



# NAVIGATION

Newsletter of the Australian Institute of Navigation Inc  
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To our Fellows and Members,

We are now in our 3<sup>rd</sup> year of the Covid experience and there was almost a feeling of normalcy when returning home on leave, the general populace seemingly going about business as usual. Statistics still show that Covid is prevalent and for those in the fields of both aviation and shipping it continues to cause disruption and inconvenience to personnel due to mandatory isolation prior to joining, prohibition of shore leave, occasional voyage diversions and extended swing lengths due to man power constraints when reliefs are unavailable.

In spite of the challenges personnel have endured, the risk of accumulative fatigue should not be ignored. Those in the aviation and shipping communities need to be both self-aware and vigilant of those who work around us to watch for the insidious effects of fatigue.

It has been pleasing to see a good turnout at recent combined monthly meetings. Whilst the meetings provide a forum for quality presentations, the opportunity to discuss relevant issues between members on an informal basis can be invaluable.

developments which enhance navigational systems is critical to the success of such ventures.

Whilst technological advances are usually to our benefit we need to maintain an awareness of their potential to erode what has previously become second nature to us. Unless practised, past skills will be forgotten, possibly at a critical time when needed most.

I am pleased to see that the strong connection we have established with the navigation training elements of the RAN and RAAF have continued through- and post-Covid and wish the new members all the best as they embark on exciting careers as professional navigators and air combat officers respectively.

I also note the upcoming IGNSS 2022 in early December in Sydney and thoroughly recommend it as a great chance to catch up on the latest in GNSS technologies.

I look forward to catching up with as many as possible at future monthly meetings.

Cheers, Gavin.

***Captain Gavin Permain, FAIN  
President - AIN  
September 2022***

**Presentation to the AIN Members on Nuclear Powered Submarines and other AUKUS technologies for the ADF – 14 July 2022**

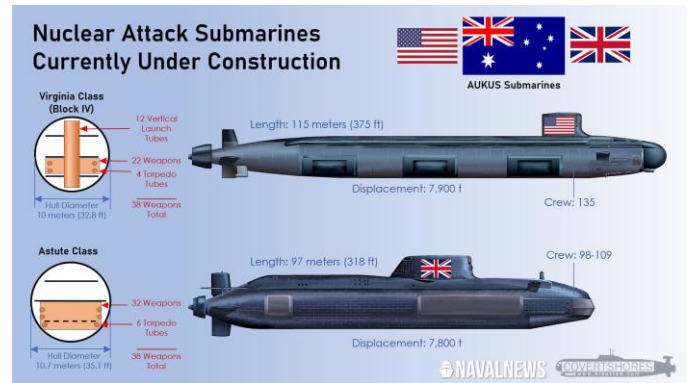
The AIN members in attendance at the July monthly meeting were privileged to hear from CAPT (ret'd) Chris Skinner, who has been widely reported as an expert on the nuclear submarine capability and Australia-UK-US (AUKUS) arrangements across the media internationally.

CAPT Skinner highlighted the operational benefits of nuclear submarines and their particular relevance to operations in Australia's region of interest. Endurance in a nuclear submarine would only be limited by human crew and other needs for consumable supplies. A nuclear submarine can maintain a much greater sustained speed than other forms of conventional propulsion and a nuclear submarine does not need to 'snort' to replenish air supplies and recharge its batteries which results in a much reduced exposure to detection. Overall reduced transit times for a nuclear submarine means more time on station and possibly smaller fleet numbers.

He displayed a chart that highlighted the improvement in operational performance and 'time on station' that a nuclear

