Serapis Tasking Form

Tasking Form Part 1: *(to be completed by the Authority's Project Manager)*

To:	Lot 1 Roke Manor Research Ltd	**From:**	The Authority

Any Task placed as a result of your quotation will be subject to the Terms and Conditions of Framework Agreement Number:

LOT 1 DSTL/AGR/SERAPIS/COL/01

VERSION CONTROL

00-01 Initial comments added.

00-02 Substantial changes to expand the tasking form.

00-03 Changes made by PMO based on feedback from Dstl.

00-04 Table fixed. MS Word messed it up (cause unknown).

00-05 Changes made after internal PMO review.

00-06 Changes made after feedback from Dstl.

01-00 Version 1.

REQUIREMENT

Proposal Required by:	[02/12/2022]	**Task ID Number:**	C83
The Authority Project Manager:	[REDACTED]	**The Authority Technical Point of Contact:**	[REDACTED]
Task Title:	Generation of anti-reflective structures on mid infrared focal plane array materials		
Required Start Date:	[24/01/2023]	**Required End Date:**	[31/03/2024]
Requisition No:	RQ0000015306	**Budget Range**	£50-100k (ST1 only)

TASK DESCRIPTION AND SPECIFICATION

Serapis Framework Lot	☒ Lot 1: Collect ☐ Lot 2: Space systems ☐ Lot 3: Decide ☐ Lot 4: Assured information infrastructure ☐ Lot 5: Synthetic environment and simulation ☐ Lot 6: Understand

Abstract

The project aims to demonstrate the improvement in the performance of anti-reflective (AR) coatings for medium-wave infrared (MWIR) sensors by using moth-eye like AR structures.

Background

Due to the wide operating band of infrared sensors, ~2000nm for MWIR sensors operating between 3-5µm, AR coatings are often unable to provide the anti-reflection performance required consistently over the entire band.

Moth-eye surface structures are highly versatile structures that can be created on a multitude of materials which exhibit significant anti-reflection properties. Work using these structures has been extensively published by the US Navy Research Lab (NRL), but we are yet to see evidence of this being translated to a focal plane array (FPA). Moth-eye structures act as a graded refractive index and often have better performance over a wide wavelength range; they are also often made from the same material as the detector and so have a higher laser induced damage threshold (LIDT) than that of thin film AR coatings. To apply this technique to an FPA could enable improved performance and lower focal plane reflectivity with less costly processes than an AR coating.

Statement of Requirements (SOR)

Proposals are invited that **shall** investigate the performance of reactive ion etching (RIE) or other similar techniques to create moth-eye style anti-reflective structures on MWIR focal plane arrays for performance enhancement and decreased surface reflectivity. The activity **shall** be bound to a single material, e.g. indium antimonide (InSb), mercury cadmium telluride (MCT), or another suitable material.

[REDACTED]. The Supplier is requested to provide a firm price proposal for ST1 and ROM costed proposals for ST2 and ST3 based on documented assumptions. If ST2 is activated by the Authority, the Supplier will be required to submit a firm priced proposal. This process will be repeated for ST3. The Authority does not wish to penalise any Supplier who does not have the necessary facilities/expertise to perform ST2/3; if this is the case, the Supplier **should** state which company or companies they would work with to achieve the aims of the project and what experience they have with working with those companies.

ST1: Feasibility and material study (duration up to 6 months)

This sub-task **shall** undertake a feasibility and brief material study on whether it is possible to achieve a ~20% or better reduction in reflectivity across the entire 3-5µm MWIR band using graded refractive index (moth-eye) structures on a base sensor material. The study **should**:

- Review the most suitable detector materials for the study and the applicability of moth-eye structures to FPAs.
- Identify the most suitable methods for moth-eye structure generation on the chosen material, e.g. RIE, material deposition, or similar techniques.
- Identify or measure the performance of current AR coatings used on MWIR FPAs to estimate the performance requirements of a moth-eye structure.

