The Significance of the Tri-Partite AUKUS Agreement

A paper based on a a presentation to the Institute in Sydney on 25 January 2022 by

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The tripartite technology information agreement between Australia, the United Kingdom and the United States of America (AUKUS) was announced on 15 September 2021. This article is based on the recent presentation given by the author entitled 'Nuclear powered submarines and other AUKUS technologies for the Australian Defence Force (ADF) at a meeting of the Royal United Services Institute for Defence and Security Studies (RUSIDSS) in Sydney, New South Wales. The article provides an overview of AUKUS and the four technology aspects explicitly mentioned in the announcement, nuclear submarine overview, the more stringent safety and design issues that are mandatory for a nuclear submarine including the full life cycle of the nuclear fuel, and the implications and opportunities for RUSIDSS in contributing to the realisation of the AUKUS goals.

Key words: AUKUS; nuclear submarines; cyber warfare; artificial intelligence; quantum computing; undersea sensory technology.

On 15 September 2021 Australia entered a new era as the three leaders of Australia, UK and the USA announced the formation a new security partnership, the AUKUS Agreement, covering the sharing of technical information and experience on cyber security, artificial intelligence (AI), quantum computing and undersea technology, especially enabling Australia to acquire nuclear powered submarines. The Australian Prime Minister expanded on the latter to state that this would be a program of at least eight nuclear powered submarines (SSN) to be built in South Australia starting in 2030, with the delivery of the first submarine by 2040. The process for this SSN program is under joint development within a Nuclear-Powered Submarine Taskforce (NPSTF) with a deadline of 18 months, by March 2023.

This paper reflects the extraordinary level and diversity of public discussion on AUKUS and nuclear technology, including submarine propulsion that erupted since the first announcement. There is little sign of any diminution of this torrent of discussion, analysis and debate on AUKUS, both domestically and in the broad international geopolitical domain.

Geopolitical Situation in the Indo-Pacific

Within the Indo-Pacific region, continental Australia is a major geographical feature with steadily increasing heft in geopolitical influence and obligations. This has changed significantly over the past five years, leading to the 2020 Defence Strategic Update[1] and the realisation, *inter alia*, that the 'Future Submarine Project' to design and build 12 Attack-class conventionally powered submarines would be too little, too late. Accordingly in late 2020, the Australian government directed an investigation of alternative means to meet more stringent requirements which has resulted in the SSN part of AUKUS.

The Scope of the AUKUS Agreement

This paper covers five fundamental aspects relating to the scope of the AUKUS Agreement for Australia:

- The geopolitical situation facing Australia changed significantly since the 2016 Defence White Paper, as was reflected in the Defence Strategic Update of 2020 which enabled consideration of nuclear submarines for the RAN for the first time.
- The nature of the AUKUS Agreement and the follow-on 16-page Agreement between the three governments for the 'Exchange of Naval Nuclear Propulsion Information'[2]. Importantly, the Agreement specifically reaffirms the commitment to the obligations under the Nuclear Non-Proliferation Treaty (NPT), including the application of International Atomic Energy Agency safeguards on all peaceful nuclear activities in Australia. The latter proviso, the strict rejection of nuclear weapons and the Agreement to not pursue a nuclear power industry, were the conditions to the prompt support for AUKUS by the Australian federal opposition party, the Australian Labor Party.
- The announcement specifically mentions several disruptive technological development areas for the three-way sharing of information discussed individually, concluding with an overview of nuclear propulsion technology, as they are expected to contribute to the capability of the Australian Defence Force (ADF).

[1]2020 Defence Strategic Update. Department of Defence, Government of Australia: https://www.defence.gov.au/about/publications/2020-defence-strategic-update

[2]Agreement between the Government of Australia, the Government of the United Kingdom of Great Britain and Northern Ireland, and the Government of the United States of America for the Exchange of Naval Nuclear Propulsion Information executed in November 2021. See: https://www.defence.gov.au/sites/default/files/2022-01/Information-Agreement_0.pdf .

- The implications of an Australian SSN program for the wider aspects of Australia's engagement with nuclear science, technology and engineering, and related legal and international frameworks.
- The implications for the RUSIDSS of the AUKUS technologies and related issues.

Artificial Intelligence (AI) and Machine Learning (ML)

AI, often linked with ML, is an extensive field of development of machine intelligence that is initiated by human programming, but has been further modified, extended or enhanced by reference to external sensing of surrounding information state and dynamic behaviour, and even more so by historical reference to very large datasets, sometimes termed 'big data.'