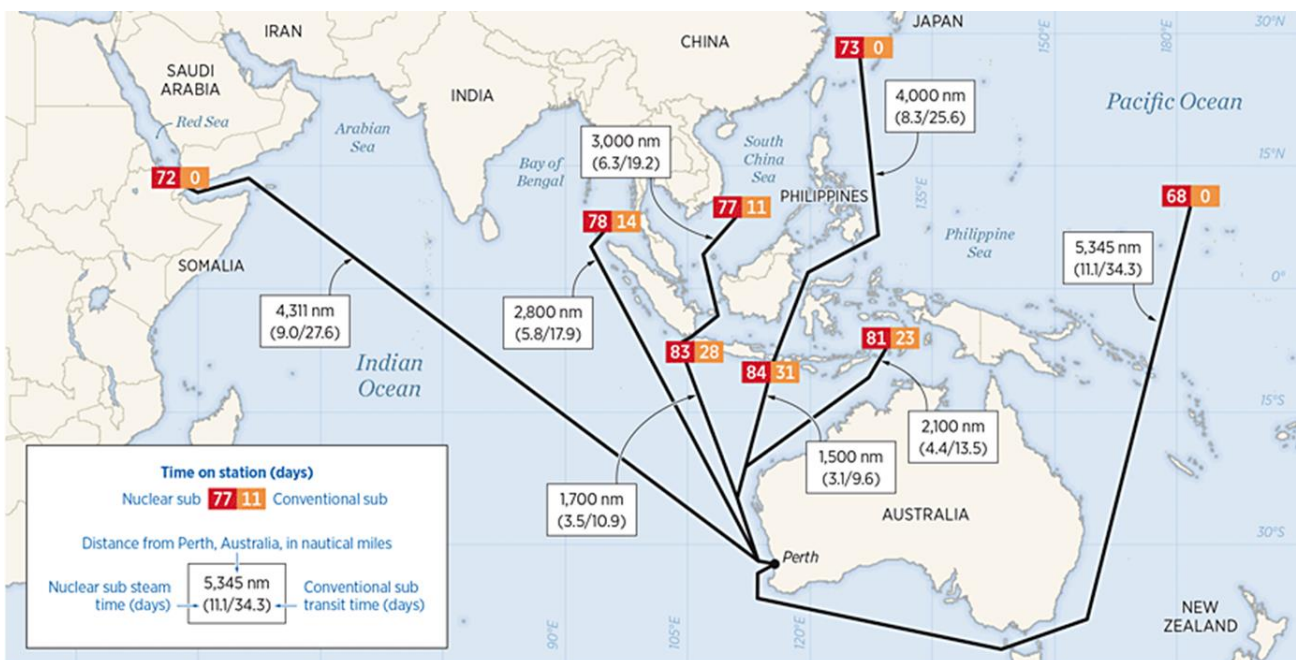
submarine would have over a conventionally powered submarine on representative cruises in the Pacific and Indian Oceans.

CAPT Skinner provided a short overview of the US and UK nuclear submarine types and compared their size, crew numbers and broad capabilities.



CAPT Skinner noted that the recent announcement of the AUKUS agreement focussed on the nuclear submarine aspects, but also very importantly included the sharing of advanced technologies among the participating nations. These other technologies that will be shared include cyber warfare, quantum computing, artificial intelligence and advanced undersea surveillance.

CAPT Skinner stated that cyber security is a growing challenge that continues to elude



comprehensive defence measures. The ADF has a strong focus on cyber and will gain benefit from leveraging the AUKUS agreement in this technology area. CAPT Skinner recommended accessing the recent talk by MAJGEN Susan Coyle CSC DSM on Cyber Resilience at <https://rusinsw.org.au/site/VideoTheatre45.php>

He also noted that quantum computing is an emerging field with the potential to provide a revolutionary increase in computer capacity. Quantum computing is able to deal with information that can take on multiple states unlike conventional digital computing based on binary (two state) numbers. Potential uses of the added capabilities of quantum computing includes improved target detection by submarines in a high noise environment