The above initial parts of the study **shall** be presented to the Authority at the mid-point technical and project management review meeting (deliverable D1.3). The study **should** then continue to:

- Create the moth-eye structure on a base sensor material (e.g. a 15×15mm piece of InSb representative of an FPA).
- Test the moth-eye structure with regards to anti-reflection performance across the MWIR band.
- Compare results of the moth-eye structure anti-reflection performance against modern AR coatings.
- If the performance is below that expected, investigate why this might the case.

The progress through this second part of ST1 **shall** be presented to the Authority at a progress review meeting (deliverable D1.4).

The output of the feasibility study **shall** be presented to the Authority (deliverable D1.5) and a report detailing the work (deliverable D1.6) **shall** also be delivered. The report and presentation **should** contain:

- Introduction to the objectives of the study.
- Discussion of moth-eye structures in the context of anti-reflection applications.
- Output of the review of the most suitable detector materials and the applicability of moth-eye structures to FPAs.
- Discussion of the most suitable methods for moth-eye structure generation on the chosen material.
- The process by which the moth-eye structure was applied to the base sensor material, with the base specified in terms of material, size, and other relevant parameters as agreed with the Authority.
- The details of the testing used to measure the anti-reflection performance.

- The results of the anti-reflection measurements.
- Comparison between the anti-reflection measurements for the moth-eye structure and a modern AR coating (the details of the modern AR coating should also be provided).
- Benefits, risks, assumptions, and dependencies of the moth-eye structure as a method to reduce reflectivity as identified during the feasibility study.
- If the desired performance could not be achieved, a discussion of why this might be the case and if there is a potential solution.
- A discussion of any issues that may arise when applying the moth-eye structure to a FPA.
- ROM costing of ST2 activities.
- References.

A reference sample and other example successful samples **shall** also be provided to the Authority for test and evaluation (deliverable D1.8). These samples can be returned upon request.

At the end of ST1 there will be a break point to decide whether or not to proceed to ST2. The Authority will consider the results of ST1 and the costed activities for ST2 and may proceed via a contract amendment to elicit a firm price proposal for ST2.

ST2: Further process optimisation (duration 3-6 months)

This sub-task **shall** attempt to further optimise the process used with the base material from ST1. The Supplier **should**:

- Optimise the process used in ST1.
- Perform materials analysis testing, including reflectivity, linear transmission, scatter, optical clarity, and other tests as agreed with the Authority.
- Provide the Authority with the sample(s) used for testing and the test results.

The output of the process optimisation sub-task **shall** be presented to the Authority (deliverable D2.4) and a report detailing the work (deliverable D2.5) **shall** also be delivered. The report **should** contain:

- Details of the process optimisations developed during this sub-task.
- Benefits, risks, assumptions, and dependencies of using the optimised process to create moth-eye structures and reduce reflectivity.
- The details of the testing performed (reflectivity, linear transmission, scatter, optical clarity, and other tests as agreed with the Authority) with results.
- A discussion of any issues that may arise when applying the moth-eye structure to a FPA, including potential problems in productionising the process.
- ROM costing of ST3 activities.
- References.

A reference sample and other example successful samples **shall** also be provided to the Authority for test and evaluation (deliverable D2.7). These samples can be returned upon request.

At the end of ST2 there will be a break point to decide whether or not to proceed to ST3. The Authority will consider the results of ST2 and the costed activities for ST3 and may proceed via a contract amendment to elicit a firm price proposal for ST3.

ST3: Processing and integration of a FPA with surface processing into a demonstrator unit (6 months)

This sub-task **shall** create moth-eye style anti-reflective structures on MWIR FPAs for performance enhancement and decreased surface reflectivity. The Supplier **should**:

- Create the moth-eye structure on a FPA.
- Test the moth-eye structure with regards to anti-reflection performance across the MWIR band including reflectivity, linear transmission, scatter, optical clarity, and other tests as agreed with the Authority.
- Compare results of the moth-eye structure anti-reflection performance against the performance of modern AR coatings as determined using the same methods used for testing the moth-eye structure.
- Evaluate the impact that the moth-eye structure has on the operation of the FPA.

The Supplier **shall** indicate in their proposal their (or their potential subcontractor's) experience in the surface processing of a FPA.

