Request for Proposals

Title:	High Temperature Sub-Assemblies RFP
DMTC Program:	Air Platforms
Issue Date:	11 August 2022
Proposal Due Date:	9 September 2022

Contents

1. EXECUTIVE SUMMARY

DMTC is a not-for-profit collaborative venture that brings together Defence, industry, universities and research organisations to develop technologies and solutions that enhance Australia's Defence and National Security capability. Defence Science and Technology Group (DSTG), through DMTC, are seeking innovative applied research proposals supporting development of high temperature structures and sub-assemblies. The aim is to complement parallel effort in the field and support the development of sovereign industrial capability with specific elements and sub-assembly knowledge that will be crucial in supporting the construction of full-scale hypersonic platforms. Australian industry, universities, and research organisations are invited to submit research proposals. Outcomes from this program will support strategic aims the Defence and National Security community have with regards to sovereign hypersonic materials and manufacturing capability.

2. INTRODUCTION

2.1. STRATEGIC CONTEXT

Sustained hypersonic flight (speeds greater than Mach 5) is viewed as a key enabler in the 21st century. It has the potential to revolutionise air travel and access to space. It is also viewed as a key element supporting the defence of Australia. Globally and within our region we are seeing the deployment of forward based long range strike capabilities. The Australian Government has committed to developing Australia's sovereign capability to manufacture and deploy long range guided weapons and explosive ordnance *to hold potential adversary forces and infrastructure at risk further from Australia*[1]. Developing the knowledge required to design, develop, test and manufacture the key sub-assemblies, materials and coatings that comprise hypersonic platforms is a critical stepping-stone in realising national aspirations in both defence and civil hypersonic capability.

2.2. ABOUT DSTG

DSTG is the lead Australian research agency undertaking advanced research into hypersonic technologies to enable sustained high-speed flight in the atmosphere. DSTG has an active program to support development of hypersonic capabilities and the underpinning materials and manufacturing technologies. Knowledge and capability developed in the field of hypersonic flight is used to support Defence Force operations; Defence capability and acquisition programs; inform threat and risk assessments; and inform National Security policies.

3. APPLICATION PROCEDURE

3.1. CALL FOR PROPOSALS

DSTG, via DMTC, is seeking innovative research proposals from Australian universities, research organisations and industries to partner with Defence to develop proposals that underpin the prototyping of one or more of the critical sub-assemblies described in section 4 Appendix – Program Context. Proposals should clearly articulate how applied research and engineering could put industrial capability on a path to manufacturing critical sub-assemblies at a representative scale (TRL 5/6) – refer 5 Appendix – TRL reference & Quad Chart Template. Proposals should outline a body of work consisting of either an in-depth stand-alone scoping study or a combination of scoping and prototyping. Proposals seeking to prototype are encouraged to consider the need to include a scoping stage gate within 6 months of project Establishment Date (ED+6). Details of submission requirements are outlined in section 3.4.

This call for proposals will support DSTG's high temperature materials programs and is focused on developing sovereign capability for the integration of advanced technologies to achieve the thermal management strategies

[1] Deputy Prime Minister of Australia, Richard Marles, address to Center for Strategic and International Studies, USA, 11 July 2022.

required for hypersonic flight. Proposals should clearly articulate how applied research and engineering could lay the foundation for manufacture of critical hypersonic platform sub-assemblies at a representative scale (TRL 5/6). Please see Section 5 Appendix – TRL reference & QUAD Chart Template for TRL definitions to be applied to this program.

Proposals can either outline the approach to an in-depth stand-alone scoping study or outline a project combining scoping and prototyping. Proposals incorporating a road mapping & feasibility stage gate early in the activity, designed as a desktop study to shortlist solutions, identify gaps and detail a subsequent work breakdown structure will be favourably received. Identifying gaps that affect scalability are targeted as a key outcome of this work.

Key areas targeted fall across several areas including:

- Hot structures
    - Materials and joining for external structure
    - Materials and joining for internal structure
    - Integration of light weight Insulating materials
    - Manufacture and union of leading edges (i.e. sharp 2-3mm radius)
    - Integration of RF antennas/apertures
    - Any environmental barrier coatings that may be required to protect structural and joining materials during exposure to high temperature oxidizing environments.
- Joining of dissimilar high temperature materials

For additional background information on these areas, please see section: 4 Appendix – Program Context.

Where there is an articulated need and corresponding DSTG infrastructure, DSTG will consider contributing facilities access and testing.

3.2. FUNDING OPPORTUNITY

DSTG has seed funded the activity and envisions an initial program consisting of 2-4 projects across a maximum of 2 years. The funding quantum requested in proposals should be proportionate to the activities proposed. Submissions will be assessed on a completive basis taking into account rationale, scope of work, risk, in-kind contributions and value for money.

