Inter-university Nuclear and Radiation Community of Practice
31 August 2023

Australian Universities Accord Panel

Australian Universities Accord Interim Report

Dear Prof O'Kane,

Thank you for the opportunity to provide input. The Inter-university Nuclear and Radiation Community of Practice (see Attachment A for background, membership and signatories) suggests three main changes that would help address the apparent skills, research, and public awareness shortcomings in the AUKUS-relevant areas of nuclear science and engineering and health physics. We detail our recommendations and arguments below.

Research and education are not decoupled

The report deals with research and education separately. In the tertiary sector as currently structured, research priorities influence available expertise, and therefore have a strong role in shaping both the educational offerings and the staff available to deliver them.

Nuclear science and engineering – mentioned in the report as an area of sovereign need – provide a clear example of this strong coupling of research and education. Based on experience – confirmed through a review of ARC Discovery Program data from the last 10 years – there is currently very little research in nuclear science and engineering in Australia. It is no coincidence that the strongest educational programs in these areas suitable for developing graduates with nuclear expertise are in close proximity to nuclear facilities, nuclear relevant industries, and health and medical radiation facilities. National facilities at ANSTO, the NCRIS-funded Heavy Ion Accelerators (at ANU and University of Melbourne), and facilities within the South Australian Health and Medical Research Institute (SAHMRI) support internationally recognised research activities and attract and train staff to enable such research and development. Staff at these facilities and affiliated Higher Education institutions do far more than perform research: they support outreach programs within their local communities and across the Asia-Pacific region, create and deliver educational offerings for students pursuing everything from secondary to postgraduate studies, and attract new international talent to Australia.

This coupling of research and education occurs by design and is important to maintain. It is well documented through student surveys that research-led education enhances student experience. It develops critical-thinking skills through solving real-life problems, providing experiential learning and opportunities to study under experts working at the leading edge of their respective fields. Student access to research environments working at the interface of nuclear science, engineering, health and medical radiation physics, also helps them develop a 'nuclear mindset' and the requisite skills required to maintain safety and security in nuclear settings – preparing them to take on roles requiring nuclear expertise in sectors where nuclear stewardship is key. We recommend:

- Clearly recognising the important connection between research and education in developing educational pathways to address sovereign skills shortages and capability gaps; and
- Considering how to use research to enhance sovereign capability in areas where skills gaps exist.

Critical education, skills and research gaps require a holistic, whole-of-nation response

As noted in the report, nuclear engineering skills are in critically short supply – but this skills gap extends well beyond nuclear engineering. The AUKUS nuclear-powered submarines program (and the industry required to support this) will need a very large number of nuclear-trained engineers and scientists. They will also need experts in law, regulation, and social science with an understanding of nuclear science and technology and the social and regulatory challenges that

come with nuclear stewardship. The Australian Government will soon have six agencies that are heavily reliant on this expertise.[1] Nuclear expertise is also a critical part of soft diplomacy on nuclear and non-proliferation issues, and is crucial for building and maintaining social licence for the use of nuclear technologies.

Sovereign capacity is not just about building an Australian skilled workforce, it is the capacity to sustain and develop this workforce over time. This requires a world-class, robust research sector capable of attracting high calibre Australian and International expertise with the capability and capacity to support a sovereign training pipeline at an appropriate scale.

- Gaps in training in very high-skill, specialist areas cannot be filled without appropriately qualified academics to develop and deliver courses. Growing training capacity requires closing the loop, with greater throughput into HDR level, and greater levels of research support to attract and retain academic staff. This needs to be coupled with sufficient sustainable funding to retain these staff on continuing contracts.
- Inspirational academics are essential to attract students into areas where skills are in high demand. In our experience, the outreach work academics do in our communities and in schools contributes strongly to our existing student pipeline.
- The support and mentorship academics provide to students from underrepresented backgrounds is essential for attracting and retaining diverse students in areas of sovereign need – particularly when students are not considered qualified for many roles until they have completed post-graduate education and extensive on the job training (as is the case for nuclear and radiation sciences and engineering). This takes time and requires that academics have sustainable workloads.
- Where these major skills gaps exist, lifelong learning is critical to allow the existing workforce to re-tool to rapidly fill gaps. Due to security requirements – and the possible existence of and risks associated with similar skill gaps abroad (as is applicable in the nuclear and radiation sciences and engineering fields) – it is highly unlikely that these skill gaps can be filled by migration. We must have a sovereign education capacity to train Australians to fill these roles.
- Government and industry demand for a sovereign workforce does not directly translate to University interest in taking on more domestic students in programs aiming to address sovereign skills gaps. Universities currently have a greater incentive to take international students over domestic students in programs that develop these skills as a result of the greater discretionary funding that international student fees bring in. In many cases, education leads would like to take more domestic students on, but are told they cannot.
- Rapid responses to changes in sovereign need are exceptionally hard to make when the existing research and training base is spread so thinly. For example, the current tenured academic nuclear physicists in Australia actively working in the field (of which there are approximately 15 total in the country – 4 at ANU, 4 at University of Adelaide, 3 at University of South Australia, 1 at UNSW Canberra, 1 at UOW, 2 at UNSW Sydney) are already at capacity for PhD student training. They are doing this while also scaling up their educational and outreach offerings considerably to meet Australian government needs — and are in many cases already working well beyond sustainable capacity. Nuclear engineering has similar challenges.
- With the existing limited investment in research in these national priority areas, it is very difficult for Universities to direct the small pool of experts they have – which are already working on existing research and education priorities – towards programs focused on building sovereign capability. To quickly incentivise growth in areas of sovereign need, demand should be signalled through funding for Universities aimed at supporting the costs of starting or growing research and education activities in these areas.