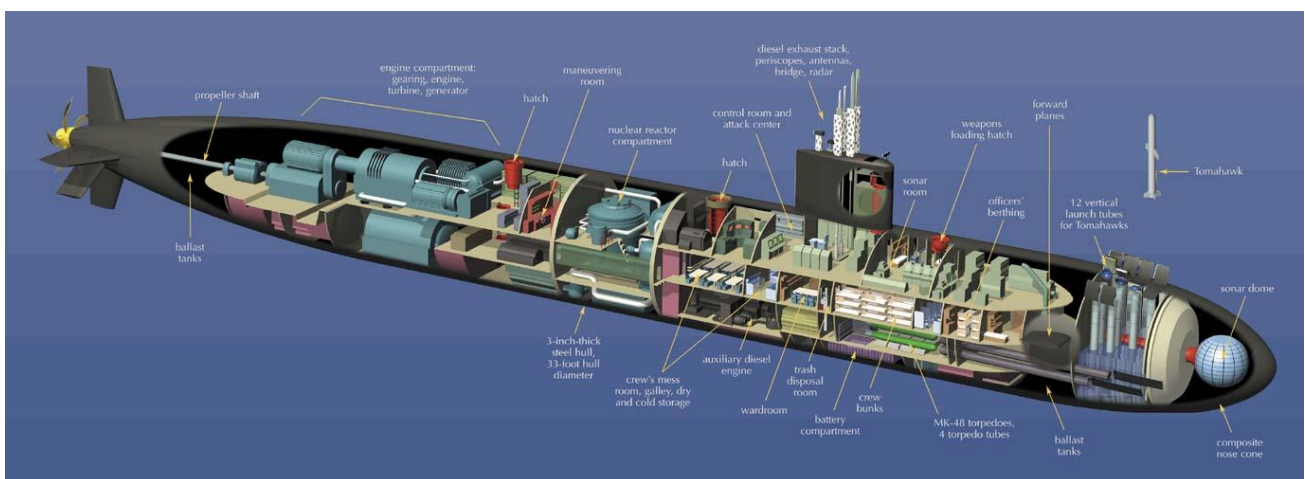
Artificial intelligence (AI) has been under development conceptually from the middle of the 20<sup>th</sup> century and has now become embedded in most digital systems. AI has been coupled with Machine Learning to acquire enhanced performance based on past experiences in the same application. Increasingly AI is based on very large datasets, colloquially termed ‘Big Data’, which have become essential to AI success.

submarines would need to consider. There are legislative bans on enrichment, fuel fabrication, power plant operation and reprocessing (spent) fuel. The lack of nuclear power experience makes entry into nuclear submarine operations a challenge. Currently the sources of nuclear expertise and workforce available to Australia are limited to France, the UK and USA.

The home porting and establishment of support bases for nuclear submarines in Australia is actually an area where there is already extant policy. Australia has a relatively long history of having nuclear vessels come into various ports around Australia. Visits to Australia by nuclear powered warships have been authorised for very specific locations and under substantial limitations. Of course the establishment of suitable nuclear submarine home ports will require bespoke facilities and support and would be costly.

Establishing a ‘sovereign’ nuclear refuelling capability would be challenging for Australia. It would require considerable expenditure in the following areas:

- Mining of uranium ore
- Milling
- Processing
- Enrichment



**Depiction of the key components in a nuclear submarine**

CAPT Skinner then discussed some of the issues that nations seeking to operate nuclear

- Manufacturing of fuel assemblies
- Fuel the reactor
- Operate the reactor
- Refuel / defuel



- Reprocess spent fuel
- Recycle / disposal of hazardous waste

In addition, Australia would then need to develop expertise in fuel processing; including fuelling / refuelling / defueling for SSN; storage of spent fuel; isolated cooling for several years; transport for reprocessing; reprocessing to remove remaining fuel and remove residual hazardous waste; encapsulation / vitrification and finally disposal.

Quite obviously, the resource implications of the above would be prohibitive for a small nation like Australia and so the AUKUS arrangement is not just desirable but is essential so that Australia can cost effectively leverage the larger UK and US nuclear fuel and reactor production ecosystems.

Production of the submarine pressure hull has been done in Australia many times before and is a proven Australian capability. This would be no different for an Australian nuclear submarine. The design and integration of underwater systems is also well within the capabilities of Australian Defence industry with appropriate support from the UK and/or the US.

The reactor section of the submarines would most likely be procured from either the US or UK, and then installed in a submarine made in Australia. Fuel assemblies to be procured at the same time as the reactor but not activated until licensed by Australian regulatory authority and supplying agency.

The organisations that will need to cooperate in the development of an Australian nuclear submarine capability include:

- Australian Nuclear Science and Technology Organisation [ANSTO]
- Australian Radiation Protection and Nuclear Safety Agency [ARPANSA]
- Australian equivalent of an Office of Naval Reactors

Scientists and engineers will need to be recruited, initially mostly from overseas.