AI/ML is a powerful addition to the field of autonomous uncrewed vehicles (AUV) which is expanding pervasively into almost all fields of activity previously performed by humans, domesticated animals and human-controlled machines.

A current reference to this area is *AI in War* (Tangredi, 2021) which is included in the Ursula Davidson Library at RUSIDSS NSW.

The Australian Department of Defence has recognised this revolutionary expansion with the establishment of the first 'Defence Cooperative Research Centre for Trusted Autonomous Systems' (TAS DCRC)[3].

Cyber Security and Information Warfare (IW)

Cyber security and cyber war are adequately described in *Cybersecurity and Cyberwar: What everyone needs to know* (Singer, 2014), and is a vexed and growing challenge that continues to elude comprehensive defence measures. It also contributes a potent new direction to the more general field of information warfare based on management of information for national security.

The scope and management approach to 'Cyber Security and Warfare' was presented by Major General Susan Coyle to RUSIDSS in 2021 and viewing the video of the presentation is recommended[4].

Quantum Computing

Quantum computing is an emerging field with the potential to provide a revolutionary increase in computer capacity and also to deal with information that can take on multiple states rather than the fundamental binary (0 or 1) state of current computing technology. The implications of this development are not yet clear but will undoubtedly be significant in ways yet to be determined. *Quantum Computer Science: An introduction* (Mermin, 2007) gives a summary of the mathematical relationship involved but is unhelpful in assessing the timeline and applications of interest to the ADF.

A recent special issue of the Institution of Engineering and Technology journal is more readily understood but is still removed from providing clear implications for Defence[5]. The recent issue of New Scientist has news of further development but admits 'there are still challenges in scaling up the technology'[6].

Undersea Technology

The fourth area of trilateral collaboration is in the general field of undersea technology, which covers a broad sweep of technological domains from visible light through to very low frequency acoustic signals. The focus on undersea technology is very appropriate as it has consistently been less developed due to the fundamental inability of radio-frequency (RF) signals to penetrate bodies of water, except at extremely low frequencies (ELF), even then, only with significant investment, such as in the Harold E.Holt Very Low Frequency Radio Communications station on Australia's North-West Cape.

The focus in undersea technology has been in two main areas – sensory and communications. The sensory field has concentrated on a variety of means of detection and measurement of underwater activity, which have been fundamentally acoustic and magnetic. The communications field has also used the same technologies but has added the use of wire or optical fibre cables to overcome the limitations of attempting secure communication through the water medium.

Nuclear Powered Submarine Capability for Australia

The dominant public discussion has focussed on the SSN capability, raising questions on the justification, selection of design and the strategic partner country, workforce development to meet onerous regulatory safety and anti-proliferation concerns, and the inevitable cost and schedule challenges of the SSN acquisition program.

Emphasis on timing has been a contentious area even before AUKUS, with the current Collins-class submarines requiring major investment to extend their service life by a further decade, which even then fall short of the announced SSN delivery dates. A major challenge for the Nuclear Powered Submarine Task Force (NPSTF) will be to optimise the timing of SSN delivery dates with submarine force structure mandatory numbers[7].

The use by both the UK Royal Navy and the United States Navy, in their current SSNs of highly-enriched uranium (HEU) nuclear fuel which could be converted for use in nuclear weapons, requires stringent management of nuclear fissionable material to ensure adherence to the multinational NPT. However, Australia has experience of these processes from the operation of the former HIFAR and current OPAL nuclear reactors by the Australian Nuclear Science and Technology Organisation (ANSTO).

[3]See: ttps://tasdcrc.com.au/about-us/.

[4]See: https://rusinsw.org.au/site/VideoTheatre45.php. *United Service* **72** (3) September 2021.

[5]FRYER, Tim. *'Quantum. Get ready for Hyperdrive'*. Institute of Engineering and Technology, Journal Vol 14 Issue, 4 May 2019.

[6]WILKINS, Alex. *'First fully programmable atom-based quantum computer'*. New Scientist, Vol 253, No.3370, 22 January 2022. P9.

[7]See: https://www.defence.gov.au/about/taskforces/nuclear-powered-submarine-task-force.

The selection of the design from the two SSN designs currently in production, or a hybrid of the two, or inclusion in the follow-on design processes that has been initiated by each country, is moot. The NPSTF has this as an early consideration, as many of the acquisition processes are dependent on this choice. Thereafter there will need for detailed analyses and selection of preferred options to present to the three governments for their respective approval, not later than the March 2023 deadline for the NPSTF.