The output of this sub-task **shall** be loan/delivery of any complete sensor system (compatibility with existing MWIR lenses is desirable) for testing and evaluation by the Authority (deliverable D3.7). There **shall** also be a presentation (deliverable D3.4) and a report (deliverable D3.5) detailing the work delivered. The report **should** contain:

- Details of the processes used to create the moth-eye structure on the FPA.
- The details of the testing performed (reflectivity, linear transmission, scatter, optical clarity, and other tests as agreed with the Authority) with results.
- Benefits, risks, assumptions, and dependencies of using moth-eye structures to reduce reflectivity.
- Potential future improvements to the process.
- Future exploitation of the technique, including a possible roadmap and indicative costs.
- References.

Monitoring

Monitoring meetings can be assumed virtual unless explicitly stated otherwise.

A start-up meeting (deliverable Dx.1) **shall** be held within the first week of each sub-task. The Authority **shall** require regular progress reports (*which are brief reports in the form of slides, not held as meetings*) in order to monitor progress (deliverable Dx.2.n). The Authority shall require a mid-point technical and project management review meeting for each sub-task (deliverable Dx.3) in order to monitor progress. These monitoring meetings/reports **should** include:

- Update on technical progress.
- Progress report against project schedule.
- Review of deliverables.
- Review of risk management plan.
- Current risks/issues.
- Commercial aspects.
- GFA and supplier performance.

At the end of each sub-task there **shall** be a close-down meeting, taking place no later than 1 week prior to the end of the sub-task contract, which **should** include:

- Lessons identified.
- Future exploitation of the work, including a possible roadmap and indicative costs.
- Benefits.
- Any administrative aspects associated with the end of the contract.

Additional meetings and technical workshops **should** be proposed by the Supplier as required.

Following any meeting, materials and minutes **shall** be delivered to the Authority within 5 working days of the event.

Quality

The Supplier **shall** provide a description of their engineering and quality management systems and how these systems will be applied in the context of the task requirements. Please note that a proposal that does not provide a comprehensive response to this element of the requirement will not be taken forward.

Procurement Strategy

☒ Lot Lead to recommend ☐Single Source / Direct Award

Pricing:

☒ Firm Pricing ☐ Ascertained Costs* ☐ Other*

Firm Pricing shall be in accordance with DEFCON 127 and DEFCON 643

Ascertained Costs shall be in accordance with DEFCON 653 or DEFCON 802.

*only at Authority's discretion

Task IP Conditions

Task IP Conditions (Follow the NIPPY guide to identify your information and IP requirements for each deliverable)	**Summary of the Authority's rights in foreground IP (IP generated by the supplier in performance of the contract)**
DEFCON 703 ☐	Vests ownership with the Authority
DEFCON 705 Full Rights ☒	Enables MOD to share in confidence as GFI or IRC under certain types of agreements. Can be shared in confidence within UK Government.
OTHER IP DEFCONS: 14* ☐, 15* ☐, 16* ☐, 90* ☐, 91* ☐, 126* ☐	Generally only suitable for deliverables at TRL 6 and above.
BESPOKE IP Clause ☐ *	Details to be added and agreed by IP Group
* Do not use without IPG advice and approval	
Please state in this text box if MOD or the customer has a requirement a) that one or more Other Government Departments is able to share confidentially with their own suppliers, b) to publish but you do not think there is a requirement to own or control the deliverable, or c) to share under a procurement Memorandum of Understanding (MOU).* *If any of these three issues applies, please contact IPG for advice before completing this form. *Listing research MOUs is not required, but can be a helpful courtesy to the supplier.*	

DELIVERABLES

[REDACTED]

DELIVERABLE: ACCEPTANCE / REJECTION CRITERIA

Unless otherwise stated below, Standard Deliverable Acceptance / Rejection applies. This is 30 business days, in accordance with DEFCON 524 Rejection, and DEFCON 525 Acceptance.

