HMAS *Anzac* conducts maritime manoeuvres during the Indo-Pacific Endeavour 21 deployment. To optimise the performance of the Royal Australian Navy's current and future fleets, DMTC's Maritime Program is providing industrial innovation leadership alongside the science and technology strategy led by DSTG.

PROGRAM
Maritime

Australia's Continuous Naval Shipbuilding Program experienced a period of consolidation over the last 12 months. Review activities were a focus, looking into how Defence can better coordinate industrial development activities across each of the ADF's naval shipbuilding programs.

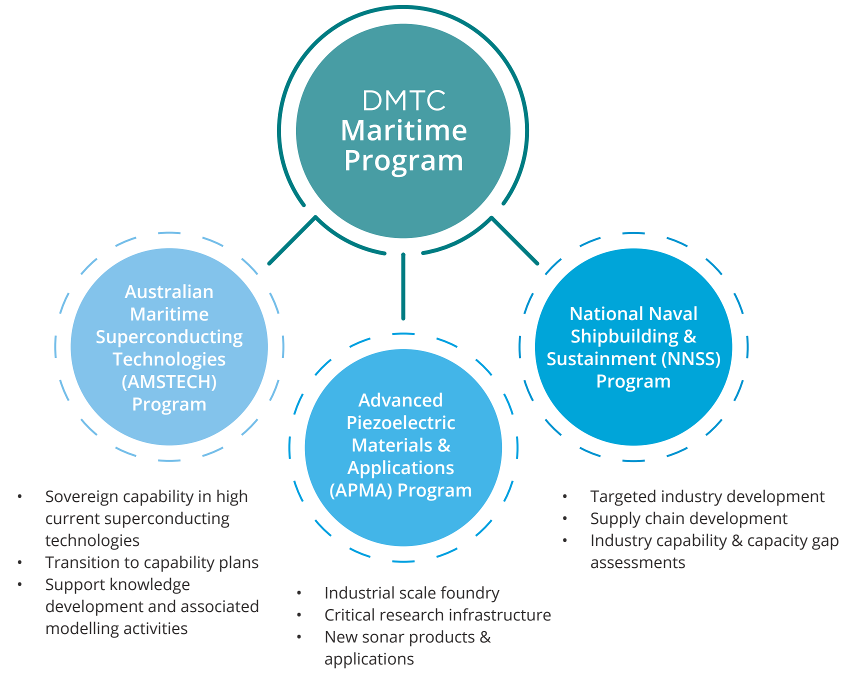
Defence continues its focus on the importance of sovereign industrial capability and its role in supporting Defence capability and the sector eagerly awaits the release of a comprehensive update of the 2017 *Naval Shipbuilding Plan*.

DMTC's Maritime Program has seen expanded activities across a number of new themes. DMTC's National Naval Shipbuilding and Sustainment (NNSS) Program, with support and funding through a long standing relationship with CASG (previously through the National Naval Shipbuilding Office and now CASG's Australian Industry Capability Division) continues to make important strides in developing industrial capability across additive manufacturing, improved maritime steel production techniques and a new project focused on shipyard welding productivity improvements for the Hunter Class Frigate Program.

In December 2020, DMTC and DSTG established the Advanced Piezoelectric Materials and Application (APMA) Program with support and funding from DSTG's NGTF Program. This is discussed in more detail below on page 30. The program is already making important gains through strategic investments in industrial and research infrastructure and know-how to support the development and manufacture of piezoelectric materials applicable to maritime applications.

DMTC and DSTG have also recently established the Australian Maritime Superconducting Technologies (AMSTECH) Program with support and funding from DSTG's NGTF Program. The AMSTECH Program will bring together a number of existing disparate programs of work to establish a strategic national capability in the application of superconducting materials in maritime applications. This will be achieved by fostering and promoting collaboration across Defence stakeholders, industrial partners and the research sector.