For example, a detailed desktop scoping study might be costed at < $100k where an activity proposing to demonstrate an exemplar high temperature sub-assembly or relevant manufacturing process might require more resources.

3.3. PROGRAM GOVERNANCE

DSTG will provide strategic and technical oversight to the program and will be responsible for approving, endorsing and guiding the projects during the initial two-year life of the program. Day-to-day administrative, management, reporting and support activities will be overseen by DMTC. Reporting delivered to DMTC will consist of quarterly and agreed technical milestone reports, and include a formal project review every 6 months throughout the duration of the project. Projects will be managed via DMTC IT systems unless Defence stakeholder requirements dictate otherwise.

3.4. SUBMISSION REQUIREMENTS

Applicants should provide a proposal that outlines, either via desktop feasibility study, physical development work, or both, an approach to address the challenges associated with one or more of the critical sub-assemblies as described in section 4 Appendix – Program Context. Proposals are to be summarised at a high level by virtue of a **1-page** quad chart – template attached in 5 Appendix – TRL reference & Quad Chart Template. Quad chart areas to address include:

- Background to the proposal:
  - Who are you, what is your relevant background?
- The Technology:
  - Which critical sub-assembly or combination of sub-assemblies are you proposing to address? What is your current capability in this regard (incl. TRL)? What do you hope to achieve? What outcome are you targeting (e.g. detailed scoping study, prototype fabrication, improved fabrication or test capability, etc.)?
- Key Challenges:
  - Does manufacturing or testing infrastructure need to be acquired/improved? Are there key materials that are not readily available or need to be developed? Is there an element of subject matter expertise that you need to source? Are there other issues to be overcome?
  - For any of these that are applicable to your research proposal please include a brief sentence on how you would want to overcome the challenges (e.g. access to third party facilities, international materials supplier, hiring of staff, etc.). For elements that are not applicable feel free to delete the bullet point within the quad chart.
- Programmatics:
  - How many personnel will be involved? How long will it take to produce the final outcome (maximum 2 years)? What are the key deliverables (milestones and outcomes) over the course of the project? Are there any 'in-kind' or other resources to be made available to the project by your organisation or collaborative group (see section 3.5)? How much cash is required? Do you need to access 3rd party facilities (e.g. DSTG facilities) or other elements required to complete the works proposed?

We encourage joint submissions between multiple universities, research organisations and companies. Submissions that seek to utilise funding to augment existing projects and share results are also encouraged so long as they directly address the topic areas.

3.5. SELECTION CRITERIA

Research proposals will be assessed according to the following criteria:

- Feasibility of the research proposal and likelihood of success;
- Innovation of methods;
- Demonstrated knowledge and experience in related fields; and
- Alignment with applicant's own research and development interest and scope articulated herein.

Where multiple proposals are complementary, DMTC may seek to introduce proposers with an aim to combine proposals – with the express permission of those involved.

Co-contributions of cash or in-kind to projects will demonstrate a genuine interest in developing a collaborative partnership and viewed favourably. Please outline any cash or in-kind contributions to support this research program in your proposal. Please also ensure that the inclusion of any cash or in-kind contributions included in the proposal have been endorsed by your organisation by an officer with the necessary delegated authority.

3.6. DOWN SELECTION PROCESS

Down-selected quad charts will be reviewed with applicants with an area of expertise, research or technology relevant to the aims of this project may be requested to provide further information. Review of additional information does NOT guarantee funding to be granted.

3.7. ELIGIBILITY

To be eligible you must:

- have an Australian business number (ABN);
- be registered for the Goods and Services Tax (GST).

and be one of the following entities:

- an entity incorporated in Australia;
- an incorporated association; and
- an incorporated not for profit organisation.

3.8. INTELLECTUAL PROPERTY

See: https://dmtc.com.au/wp-content/uploads/2018/03/DMTC_IP-Factsheet.pdf

3.9. CONFIDENTIALITY

DMTC will treat all applications confidentially. DMTC will share submitted proposals for this Call for Proposal with Australian Government personnel including DSTG and Defence Department stakeholders.

3.10. CONTACT PERSON

All questions related to this Call for Proposal and lodgement of application should be directed to the Program Manager via the email address provided:

Name:	Dr Scarlet Kong
Title:	Program Manager
Email:	HTSA@dmtc.com.au

3.11. LODGEMENT INSTRUCTIONS

Please use the attached DMTC Quad Chart Template for your submission.

Please return the completed proposal by COB, 9 September 2022 at the latest. Earlier applications are welcomed.

Please submit applications to: HTSA@dmtc.com.au

All submissions should be in **Word** or **PDF format**.

When responding to the Call for Proposal by email, please ensure the following line appears in the subject line:

- "***Call for Proposals:*** **Applied Research into High Temperature Sub-assemblies".**

Late proposals and Quad charts exceeding one (1) page will not be considered.