Standard Deliverable Acceptance / Rejection:-

Yes ☒ (DEFCON 524 Rejection, and DEFCON 525 Acceptance)

No ☐ (if no, please state details of applicable criteria below)

Deliverable Acceptance / Rejection Criteria:-

N/A

Government Furnished Assets (GFA)

ISSUE OF EQUIPMENT/RESOURCES/INFORMATION/FACILITIES (*if not applicable, delete table and insert "None" in this text box)*

None

QUALITY STANDARDS

☐ **ISO9001** (Quality Management Systems)

☐ **ISO14001** (Environment Management Systems)

☐ **ISO12207** (Systems and software engineering — software life cycle)

☐ **TickITPlus** (Integrated approach to software and IT development)

☐ **Other:** (Please specify in free text below)

SECURITY CLASSIFICATION OF THE WORK

[REDACTED]

TASK CYBER RISK ASSESSMENT. *(In accordance with DEF STAN 05-138 and the* Risk Assessment Workflow)

Cyber Risk Level	[N/A]
Risk Assessment Reference	[RAR-573639650]

ADDITIONAL TERMS AND CONDITIONS APPLICABLE TO THIS CONTRACT

[REDACTED]

Please ensure all completed forms are copied to DSTLSERAPIS@dstl.gov.uk when sending to the Lot Lead.

Tasking Form Part 2: *(To be completed by the Lot Lead)*

To: The Authority	From: The Lot Lead

Proposal Reference **MO2022Q0059_C83-Generation of AR Structures_MO Technical Proposal_V2.1_O** **(attached)**

Delivery of the requirement:

The proposal shall include, but not be limited to:

- A full technical proposal that meets the individual activities that are detailed in Statement of Requirements (Part 1 to Tasking Form).
- Breakdown of individual Deliverables, with corresponding Intellectual Property rights applied.
- Breakdown of Interim Milestone Payments, with corresponding due dates.
- A work breakdown structure/project plan with key dates and deliverables identified.
- A list of required Government Furnished Assets from the Authority, including required delivery dates.
- A clear identification of Dependencies, Assumptions, Risks and Exclusions which underpin your Technical Proposal.
- Sub-Contractors Personnel Particulars Research Worker Form and security clearances (if applicable)

PRICE BREAKDOWN

You are to use the costs detailed in Item 2 Table I in the Schedule of Requirement and at Annex E Table 2 of the Serapis Framework Agreement. Please also provide a price breakdown which should include, but is not limited to: Lot Lead Rates, Sub-contractors costs and rates, travel and subsistence. In support of your Proposal you are requested to provide clear details of all Dependencies, Assumptions, Risks and Exclusions that underpin your price.

Offer of Contract: *(to be completed and signed by the Contractor's Commercial or Contract Manager)*

Total Proposal Price in £	£97,196.30		(ex VAT)
Start Date:	09/02/2023	**End Date:**	08/08/2023

Lot Leads Representative	Name	[REDACTED]
	Tel	[REDACTED]
	Email	[REDACTED]
	Date	01/02/23
Position in Company	[REDACTED]	
Signature	[REDACTED]	

Core Work – Breakdown

[REDACTED]

[REDACTED]

Core Work – Milestone breakdown costs

Proposed Milestones Payments

Your TMS bid costs shall be included in milestone 1.

The final Milestone must reflect the actual cost of the deliverable, and be greater than 20% of the Task value, unless otherwise agreed with your Commercial POC

Please duplicate the template per milestone table format below as necessary, and rename milestone number accordingly.
[REDACTED]

Options – Summary

[REDACTED]

Tasking Form Part 3:

To be completed by the Authority's Commercial Officer and copied to the Authority's Project Manager.

1. **Acceptance of Contract:**		
Authority's Commercial Officer	Name	[REDACTED]
	Tel	[REDACTED]
	Email	[REDACTED]
	Date	16/02/2023
Requisition Number		RQ0000015306
Contractor's Proposal Number		MO2022Q0059_C83-Generation of AR Structures_MO Technical Proposal_V2.1_O
Purchase Order Number		DSTL0000013115
Signature		[REDACTED]
Please Note: Task authorisation to be issued by the Authority's Commercial Officer or Contract Manager. Any work carried out prior to authorisation is at the Contractor's own risk.		