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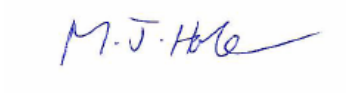
NCRIS Secretariat,
Department of Innovation, Industry, Science and Research
GPO Box 9839
CANBERRA, ACT 2601

Dear Secretariat,

Please find enclosed a submission to the 2008 Review of the NCRIS Roadmap. The submission is made on behalf of the Australian ITER Forum. I enclose as attachments the Australian ITER Forum strategic plan for fusion science and engineering, and letters of support.

Yours Sincerely,



Dr Matthew Hole,
Chair, Australian ITER Forum

Response to NCRIS Discussion Paper: "2008 Review of the NCRIS Roadmap"

This submission relates to Australian involvement in the ITER project, which was promoted from "Low-emission, large-scale energy processes" capability to the (NCRIS unfunded) category of Landmark Infrastructure in the February 2006 NCRIS roadmap. We draw attention to significant developments since this roadmap was compiled, and make recommendations for infrastructure to facilitate ITER engagement that are within the NCRIS funding envelope. When combined with separate human capacity investment, we submit that these would constitute an appropriate level of Australian engagement in ITER.

The Australian ITER Forum[1] now spans over 130 Australian scientists and engineers drawn from universities, Government research laboratories and industry, who support an Australian involvement in the international development of fusion energy via ITER project participation. In October 2006, the Forum held a workshop "Towards Australian involvement in ITER", which was attended by delegations from five of the seven ITER partners, Australian industry and government representatives, and opened by the Chief Scientist of Australia. Building on this, the Forum developed a strategic plan for fusion science and engineering,[2] drawing input from the international and domestic research community, as well as government departments and industry. The strategic plan articulates the opportunities and benefits presented to Australia by joining other nations in the development of fusion power and proposes a new, multi-faceted Australian Fusion Initiative ("the Initiative") that spans the innovation system as it pertains to strategic research, innovation and industry involvement. This Initiative, if supported, secures Australian scientific expertise with a targeted fellowships scheme, provides appropriate support for Australian fusion science infrastructure, and yields Australian involvement in ITER through provision of an instrument or similar apparatus. The Initiative is budgeted at $63 million over 10 years, with $24.2 million relating to infrastructure and infrastructure management.

To date, letters of support for the strategic plan and Initiative have been received from the ITER organization, the Australian Nuclear Science and Technology Organisation, the H-1 Board, seven Australian Universities, and five Australian learned societies and Academies. In conjunction with these planning efforts we have pursued substantial outreach activities, policy engagement, and government consultations to explain the opportunities provided by fusion and ITER.

In light of these developments, we submit that:

- ITER engagement be removed from the Landmark Infrastructure category, and the $24.2 million infrastructure component of the Fusion Initiative be placed in the "Low-emission, large-scale energy processes" capability
- The "Low-emission, large-scale energy processes" capability is relevant to both the "An Environmentally Sustainable Australia" and "Frontier Technologies" National Research Priorities, and so should have been assessed by both Expert Working Groups. The NCRIS committee should appoint energy experts to both Working Groups, who are qualified to evaluate ITER participation as well as any other proposals in the "Low-emission, large-scale energy processes" capability.
- The NCRIS Committee recommend that Government further develop the fusion science and engineering strategic plan, by funding a facilitator to work with the ITER organization, international scientists and the Australian community to identify and fully cost an ITER machine contribution within the scope of the strategic plan, and produce an engagement contract with the ITER organization. Such detailed discussions can only occur at a government-to-government level.

In the remainder of this document, we frame the detail of our response according to the document compiled by the Frontier Technologies Expert Working Group, and the questions it raises.

Section A: General comments/views on relevant capabilities in the current Roadmap
Do you generally agree with the views of the expert working group on the current NCRIS Roadmap capabilities?

As noted by the Expert Working Group, alternative energy sources are not explicitly addressed in the current Roadmap. Given the central importance of energy to economic growth and the intimate connection with climate change, we believe emerging alternative energy technologies must be included, noting the potential for substantial cross-fertilization (e.g. high temperature materials). In particular we propose an appropriately scaled investment to engage in the ITER project for the continued development of expertise and capability in fusion energy research and development.

We submit that the detail currently in the low-emission, large-scale energy processes capability is insufficient, and does not capture any Australian strategic planning in relation to that capability. The expert working group should include a description of relevant strategic planning developments, and appraise the benefits of relevant research infrastructure investment, as they have done for the characterization, fabrication, astronomy, biomolecular platforms and ion accelerator capability.