4. APPENDIX – PROGRAM CONTEXT

Australian industry, universities and research agencies have demonstrated an ability to design, fabricate and test individual components and materials associated with hypersonic platforms at laboratory scale (TRL 3/4) - refer 5 Appendix – TRL reference & Quad Chart Template. The logical next phase of developing a national capability is to collaborate to conduct applied research that supports the design, fabrication and testing of critical sub-assemblies at a representative scale (TRL 5/6) - refer 5 Appendix – TRL reference & Quad Chart Template. In doing so foundational knowledge in assembly of high temperature structures will be developed as well as critical capability associated with larger scale fabrications. Work of this nature will also highlight capability and infrastructure gaps to be filled in across the process of building a mature end to end capability.

The critical sub-assemblies identified include:

1. **Rapid manufacture of light weight internal load bearing structures (e.g. ribs, stringers, spars etc.).** Whilst these assemblies are not directly exposed to the aerodynamic heating induced by atmospheric friction, they do need to operate in the 250C to 400C range. Where this can be achieved using standard composites & manufacturing technologies, making design allowances to achieve an interface between these structures & higher temperature external surfaces they support has not been reduced to practice.
2. **Joining of high temperature materials for external surfaces (e.g. platform skin).** Surfaces exposed to aerodynamic heating experience a dynamic range of temperatures depending on 1) where they are located on the airframe and 2) what stage of flight they are operating in. All materials must be able to operate from ambient to at least 1200C with some surfaces needing to sustain flight temperatures up to 2000C. A range of materials is used in these applications depending on required surface temperature. These materials broadly fall into two groups with comparatively low thermal expansion & comparatively higher thermal expansion & include Carbon-Carbon composites, high temperature & refractory metals (e.g. Ti, TZM, SS309, SS310, Inconel) & ultra-high temperature ceramics. Joining high & low thermal expansion materials is a challenge, joining systems must remain intact prior to & during flight.
3. **Manufacture of sharp (2-3mm radius) leading edges.** Sharp leading edges are required to achieve stable, controlled and sustained hypersonic flight. During flight leading edges are heated to ~2000C and experience dynamic pressures up to 280kPa. In order that the edges maintain their aerodynamic profile they must not be frangible in flight and must be successfully jointed to associated supporting structures. Manufacture of these components and shapes remains intensive, challenging and costly. Improved manufacturing routes need to be developed to bring the serial production of hypersonic platforms within reach.
4. **Integrated Data link assemblies.** Hypersonic platforms are for the foreseeable future unmanned. They are therefore for the foreseeable future required to sustain a data link with ground operators for the communication of flight telemetry and to allow for terminal control as required. Conformal antennae and/or receiver apertures must be able to withstand dynamic pressures up to 280kPa, temperatures in the range of 800-1500C, and maintain electromagnetic performance in the range of 6-36GHz (X-Ku-Ka bands). Importantly they must physically integrate with external surfaces and associated load bearing internal structures. There are a number of plausible configurations and materials solutions that potentially address this challenge, however an optimised solution allowing for platform integration is yet to be settled on.

NB: All of the above critical sub-assemblies will operate in high temperature oxidising environments and proposals may wish to address the inclusion the high temperature barrier coatings.

DMTC and DSTG are aware that there are a significant number of concurrent efforts in the broader hypersonic topic area.

This effort should dovetail with rather than duplicate work in train.

5. APPENDIX – TRL REFERENCE & QUAD CHART TEMPLATE

#	Concept Maturity	Systems Integration	Environment
1	Concept	Postulated	Lab / Simulation
2	Proof-of-Principle	Formulated	Lab / Simulation
3	Low Fidelity Component	Studied	Lab / Simulation
4	Medium Fidelity Component	Reviewed	Lab / Simulation
5	High Fidelity Component	Understood	Relevant
6	Low Fidelity System	Demonstrated	Relevant
7	Medium Fidelity System	Qualified	Operational Test
8	High Fidelity System, Pilot Production	Proven	Operational Demo or Trial
9	In Production	In Service	Operations

Project Title:

BACKGROUND • **Proposing Organisation(s):** • **Point of Contact:** • **Background (incl. prior work with Defence):**	**THE TECHNOLOGY** • **Basic description of technology relevant to Proposal:** • **Current stage of development (TRL):** • **Describe the Targeted Outcome:**
KEY CHALLENGES • **Manufacturing and/or testing infrastructure:** • **Materials Availability:** • **Subject Matter Expertise:** • **Other:**	**PROGRAMMATICS** • **Approx. how many people and how long?:** • **Key milestones or outcomes:** • **What resources is the group able to bring to the project – financial, in-kind staff, in-kind facilities:** • **Financial and other resources required:**