There would be an increased demand for nuclear engineering degrees from universities such as UNSW and other tertiary institutions across Australia. Training requirements would include an operational live reactor. Initially this may be overseas in a country from where the reactor technology is sourced. Of note, the qualifications obtained by personnel would be readily transferable from Navy to civil and vice versa.

CAPT Skinner in conclusion indicated that the decision on the SSN platform (either UK- Astute class or US- Virginia class) would need to be made as soon as practicable to minimise wasted time and resources. He noted that 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 Australia needs to step up now in capability and commitment to regional defence and security.

### **International Global Navigation Satellite Symposium 2022 – 7-9 December 2022 in Sydney**

The next iteration of the International Geospatial Navigation Satellite Symposium (IGNSS) is planned for 7-9 December 2022 at the University of NSW Sydney Campus.

IGNSS 2022 is Australasia's premier conference and exhibition for technology, products and services in Positioning Navigation and Timing, including GNSS.

Since the last conference in 2019, the Australian Space Agency and Geoscience Australia have begun developing a national Roadmap for PNT. The roadmap documents the capabilities of the PNT sector in Australia, as well as the decadal vision for new PNT capabilities and applications, including in space. The PNT Roadmap is also building on Geoscience Australia's work on the Positioning Australia program, including the partnership with New Zealand to deliver

and sustain the SouthPAN Space-Based Augmentation System.

As well as these overarching developments, IGNSS 2022 will examine the growing interest in alternatives to GNSS; including the hot topic of LEO PNT; where constellations of Low Earth Orbit satellites are being developed to deliver new PNT services. There will also be updates from existing GNSS System Providers as they start delivering new services such as signal authentication and increased accuracy.

IGNSS 2022 will not only address the wave of new opportunities but also the risks posed by jamming, spoofing and cybersecurity threats.

It will gather leaders in GNSS and PNT to examine the latest technology, present cutting edge research and development, and discuss in open forums the implications for policy, market development and positioning infrastructure deployment.

Sessions will cover the following topics:

- Autonomy on Land, Air, Sea and in Space
- Aviation and Avionics
- Cooperative Intelligent Transport Systems
- Machine Guidance Applications in Agriculture, Construction and Mining
- Maritime Applications
- Unmanned Aerial Systems
- Space Applications of PNT in Earth orbit and for Lunar and Martian exploration
- Positioning Infrastructure
- GNSS Vulnerability
- Interference Detection and Mitigation
- Policies and Standards
- SBAS and Other Augmentations
- Datums and Geodesy
- National and International GNSS Developments
- Emerging Application Areas for GNSS
- Key Industries and reliance on GNSS
- Embracing the Multi-GNSS Era

- Cyber Security in PNT Applications and Infrastructure
- Alternative PNT
- State of the art in PNT algorithms and software development
- GNSS Aiding and Sensor Fusion
- Positioning in GNSS Denied Environments
- Development of GNSS Receiver Hardware and Firmware
- Precise position using Smartphones

The IGNSS organisers encourage PNT researchers as well as industry R&D practitioners to present their work.

### **RAN Intermediate Navigation Warfare Officer Course #2 Graduation – 14 December 2021**

The RAN Intermediate Navigation course recently became part of a broader program – Intermediate Navigation Warfare Officer Course. The December 2021 courses was the second INWO Course where the students are required to complete a ‘warfare enablers’ component prior to completing their Intermediate Navigation course.

The Intermediate Navigation Warfare Officer Course #2 had six graduates, but in a sign of the times and the hectic pace of military training, only four were present for the graduation ceremony and the other two had already proceeded on posting. The Secretary of the AIN, Kym Osley was present to award the Dux of the Course, LEUT Luke Murray, the AIN Prize for Dux.

Congratulations to all the RAN INWO Course graduates from the AIN!



*Kym Osley (Secretary AIN) with the INWO Graduates at HMAS Watson*

**RAN Intermediate Navigation Warfare Officer Course Graduation – 8 June 2022**

The AIN Secretary was invited to attend the most recent INWO Course graduation at HMAS Watson on 8 June 2022. The event was well attended by graduates, families, friends and staff and provided a great opportunity to meet and congratulate the RAN's newest navigators. The AIN Secretary presented the AIN Dux Prize. The new Chief of Navy, Admiral Mark Hammond attended the ceremony.



