

RCloud Tasking Form – Part B: Statement of Requirement (SoR)

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| Title of Requirement | Additive Manufacture of Tailored Electromagnetic Materials (AMOTEM) Hybrid Printing Testing |
| Requisition No. | RQ0000010309 |
| SoR Version | 1.0 |

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| 1. | Statement of Requirements |
| 1.1 | Summary and Background Information |
| | <p>Summary:</p> <ol style="list-style-type: none"> 1. The purpose of this work is to follow up previous work in the fabrication of tailored electromagnetic materials. Past work, commencing with a CDE (now DASA) proposal, has investigated the fabrication of such materials by ink jet printing. 2. Recent work has identified a number of issues which, to some extent, have been solved by targeted research. For practical AMOTEM applications two-material 3D printing is much more challenging than single-material 3D printing. To achieve electromagnetic functionality, two or more very different inks need to be used, a fact which presents issues of compatibility between 'host' and 'inclusion' inks, and presents practical difficulties when printing with inks, for instance, that have different viscosities and curing regimes. 3. Dimensional measurements on lattice structures show considerable departure from specified dimensions. The AMOTEM project has stretched printer technologies by attempting 3D manufacture of materials that today's ink-jet printers are not optimised for and actually are not envisioned for. Long term cost-effective realisation of the AMOTEM vision will, at the very least, require customisation of printers but, more likely, development of purpose-built printers. 4. Redacted under FOIA Section 26 - Defence 5. The most recent work was based on the experiences and lessons learned from the previous investigations and the focus in this study was to improve the dimensional accuracy of fabricated structures, increase the particle loading of the lossy inclusions that make up the cubic matrix, minimise the thickness of dielectric walls and to identify materials that are stable at higher temperature to facilitate higher lossy material loading. The project also looked at processes for manufacturing of these composites including hybrid printing of low/high viscosity inks and masked-SLA/ Micro-SLA (µSLA) techniques in conjunction with manual coating/ jetting. 6. This proposal is to extend the work to try to solve problems encountered with maintaining consistent wall thicknesses and unintended mixing of inks. |

Background:

Conventional electromagnetic materials make use of random composites to produce materials with desired dielectric properties. Their manufacture that usually results in their complex permittivity departing from the ideal, and they are rarely uniform in their properties from one point to another; both issues compromise the material's final performance.

AM now allows novel regular-lattice, or irregular for that matter, composites to be tailored precisely and uniformly to generate desired properties, prior work has shown the capability of producing relatively simple conducting/insulative lattice materials. Tailoring of electromagnetic (EM) has become possible because of the advent of AM systems that can drop-on-demand (e.g. by ink jetting) a range of materials and effectively produce 'designed' composites which can ultimately be tailored to have specified dielectric and magnetic properties.

There is the potential to have material properties which can readily be 'profiled' (changed from place to place) across a block of material by varying the relative proportions of material components. This feature could be used to produce material structures which condition (i.e. reflect, deflect, transmit, focus, and absorb) EM waves optimally for a broad range of applications.

Products can also be made to desired shapes, potentially without post-processing, and potentially in the field at short notice.

Redacted under FOIA Section 26 - Defence

Inkjet printing has been in use for prototyping and manufacturing purposes for around five decades for depositing various inks with a wide range of properties and although mostly used in the graphics industry, recent reports have shown the potential to use inkjet printing in areas like printed electronics printed optics and medical applications.