The next 12 months promise to be a busy period for DMTC's Maritime Program, with exciting outcomes expected from existing activities and the establishment of several new projects within the APMA and AMSTECH Programs.



PROGRAM
Maritime

Bridging the gap

With the Australian Government recently announcing the AUKUS trilateral security partnership, the first initiative of this alliance has resulted in Australia pursuing an alternative option of nuclear-powered submarines to replace the six conventional Collins Class submarines currently in operation.

This change in force posture places a renewed importance on life-of-type extension (LOTE) program planning for the Collins Class fleet. Sustainment technologies and practices for the Collins Class will be critical for the ongoing operation of the fleet until the new nuclear-powered submarine capability is realised.

DMTC is currently working with partners ASC and CSIRO to develop and specify cold spray repair methodologies for Collins Class submarine components that will assist with LOTE planning. The project captures four distinct work packages – two assigned to the repair of worn or corroded metal surfaces, a third for the rapid additive manufacture of welding inserts, and the fourth investigating the constraints of in-situ robotic application.

The cold spray metal deposition process has been chosen because it does not cause distortion or microstructural changes in the base metals. Secondly, the ability to blend metal powders that feed into the cold spray process means unique metal alloys can be formed. Finally, when coupled with portable automation, in-situ repair becomes an option, potentially eliminating the need for docking repair and allowing submarines to remain at sea longer.

Researchers are currently completing the first three work packages, with ASC about to begin production trials using the cold spray, additively-manufactured welding inserts. The fourth package is on track to be completed by mid-2023.

Establishing national capability

Backed by NGTF funding, DMTC's APMA Program creates an overarching framework to realise a coordinated, collaborative, long-term vision to establish a strategic national capability in advanced piezoelectric materials and their application.

The Australian Defence Force requires access to advanced piezoelectric materials to maintain operational superiority in both Above Sea Warfare (ASW) and Under Sea Warfare (USW) environments, and as a key enabler for remote undersea surveillance as well as other Defence domains such as sensors for aerospace platforms.

An Information Session with potential industry and research partners was followed by a call for Expressions of Interest. Thirteen responses were received and the APMA Program is now working through detailed project agreements that will:

- establish an industrial scale foundry facility that will ensure security of supply of single crystal materials for defence and associated research applications
- support critical research infrastructure and develop national expertise in advanced piezoelectric materials and their applications, and
- enable the development of new sonar products for ASW and USW applications, as well as sensors for aerospace platforms, ensuring Australia remains at the leading edge of innovation.

The power of high temperature superconductors

As modern naval platforms are upgraded to account for evolving threat environments, design constraints with power, weight and space margins are an ever-present consideration. High Temperature Superconductors (HTS) offer an effective way to alleviate many of these challenges because of their increased electrical current carrying capacity and almost zero energy losses when compared to traditional conductors. The unique physical properties of HTS systems allow for either transmission of significantly more energy within the same weight allowances, or alternatively, the same energy requirements at reduced weight.

HTS systems have been successfully used in medical and civil energy distribution sectors and have great potential for many naval applications. However, the unique properties of a HTS device can only be achieved when operated under cryogenic conditions. Cryogenic cooling systems technology is reasonably established and commercially available, but the requirements for naval operation are not well understood.

DMTC is working with Queensland University of Technology (QUT), DSTG and Siemens Energy to understand what unique demands a naval platform will place on a cryogenic cooler for defence operations. Researchers at QUT have now completed a comprehensive scientific assessment of a number of cryogenic cooling technologies in a laboratory simulated sea state environment.

Tests have measured and characterised operational performance relative to naval applications and requirements, including heat load capacity and acoustic signatures, allowing the collaborative partners to down-select the most appropriate cryogenic cooling technology for naval applications.

This research has provided the Royal Australian Navy with risk-assessed options for critical cooling requirements for HTS systems.

With funding support from the NGTF, DMTC's collaborative research team is preparing for instrumented sea trials of the down-selected cryogenic system on a naval vessel, with the results expected to validate laboratory observations.