*INWO graduates, staff and Kym Osley (AIN Secretary) at the recent Graduation Ceremony*



*RADM Mark Hammond (who was recently promoted to become Chief of Navy), LEUT Gilbert (graduate INWO Course) and Kym Osley AIN Secretary at the Graduation*

**Chief of Army Symposium – Adelaide 10-11 August 2022**

The AIN Secretary was able to attend the Chief of Army (CA) Symposium in Adelaide during the period 10-11 August 2022. This CA Symposium was of key interest to those involved in autonomous navigation, satellite navigation and the use of quantum computing and artificial intelligence in support of land and air operations. The conference brought together practitioners across Defence, industry, and Academia to examine (among other things) the application of AI, robotics and autonomous systems in military and commercial operations.

The symposium included an industry showcase (about 70 companies were present over the two days) also with a focus on AI and robotics/autonomous systems. About 300 attended the CA Symposium and about 1500-2000 attended the industry exhibits and associated seminars/events.

CA's priorities reflected the themes of the 2022 CA Symposium – eg AI (note that world-wide investment in AI will double from 2020-24), autonomous systems, space



and quantum computing. CA noted that Army is already the largest user of Uninhabited Air Systems in the Australian Defence Force. The Head of the Australian Space Agency, Enrico Palermo, provided an overview of recent developments in the Australian space ecosystem. He noted that the next ASA capability roadmap to be released (very soon) will be *Space Situational Awareness and Debris Mitigation*.

The Robotic and Autonomous Systems Strategy V2.0 was developed by the Robotic and Autonomous Systems Implementation Coordination Office (RICO) in Future Land Warfare Branch and ‘launched’ at the conference.

The RAS strategy is to be implemented through Land 135 which is currently at Gate 0 (eg yet to be funded). Land 135 is not a traditional capability development project and does not seek to buy specific RAS capabilities to a defined specification. It is proposed as a project to provide seed funding to advance RAS technologies and explore what level, configurations and combinations RAS can be employed in the Army. The systems that will be procured through Land 135 are representative systems of future capability and therefore lower on the TRL scale.

Some companies with very interesting products on display included:

**AMSL.** AMSL is an Urban Air Mobility startup company located at Bankstown. They are expecting their first flight (tethered) this year.

**Swoop Aero.** Swoop Aero has made great progress in the commercial field of specialist logistics where they provide UAS-delivered pharmaceuticals, etc as a complete service. Their commercial operations are based in Victoria at this time (with a NSW-based company, Quickstep as a prime manufacturer of the Swoop UAS airframes).

**3ME.** Great interest was shown by the Army senior officers present in the electric powered Bushmaster displayed by 3ME at the Symposium.

### Some Notable Senior Defence Changes – July 2022

The key leadership across the Australian Defence Force changes out about every three years – and that occurred in mid-2022.

While the Chief of Defence Force was retained (GEN Angus Campbell) for continuity, new people were posted into many of the other positions. The new Chief of Air Force is Air Marshal Rob Chipman, who has a fighter pilot background. The new Chief of Navy is an ex-submariner – Vice Admiral Mark Hammond. The Army is now led by LTGEN Simon Stuart.

Of note an ex-RAAF navigator, Mr Chris Deeble, is the new Deputy Secretary Capability Acquisition and Sustainment Group. Chris flew as a navigator on Canberra and then F-111 aircraft in the 1980s and 1990s.

The most senior serving permanent Air Force navigator, AVM Steve Meredith, will retire at end-2022 as the Deputy Chief of the Air Force.

Congratulations from the AIN to the new appointees, and also to those who are retiring after giving such sterling service over many decades.

### Are City Dwellers or Country Dwellers Better Navigators? And does using GPS affect your innate navigational skills?

A recent report has highlighted that country dwellers who are less reliant on GPS and generally more aware of their surrounding are naturally better navigators with improved natural senses of direction. The AIN Secretary participated in a radio program on 3AW in Melbourne a couple of months ago where this ‘factoid’ was explored.