Redacted under FOIA Section 26 - Defence

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| 1.2 | Requirement |
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| | <p>The overall aim of this project is to develop a structure that combines an active, nanoparticle-loaded material in a polymer dielectric matrix that exhibits metamaterial behaviour at microwave frequencies.</p> <p>The key aim is to develop additive manufacturing technology that will maximise the ratio of active to dielectric materials with a target wall thickness for the matrix of below 100 microns in the X-Y plane. The manufacturing process should also be capable of building 3D, layered structures, and the method selected or developed must be a suitable candidate for scaling up to production rate manufacture.</p> <p>Measurement samples should be designed and sized for measurement in X-Band Waveguide (8.2 – 12.4 GHz).</p> <p>The hybrid printing of low/high viscosity inks has some further barriers to overcome and there is a requirement to address:</p> <p>Methods to achieve uniform wall thickness</p> <p>Reduction of the risk of potential mixing of the two materials while printing.</p> <p>Methods for achieving this should include, but not be limited to, manufacturing the dielectric structure using <small>Redacted under FOIA Section 26 - Defence</small> (which provides a range of benefits as it can produce uniform and accurate wall thicknesses at the same time (up to 2 µm) and <small>Redacted under FOIA Section 26 - Defence</small> which provides a means to do high throughput printing.</p> |
| 1.3 | Options or follow on work <i>(if none, write 'Not applicable')</i> |
| | <p>If successful, the next step will be the production of a technology demonstrator, possibly a <small>Redacted under FOIA Section 26 - Defence</small></p> |
| 1.4 | Contract Management Activities |
| | <p>A start up meeting will be arranged within the first month of the successful placement of the contract with all key players. The contract placed will be assigned a Dstl Technical Partner who will monitor the progress of the research through regular meetings (quarterly at a minimum, more if required) and monthly progress email reports on technical work.</p> |

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| 1.5 | Health & Safety, Environmental, Social, Ethical, Regulatory or Legislative aspects of the requirement |
| | Not applicable |

Redacted under FOIA Section 43 - Commercial Interest

| 1.7 | Deliverable Acceptance Criteria | | | | | | | | | | |
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| | <p>Deliverables will be accepted by the Dstl Project Manager. Deliverables will be held for consideration by Dstl for up to 30 days and returned with any requested edits or changes. These changes should be made and returned to Dstl within 14 days. After acceptance of a given deliverable, the supplier may then invoice for payment.</p> <p>All reports/presentations included as Deliverables under the Contract e.g. Progress and/or Final Reports etc. must comply with the Defence Research Reports Specification (DRRS)¹, which defines the requirements for the presentation, format and production of scientific and technical reports prepared for MoD.</p> <p>Final Reports: shall describe the entire work performed under the Contract in sufficient detail to explain comprehensively the work undertaken and results achieved including all relevant technical details of any hardware, software, process or system developed there under. The technical detail shall be sufficient to permit independent reproduction of any such process or system. The reports should be delivered in MS Word format and include: Approach/Methodology, Key findings (and supporting evidence), Additions or Amendments made to the Behavioural Matrix, Conclusions and Recommendations.</p> <p>All Reports shall be free from spelling and grammatical errors and shall be set out in accordance with the Statement Of Requirement (1) above.</p> <p>Failure to comply with the above may result in the Authority rejecting the deliverables.</p> <p>The Contractor shall be advised if and when the deliverable is acceptable. If any deliverables are not accepted, the Contractor shall be required to take remedial action to the satisfaction of the Authority, at no additional cost to the Authority.</p> | | | | | | | | | | |
| 2 | Evaluation Criteria | | | | | | | | | | |
| 2.1 | Method Explanation | | | | | | | | | | |
| | <p>Value for Money index</p> <p>This approach divides the total score of the non-cost (quality) criteria by the tender cost. It ranks tenders on the quality (represented by the non-cost score) for each £ (or £k or £m) of cost. It is simple to calculate, transparent, and maximises return on investment. It should be noted that very different solutions can give the same VFM index and be considered equal .</p> | | | | | | | | | | |
| 2.2 | Technical Evaluation Criteria | | | | | | | | | | |
| | <p>Proposals must include a concise response to each evaluation including the criteria for Pass/Fail. Supporting evidence may be provided separately, but will only be read if time allows.</p> <table border="1"> <thead> <tr> <th><u>Question</u></th><th><u>Criteria</u></th><th><u>Max Score</u></th><th><u>Weighting %</u></th></tr> </thead> <tbody> <tr> <td><u>No.</u></td><td></td><td></td><td></td></tr> </tbody> </table> | | | <u>Question</u> | <u>Criteria</u> | <u>Max Score</u> | <u>Weighting %</u> | <u>No.</u> | | | |
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| <u>No.</u> | | | | | | | | | | | |

