infrastructure upgrade in the most recent Super Science funding round.

Fusion is the process that powers the stars, and with the exception of nuclear fission, underpins all of the energy sources available to human beings today. With the construction of the international ITER tokamak reactor in France, the world has committed to the practical realization of fusion energy - essentially undertaking to build our own sun.

Given our vision to ensure that Australia retains a critical capability in this strategically important field, we have taken a keen interest in the recommendations of the various Working Groups, and welcome the opportunity to provide feedback on the 2011 Strategic Roadmap for Australian Research Infrastructure.

Enclosed you will find a detailed response to various of the questions posed by the Expert Working Groups in the areas of "Environmentally Sustainable Australia" and "Frontier Technologies". Our comments have also been endorsed by a covering submission from the Research School of Physics and Engineering at the ANU.

Yours sincerely,



A/Prof Boyd Blackwell,
Director, APFRF



Prof John Howard,
Head, Plasma Research Laboratory

Environmentally Sustainable Australia Expert Working Group

1.A.1 What are your views on the key future research directions identified and are there other key areas that have not been included?

Fusion looms as a truly sustainable base-load energy option. Australia should ensure that it at least retains, and preferably expands its research capability and knowledge base as ITER comes on line in the next 10 years.

1.B.1 What are your views on the research infrastructure Capability areas identified, including their relative priority and their ability to support the current and future research needs?

While we acknowledge the need for greater support of energy systems research in the broader field of “a Sustainable Energy Future”, it should remain a priority to support research that promises delivery of clean base-load energy generation in the longer-term.

1.C.1 What are your views on the existing funded facilities, including their ability to meet the current and future research needs?

Recent Super Science investments have allowed for a much needed rejuvenation of dilapidated infrastructure at the Australian Plasma Fusion Research Facility (APFRF). Some immediate issues remain to be addressed:

- The Facility requires recurrent funding of order \$0.5M pa in operational support in order to fully utilize the upgraded infrastructure for magnetic confinement fusion research.
- An additional \$5M is required to address unfunded research infrastructure needs such as electron heating, diagnostic and magnetic configuration enhancements.
- Targeted Research Funding: The funding schemes presently operating in Australia do not suit the mission-oriented nature of plasma fusion research. The Future Fellowship and to a greater extent the Super Science Fellowship schemes are a move in this direction but targeted support for mission oriented research is required for optimum exploitation of facility infrastructure and to maximize the outcomes from “Big-Science” projects.

The Australian fusion science community plans a staged approach to engagement with ITER and the international fusion effort. This is being built on

- expanded international collaboration in areas of Australian expertise relevant to ITER research needs, especially in the areas of advanced diagnostics and fusion materials,
- exchange of personnel between Australia and ITER organisation partners working on advanced modeling, theory development and data analysis and
- the development of new local research capabilities such as the Materials Diagnostic Facility, a prototype of which has been constructed under Super Science funding.

With the closure of the International Science Linkages program, new avenues of funding need to be urgently found in order that the strong momentum in these activities is not lost. A feature of the ISL program was its ability to support research that exploited Australian infrastructure and thereby levered international engagement.

The Australian fusion science community aims to contribute home-grown technology and knowhow to the ITER project at a much lower cost than the entry cost to partners. This would most likely be in the form of diagnostic instrumentation for measuring some aspect of the plasma or machine performance. While this involvement will not buy Australia a share of the

industrial intellectual property underpinning ITER, it will enable the nation to remain technologically competent and cognizant of the science of fusion reactors.

An ITER engagement would, in many respects, be very similar to the Australian contribution to the Atlas detector on the Large Hadron Collider in CERN. The total investment, anticipated to be of order \$20M (excluding the Targeted Research Funding), is well within the remit of NCRIS.

1.F.1 Are there other programs/issues/developments not listed that you consider could be a driver for future research infrastructure investments or may impact on such investments

In line with our staged ITER engagement strategy, we have established thriving collaborations with many new and established Facilities and programs in Europe, Asia and the USA. These collaborations have delivered extended dedicated experimental run-time on major international devices, won international support for local R&D programs and led to multiple Australian-funded joint research activities. Australia should ensure that dedicated funding is available to consolidate international linkages and to establish collaborations on new frontline devices under construction in Europe (ITER, W7-X) and Asia (JT-60SA, IFMIF).

Frontier Technologies Expert Working Group

3.A.1 What are your views on the key future research directions identified and are there other key areas that have not been included?

In our view, fusion science and engineering is, itself, an emerging technology with the potential to transform base-load power delivery within the next generation.

In any case, fusion science embraces many of the key frontier technologies identified by the EWG, including data-mining, reduction and processing, advanced materials and measurements systems. For example, real-time control of fusion reactors based on realistic physical models, information from multiple distributed sensor systems and powerful computing is one of the key challenges for fusion science.

3.B.1 What are your views on the research infrastructure Capability areas identified, including their relative priority and their ability to support the current and future research needs

Australian fusion science will benefit from advances in computational and simulation science. In particular, future engagement with the international fusion program could leverage domestic advances in sensors and measurement systems.

3.B.2. Should there be a shift in the balance between funding new infrastructure and funding expertise to serve the needs of researchers?

We support investment in development of expertise to enable full exploitation of new or upgraded facilities and infrastructure (see “Targeted Research Funding” in 1.C.1).

In particular there is a need to support Australian participation in overseas programs and consortia. We would regard possible Australian partnership in the European Eighth Framework Program (FP8), which includes the nuclear component, as an important step towards facilitating a more seamless engagement with ITER and the EU fusion program.

3.C.1 What are your views on the existing funded facilities, including their ability to meet the current and future research needs?

See response at 1.C.1

3.E.2 Are there particular areas of research strength within Australia that could be harnessed to create powerful new research capacity and impact through the provision of new cross-disciplinary infrastructure and expertise?

The ANU and ANSTO, under the auspices of a recently signed MoU that encourages greater mutual collaboration, have established a new research activity in the area of advanced materials for fusion science applications (see also the materials diagnostics facility noted in 1.C.1). Should the prototype device (now complete) deliver new and important results, we anticipate the construction of a more advanced device that, at modest levels of further investment (\$4-5M), could be configured to harness the full power of the existing APFRF magnet supply and heating infrastructure.

3.F.2 Do NCRIS/EIF/Super Science Frontier Technologies investments adequately balance the needs between science and engineering?

In the case of the Australian Plasma Fusion Research Facility, the upgrade funding has been allocated to deliver both essential engineering refurbishments and improvements in scientific research capability. In the latter case, however, there is a need for ongoing operational support, and targeted research funding, to ensure that the new scientific capabilities are fully exploited.