The study results in this case indicated that country dwellers are more likely to be able to more accurately describe how to get from their current location to a significant point in their environment, and features along the direct path, than city dwellers.

There are considerable research results to indicate that relying on GPS and turning off our own internal 'human' navigation systems may actually inhibit the development of those areas of the brain used in navigation and potentially inhibit memory overall. A study by neurological researchers found that the brains of frequent GPS users were different in a critical way than people who were not so reliant on the technology.

The 2020 study published in the journal *Scientific Reports* looked at 50 drivers. Researchers found that those who used GPS more often had worse spatial memory—the ability to remember the position of objects and places—when trying to navigate without the mapping technology. When 13 of the participants were retested three years later, more frequent GPS usage was associated with worse spatial memory.

So, I guess the comment (firmly tongue in cheek) to be made by someone who has been a professional navigator (in the air) most of their life is 'use it or lose it'!!

### **Australians See Space as a Risk Rather than an Opportunity!**

Australia was at the forefront of the first Space Race and played a vital role in Apollo 11's iconic Moon landing in 1969. Half a century later, Australians are more likely to see space as a threat than a frontier full of positive possibilities, and just one in ten say they would like to work in the space industry.

According to a new global report from Inmarsat - 'What on Earth is the value of space?', based on a survey of 20,000 people in 11 countries - 49% of Australians are concerned about space junk and collisions and 44% are worried about polluting space, while just over one third (36%) say they feel

hopeful about the possibilities of space, one fifth (21%) say they don't understand much about space and 10% say they don't care about space at all.

With the space sector attracting record levels of investment and expanding faster than ever before, it is essential that Australians learn more about an industry that will increasingly impact their lives, according to Inmarsat. According to the report, Australians are twice as likely to associate space with 'aliens' (21%) than with communications and connectivity (10%).

It looks like the Australian Space Agency and the Defence Space Command need to spend some more time on public messaging about the benefits of space to the Australian general population in the next few years!

### **Focus on a Current AIN Member – Dr Ron Houghton DFC FAIN**



Dr Ron Houghton joined the RAAF 1941 where he became a bomber pilot and flew Halifax bombers in Bomber Command. He was later posted to fly Spitfires and Hurricanes and was awarded the Distinguished Flying Cross in 1945 for 'skill and

fortitude in operations against the enemy'. Later in 1945 he worked in Eisenhower's Headquarters in the UK.

After the War, Ron was employed by Qantas as a pilot, eventually working his way up to executive level. After leaving Qantas, Ron worked with several Asian airlines. He then completed a PhD in aeronautical engineering at Sydney University.

Ron currently serves as President of the Bomber Command Association of Australia.



Ron is a Fellow of the Australian Institute of Navigation. The AIN wishes Ron all the best for the coming year, and the Secretary looks forward to catching up with him again in 2023 at the Canberra Bomber Command Ceremony!



**Ron Houghton and other ex and serving RAAF members at the AWM in Canberra June 2022 for the Bomber Command Commemoration**

### #52 Mission Aircrew Course Graduation – 16 December 2021

The Air Mission Training School (AMTS) has continued to operate through the various Covid restrictions to graduate non-pilot aircrew to be crew on maritime, air refuelling and fast jet (F-18F/EA-18G Growler) aircraft.

In December 2021, the AIN Secretary, AVM (retd) Kym Osley became the Reviewing Officer for the MAC Graduation when the original Reviewing Officer was unable to arrive at East Sale in time for the Graduation Parade due to having to wait for a Covid test before travelling!

The parade was held near the Officer Training Facilities at RAAF East Sale, followed by a Graduation Dinner at the Officers Mess.

The AIN has been awarding prizes to RAAF non-pilot aircrew graduates for over 40 years. The Australian Institute of Navigation Award for the highest academic assessment on the course. It is presented to the trainee who achieves the highest overall mark in ground school. Ground school covers theory lectures in over 20 different areas with practical exercises and exams.

AVM Osley presented the various awards to graduates, including the AIN Prize for Highest Academic Achievement to PLTOFF Mia McChlery. PLTOFF McChlery is now undertaking P-8 Maritime training at RAAF Edinburgh.