[1] Australian Radiation Protection and Nuclear Safety Agency (ARPANSA); Australian Nuclear Science and Technology Organisation (ANSTO); Australian Radioactive Waste Agency (ARWA); Australian Safeguards and Non-proliferation Office (ASNO); Australian Submarine Agency; Australian Nuclear-Powered Submarine Safety Regulator.

- When capability in an area of sovereign need is in such short supply nationwide, competition is counterproductive. Instead, providing incentives to collaborate – to encourage efforts to scale education and research training across multiple institutions, share capability across state and territory borders, and help students access training even if they are not near universities with existing expertise – are crucial. We note that scaling training cannot simply look like providing online offerings when hands-on training is crucial for developing the required skillset.
- Such skills gaps cannot be considered in a vacuum. In nuclear and radiation sciences and engineering, for example, there is significant demand for these skills in other sectors, including in resources and mining, healthcare, and critical advanced technology fields such as space, defence and quantum computing. The needs of AUKUS Pillar 1 alone will have a substantial impact on adjacent sectors where nuclear skills are necessary, requiring careful coordination and planning between industry, government, and academia.

As such, we require a holistic approach to addressing sovereign risks in education and research. We recommend:

- Limited term ring-fenced research funding for research in areas with critical skill shortages to support pipeline growth. Current Category-1 funding sources such as the ARC and NHMRC are not fit for purpose - they cannot be easily accessed without a track record of existing research activity, and require a significant time commitment to apply, with low application success rates. Funding should encourage nationwide collaboration between institutions to help seed new education and research activity in a strategic way.
- Funding research groups and HDR scholarships by research area rather than project. This could be a more sustainable approach to research training and expertise development in areas of sovereign need, and could incentivise high quality research training through regular assessments of training outcomes. This approach is used by the US Department of Energy (DOE) to support nuclear skills development in DOE labs, and in the UK through UKRI funding to universities for Centres for Doctoral Training.
- A reconfiguration of how funding for Commonwealth Supported Places is distributed for sectors with critical sovereign need. For example, providing start-up funding based on a budget and plan submitted with a CSP application could provide essential setup funds before students start to support an uplift in critical capability areas.

Research assessments have value beyond evaluation of quality

Research assessment frameworks provide a means of capturing the status of Australia's research and HDR training capacity in detail, both in terms of quality, and the breadth and depth of capacity. This broader set of information is essential for defining a research funding strategy, and to identify critical fields where there is either insufficient capacity (e.g., by number of outputs, HDR completions, dollar value), a need for enhanced quality, or both. Critically, to effectively identify gaps the information must be sufficiently fine-grained – at the six-digit FoR code level – whilst not adding significantly to the burden of completing the assessment. Valuable information could include:

- Data on research training, including PhD disciplines and career pathways following graduation.
- Measures of research and educational impact, student training, and contributions to employment pipelines in areas of sovereign need.

Such data should be aggregated at a national level, to identify national gaps in capability – and should be connected to policy mechanisms designed to fill gaps in a strategic way.

Attachment A - Inter-university Nuclear and Radiation Community of Practice

The Inter-university Nuclear and Radiation Community of Practice was established in 2022 as a forum for discussion and collaboration on higher education and research relating to nuclear and radiation science.

The group represents a large fraction of Australia's research community in nuclear and radiation science and engineering, and extends into health physics and medical radiation physics. Representatives from nine Australian universities are included in the membership, and all are co-signatories of this submission.

Co-signatories for this submission: [In alphabetical order by surname]

Professor Eva Bezak *Prof. Medical Radiation, PhD Nuclear Physics* University of South Australia	**Dr Patrick Burr** *Nuclear Materials Engineer* UNSW Sydney
Professor Mahananda Dasgupta *Nuclear Physicist* Australian National University	**Dr Julieanne Dougherty** *AUKUS Program Manager* Australian National University
Dr Pejman Rowshan Farzad *Medical Physicist* University of Western Australia	**Dr Paul R. Fraser** *Nuclear Physicist* UNSW Canberra (ADFA)
Associate Professor Antony M. Hooker *Radiation Biologist* University of Adelaide	**Professor Michael Lerch** *Solid State Physicist* University of Wollongong
Associate Professor Nigel Marks *Materials Physicist* Curtin University	**Dr AJ Mitchell** *Nuclear Physicist* Australian National University
Dr Edward Obbard *Nuclear Engineer* UNSW Sydney	**Dr Freyja Peters** *Research Strategy and Development Manager* Monash University
Professor Michael Preuss *Metallurgist* Monash University	**Professor Anatoly Rozenfeld** *Radiation Physicist* University of Wollongong
Dr Edward Simpson *Nuclear Physicist* Australian National University	**Professor Nigel A. Spooner** *Radiation & Materials Physicist* University of Adelaide
Associate Professor Dr Heiko Timmers *Nuclear Physicist* UNSW Canberra (ADFA)	**Dr Elizabeth Williams** *Nuclear Physicist (based in Engineering)* Australian National University