Essential Areas for the NPSTF to Address

The NPSTF must address several essential areas of policy and technology that are inherent in the adoption of nuclear propulsion, as has been documented in several recent papers[8].

The major topics and the related key issues are:

- What are the benefits of nuclear propulsion for Australia's submarine fleet?;
- History of nuclear propulsion since its first introduction in 1955;
- Challenges in nuclear propulsion that are unique to Australia, a country without a general nuclear industry supporting electric power generation;
- The full nuclear fuel cycle and specifically the differences that apply to stages of the fuel cycle for a submarine nuclear reactor, compared with a civil reactor such as the ANSTO OPAL reactor. There is also the common requirement for permanent disposal of intermediate level nuclear waste material that results from spent nuclear reactor fuel after reprocessing, to remove residual fuel and other products requiring explicit management such as plutonium;
- The additional infrastructure needed for the safety and security of nuclear propulsion. This requires existing infrastructures to be reviewed and new facilities to be built to meet stringent standards to be approved by the Australian nuclear submarine regulatory bodies yet to be established;
- The additional regulatory policy and organisational needs must be fully addressed at an early stage to provide the basis for all other work to proceed. If the practice of other western nuclear navies is followed, there will need to be an independent nuclear propulsion regulatory body established with reporting lines independent of the Defence portfolio, to ensure there is full objectivity and accountability in nuclear propulsion development;
- Construction of nuclear submarines, both, in general, and specifically for construction in Australia. This is a complex question because the final assembly in Australia will necessarily include the integration of the nuclear reactor section or module with other sections and modules some of which may be constructed at the same site, but could also be manufactured elsewhere at sites that are not necessarily nuclear licensed. The current submarine building and deep maintenance site at the Osborne North site in South Australia has not yet been assessed as meeting the safety and security criteria that have been mandated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) for visits by nuclear powered warships, which may be expected to form the basis for extended rules for construction and reactor initiation after launching;
- Workforce development, both civilian and uniformed, will be a major challenge that will take several years to enable full Australian participation in the design and development work. In many respects this could be the critical path in the program. The leasing of one or more commissioned and crewed nuclear submarines from the source country for the Australian program is proposed as a practical means to raise the level of experience and on-the-job training with boats to be based at Fleet Base West, and to provide crewing spaces for Australian submariners to acquire nuclear submarine qualifications of that source navy.
- The engagement with the civil nuclear activities of ANSTO and the international community in matters such as the NPT must be fully agreed with all involved parties in all relevant portfolios, including Foreign Affairs and Science and Technology.
- The cost and time budget for all of the work to be undertaken are critical issues, especially with the looming end of service life of the current Collins-class submarine fleet, even with the commitment of the life-of-type-extension of a further decade for each boat. The NPSTF have a major challenge to advance the delivery dates for nuclear submarines, compared with the original announcement to avoid the possibility of a reduction in submarine force numbers.

Geopolitical changes arising from SSN acquisition

Overall, the revolutionary change in strategic direction that AUKUS has precipitated is most evident in the switch to nuclear powered submarines. The support for AUKUS by both UK and USA was essential in the nuclear submarine decision because the original agreement by USA to provide critical nuclear technology to the UK carried with it the obligation for US approval for any transfer to a third party. This is clearly laid out in the text of the AUKUS Agreement for 'Exchange of Information on Nuclear Propulsion', and further elaborated in the report from the Commonwealth Joint Parliamentary Committee on Treaties which concluded:

> "The proposed Agreement would establish a legally-binding framework for the disclosure and use of information related to naval nuclear propulsion among the three nations, without which it would not be possible for Australia to determine the optimal pathway to deliver the submarine capability" (Joint Standing Committee on Treaties, Report 199, December 2021).

Other Areas of Australian Defence Significance

There are areas of technological development worthy of consideration but are not explicitly mentioned in

[8]For example: SKINNER, Christopher. *'Nuclear Propulsion Roadmap for Australia – 2021: Update to Reflect AUKUS.'* Australian Naval Review 2021, Issue 2. Australian Naval Institute, Canberra. 2021.

AUKUS, including the major investment in guided weapons design and manufacture, with special interest in the emerging field of hypersonic cruise missile strike capability[9]. Then there is the field of autonomous and remotely operated vehicles in air, surface land, sea and sub-sea domains. This is well underway es evidenced by the Australian Loyal Wingman program for remotely operated air vehicles.