**AVM (retd) Kym Osley, AIN Secretary, presents PLTOFF Mia McChlery with the AIN Award for Highest Academic Achievement at the Graduation Parade of #52 MAC.**

### #53 Mission Aircrew Course Graduation – 21 July 2022

On 21 July 2022, the AIN Secretary, AVM (retd) Kym Osley was able to travel to East Sale with the Reviewing Officer, AIRCDRE Carl Newman, CDR AMG, for the latest graduation. Our host for the graduation was Wing Commander Arran Moore, CO of AMTS. Following a parade and a tour of the AMTS facilities, a graduation dinner was held in the Officers Mess at RAAF East Sale.

AVM (retd) Osley was able to present the AIN award for Highest Academic Achievement to FLGOFF Keirin McCullagh.



**Kym Osley, AIN Secretary with FLGOFF Keirin McCullagh, recipient of the AIN Award for Highest Academic Achievement on #53 MAC. FLGOFF McCullagh is undertaking WSO training on the F-18 Super Hornet.**

By coincidence, FLGOFF McCullagh's father had served as a fighter pilot in Air Combat Group when the AIN Secretary had been Commander of Air Combat Group. It was great to catch up again!

Some of the attendees at the parade came down in style – in a couple of EF-18G Growler aircraft! The aircraft were certainly a hit when they provided a high-speed flyover of the parade.



**EF-18G Growler aircraft at RAAF East Sale for the MAC Graduation on 21 July 2022.**

The AIN congratulates all the successful Air Combat Officers on graduating from their respective courses and particularly congratulates all the winners of the AIN Award for Highest Academic Achievement.

**Vale – Professor Brian O’Keeffe AO  
FAIN**



One of the most influential Australian innovators in the field of aerial navigation is no longer with us. Professor Brian O’Keeffe Hon LLD (Monash), BE (Qld), FIE Aust, FAIN joined the Department of Civil Aviation in 1956, and over the ensuing

decades he worked for the successor organisations Civil Aviation Authority and Airservices Australia, and contributed to the development of the instrument landing systems, the Microwave Landing System, the Future Air Navigation System, and to the development of satellite-based navigation for aircraft. In 1988 he joined the Civil Aviation Authority as General Manager, Advanced Systems Development, and assisted in developing the Automatic Dependent Surveillance system. This evolved into Airservices Australia in 1995 where Brian was appointed General Manager International & ICAO. Brian left Airservices Australia in 1997. In 1992 he was appointed an Officer in the Order of Australia ‘for service to civil aviation, particularly international civil aviation’. In 2004 he received the highest award of the International Civil Aviation Organisation, the Edward Warner Award for his leading role in air navigation.

**Payment of Subscriptions for 2022/23**

Subscriptions for the AIN are able to be paid by direct deposit through BPay:

**Bank:** Commonwealth Bank of Australia

**Account Name:** The Australian Institute of Navigation

**BSB:** 062001

**Bank Account number:** 00918322

Please include a clear identification name of the member when making the bank deposit.

The subscription fees are used to support speakers for the monthly dinners, and to procure awards for the RAN and RAAF navigation-related courses. The fees have been kept very low as follows:

- Patron, Life Members, Honorary Members (eg Chiefs of the Military Services) – no cost
- Senior Members (any Member or Fellow 60 years old or older) - \$50.00
- Full Members/Fellows - \$75.00
- Recent Graduates from RAN or RAAF ‘navigation-related courses’ – Free for the first year

*If you require a tax receipt then please send an email that you have made payment (and the amount) to the Secretary below.*

### **Current AIN Committee Members**

The last AIN AGM was held in September 2021. The elected office holders for 2021/22 were as follows:

- President – CAPT Gavin Permain
- Vice-President – CAPT Peter Martin
- Executive Secretary – AVM Kym Osley
- Treasurer and Public Officer – CAPT Dave Pyett
- Councillor and IGNSS Representative – PROF Chris Rizos
- Councillor – Mr Simon McEvoy

### **AIN Webpage**

Please send any items of general interest to the AIN Secretary. The website is at [www.ain.org.au](http://www.ain.org.au).

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