In the case of fusion, we note that the 2005 NCRIS Exposure draft highlighted "the long-term potential of nuclear fusion as an abundant, relatively more environmentally friendly source of energy" and recognized "Australia's strong background and expertise in fusion physics". At the time, the NCRIS Committee did not "view Australian participation in ITER as an immediate priority for NCRIS funding, in part because of uncertainties relating to the scale and nature of the commitment required and in part because of the very long-term nature and uncertain outcomes of the research itself." Participation in ITER was subsequently promoted to the Landmark infrastructure category of NCRIS in the 2006 roadmap. Our strategic planning activities have now removed most of the uncertainties in scale and commitment required regarding ITER participation. We also note fusion power development has a similar time frame and outcome-uncertainty to CO2 sequestration, but with global rewards that dwarf those of sequestration, which was promoted in the 2005 roadmap.

What are your views on the currency/relevance/prioritisation of the NCRIS capabilities discussed here?
The currency of the low-emission, large-scale energy processes capability, as it pertains to fusion, is now critical. Major National Research Facility funding of Australia's only toroidal magnetic confinement experiment, the H-1 National Plasma Fusion Facility, expires in 2010. Beyond this time the ANU can not guarantee operation of the facility, and so without future investment, much of the enabling infrastructure for Australia's fusion research effort will cease. As outlined in the strategic plan, the nation also needs immediate complementary investment in human capacity, to maximise leverage of the $20 billion, next generation international fusion science facilities associated with the ITER experiment that are currently under construction.

It is now accepted that climate change is the greatest threat to our way of life, and that CO2 produced by large-scale energy processes is largely responsible. In our opinion, many of the capabilities assessed by the Frontier Technology panel, whilst important, provide either incremental improvements to our standard of living, or are entirely discovery based (e.g. astronomy). Given the impact of climate change and the pressing need for alternative base-load energy generation sources, we submit that large-scale low-emissions energy processes capability is extremely relevant, and should have top prioritisation.

Section B: Views on current NCRIS investments

Do you consider the current NCRIS investments are meeting the identified needs?
No. The large-scale low-emissions energy processes capability is unfunded.

Are there other needs that are or could be met in the future by/for the current capabilities described here and how would you prioritise these?

As described in our strategic plan, we have outlined investments that would be required to provide a sustainable capability in fusion science and engineering and to engage the ITER project. In detail, the proposed investments components comprise:

A. 40 competitive fusion fellowships ~$32M over 10 years. These are essential to providing a sustainable capability, and to maximize broader leverage of international infrastructure investments.
B. ITER "flagship" machine contribution ~$9.3M - multi-institutional, multi-disciplinary. While the machine contribution has not been decided, there is strong international support and domestic skill base for a plasma diagnostic.
C. Key infrastructure ~$1.8M – essential to mounting machine contribution, subject to international review
D. Infrastructure leverage fund ~$9.5M over 10 years, with open competition for infrastructure.
E. Operating fund $2.5M over 10 years. Open competition. 2/3 funding from initiative, 1/3 from elsewhere.
F. Collaboration and exchange ~$4.7M over 10 years
G. Management ~$3M over 10 years

The infrastructure and operational components, items B, D, E, and the infrastructure fraction of G, total $24.2 million.

Section C: Views on other current developments relevant to the capabilities and areas under consideration

Are there other programs/developments not listed that you consider are of relevance to the capabilities discussed here?

The NCRIS roadmap discussion paper poorly reflects on international developments and how they relate to the capabilities under consideration.

With respect to the programs described in the discussion paper, we note that fabrication and characterization capabilities may have benefit to fusion development, in context of developing new high heat-flux and neutron flux resilient materials.

Are there any specific ICT requirements that you want to highlight as necessary to the specific capabilities discussed here?

Fusion science has become increasingly global in nature, and this trend will only accelerate as the next generation, truly international experiments come on line. Both remote data access and remote participation in experimental campaigns, such as provision of a virtual control room environment, will be necessary to gain maximum benefit.

Section D: Strategic, emerging and/or new areas of research - future directions?

Do you agree that those areas identified are of importance/relevance?

Interpreted in a broad sense, the research area, "Complex static and dynamic systems modelling, simulation and visualization across wide time and length scales", is highly relevant. Fusion plasmas comprise more than 10^{20} charged particles which are confined in an electromagnetic structure full of resonances. Physics phenomena range in spatial scale ranging from the electron Larmor radius (micrometres) to the device scale size (metres), and temporal scale ranging from the electron

cyclotron period (picoseconds) to the energy confinement time (seconds). The modeling, simulation and visualization of this complex system are extremely challenging, and a field rapidly growing with the growth in computer power.

The Fabrication and Characterization Frontier Technologies should be modified to include high heat flux, neutron-flux resilient materials.

Are there other areas that have not been identified?

N/A

What are your views on how these areas relate to current NCRIS capabilities?

The above two are relevant to fusion.

Section E: Cross-capability research infrastructure needs

Are there other cross-capability areas and linkages that have not been identified?

Facilities to enable distributed, remote real-time participation in experiments as described in response to Section C

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1 www.ainse.edu.au/fusion.html

[2]2 "A strategy for Australian fusion science and engineering: Through ITER and into the future", http://www.ainse.edu.au/__data/assets/pdf_file/0003/16482/aust_fusion_strategy_2007.pdf