Implications of AUKUS for RUSIDSS

The area for consideration by RUSIDSS is how to contribute most effectively to the development and adoption of the AUKUS technologies, and how to do this in the manner identified in the RUSI Seminar of 23 November 2021[10], when it was concluded that RUSIDSS should imagine the future of defence and security confrontation in the light of advances in technologies and changes in societal values and resources. The rationale for this approach is to challenge the current thinking in Defence and ask what else needs to be done or avoided, based on the extraordinary accumulation of knowledge and experience within the RUSI membership and its network of contributors.

The SSN taskforce is expected to report to the Australian parliament in mid-2022 when there will be a much greater focus on what is intended to be done. RUSIDSS will then be able to select from a broad range of issues to pursue in the latter part of 2022.

The wider range of issues that seem worthy of consideration are:

- AUKUS is a game-changer in many differing ways;
- Technology is the formal focus of AUKUS, and will show the visible progress following the agreement;
- The geopolitical landscape in the Indo-Pacific is changing rapidly and Australia's commitment to nuclear submarines is only one of several manifestations of the changes;
- The other technologies mentioned in AUKUS are current and emerging challenges for national defence and security;
- However these and other significant technologies, including autonomous vehicles, guided weapons and new energy sources are achievable more broadly;
- Future measures proposed are:
  - Work with academia, industry and wider community for technology innovation;
  - Collaborate and support NPSTF work; and
  - Engage internationally.

Conclusion

The AUKUS Agreement is an extraordinarily significant event in Australia's geopolitical future and will be regarded as a point of departure in our sovereign capability development, irrespective of the actual trajectory that is ultimately followed.

AUKUS may well have been mandated by the original agreement transferring nuclear propulsion information from USA to the UK requiring US approval for any further transfer. But the over-arching significance of both UK and US leaders stating publicly their support for transfer of such information to Australia is of profound significance as the wide-ranging global commentary on AUKUS has confirmed.

The result is the greatest technological challenge that Australia has ever faced to prepare for and execute the nuclear submarine program within a challenging time-frame, that reflects the previous inattention to the ongoing maintenance of the Australian submarine force but also the decades-long false assumption of the necessity for a nuclear power industry when that is no longer asserted.

The Author

Christopher Skinner served 30 years in the RAN as a Weapons and Electrical Engineering officer in six surface warships in the South-East Asia Treaty Organisation, the Vietnam War and North-West Indian Ocean surveillance. He served in all three of the previous class of guided missile destroyers. Shore postings included involvement in the Oberon-class Submarine Weapons Update Project, secondment to the US Naval Sea Systems Command to conduct first-of-class trials of a joint frigate project, and initial Project Director for the ANZAC Frigate program of ten ships for Australia and New Zealand. His involvement in submarine matters is more recent. In 2019, he registered the business name 'Nuclear Propulsion Roadmap for Australia®'. The views expressed in the paper are his own.

Bibliography

Agreement for the Exchange of Naval Nuclear Propulsion Information. Report 199, Joint Standing Committee on Treaties, Parliament of the Commonwealth of Australia, Canberra: https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Treaties/ENNPIA/Report.

MERMIN, N. David (2007). *Quantum Computer Science: An introduction* (Cambridge University Press: Cambridge UK).

NICHOLLS, Andrew, DOWIE, Jackson, and Dr HELLYER, Marcus, (2021). *Implementing Australia's nuclear submarine program.* Australian Strategic Policy Institute, Canberra: https://www.aspi.org.au/report/implementing-australias-nuclear-submarine-program.

SHOEBRIDGE, Michael, (2021). What is AUKUS and what is it not? Strategic Insight, Australian Strategic Policy Institute, Canberra: https://www.aspi.org.au/report/what-aukus-and-what-it-not.

SINGER, P.W. and FRIEDMAN, Allan (2014). *Cybersecurity and Cyberwar: What everyone needs to know*. (Oxford University Press: Oxford UK).

TANGREDI, Sam J., and GALDORISI, George (2021). *AI at War. How Big Data, Artificial Intelligence, and Machine Learning are Changing Naval Warfare.* (Naval Institute Press: Annapolis, USA).

[9]See https://breakingdefense.com/2022/01/aussies-unveil-new-hypersonics-center-signal-distance-from-ukraine-crisis/.

[10]See https://rusinsw.org.au/site/VideoTheatre48.php.