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| R1 | Supporting the requirement and Capability and Expertise of the Delivery Team. Please provide evidence (up to 3 examples) that your organisation has the experience / knowledge to perform work in the fields of additive manufacturing and electromagnetic measurements and please provide evidence (up to 3 examples) that your organisation has the experience / knowledge of technical capabilities and expertise, especially in the areas of additive manufacturing and electromagnetic interactions with materials. | 100 | 20 |
| R2 | Please demonstrate the knowledge the delivery team have of Dstl and its working practices, including experience in presenting technical findings to defence and commercial audiences and in general communications with the wider team (Email, etc). Please identify key members of your delivery team and provide short CVs and references to published work in related fields for your technical team and any supporting staff. | 100 | 15 |
| R3 | Understanding of concept and Technical and Scientific Approach. Provide a description of your understanding of the Project Scope and Requirements into the research into novel materials for RF applications and how you will maintain capability in this technology and detail the scientific and technical approach that will be employed to meet the requirements of this work. The work plan should demonstrate the variety of technologies which could be researched, | 100 | 45 |
| R4 | Risk Management. Please identify the key technical and project risks, and critical dependencies, and describe how these will be mitigated. | 100 | 15 |
| R5 | Interaction with Stakeholders and other researchers. Please provide evidence of interaction (describe current interactions) with Stakeholders within MoD, OGDs, Defence Primes, academia and wider Industry. | 100 | 5 |

The following scoring guide will be used to evaluate against each criteria:-

100 = Excellent: The response fully addresses the question providing a comprehensive, unambiguous and through explanation of how the requirement will be fulfilled.

70 = Good: The response addressed all of the elements of the requirement and provides sufficient detail and explanation of how the requirement will be fulfilled.

30 = Adequate: The response addressed the majority of elements of the requirement but is weak in some areas and does not fully detail or explain how the requirement will be fulfilled.

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| | <p>0 = Inadequate: The response does not address or explain how the requirement will be fulfilled and fails to demonstrate the ability to meet the requirement.</p> <p><u>NON SCORING CRITERIA</u></p> <table border="1"> <tr> <td>How many staff have appropriate security clearance to perform the work?</td> <td></td> </tr> <tr> <td>Please provide details of your internal quality controls.</td> <td></td> </tr> </table> | | How many staff have appropriate security clearance to perform the work? | | Please provide details of your internal quality controls. | |
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| 2.3 | Commercial Evaluation Criteria | | | | | |
| | <p>The commercial evaluation shall apply a series of Pass / Fail questions.</p> <p>Please be aware that a fail on any of the questions will result in your proposal being considered as Non-Compliant, and excluded from further evaluation.</p> <ol style="list-style-type: none"> 1. Has the supplier uploaded One Fully priced copy of their proposal, and One Unpriced Copy of their proposal? 2. Has the supplier submitted a completed Part C - Task Response Form? 3. Has the supplier accepted in full the RCloud Terms and Conditions that govern this requirement? 4. Has the supplier provided details of the points of contacts for commercial, project management and technical? 5. Compliance with the required price quotation validity period of 60 days. 6. The supplier must provide their full FIRM price breakdown for all costs to be incurred to fulfil this requirement, including: What rates are being used for what Grade (using their respective R-Cloud Grades), Quantity of manpower hours per Grade, Materials costs Facility costs, Profit rate applied, Any sub-contractor costs and the level of sub-contracting required, Any other costs applicable to this requirement. 7. Research is at an <small>Redacted under FOIA Section 26 - Defence</small>, the contractor MUST have the capability to handle and store materiel at this level and demonstrate satisfactory experience of managing this requirement. 8. The Authority will assess the proposal to ensure that all costs are fully detailed, in line with the R-Cloud rates and price shall be commensurate with the work to be undertaken. 9. When placing any contract the Authority is required to satisfy itself that the agreed price represents Value for Money (VFM). In single source contracting you must provide to the Authority sufficient information in support of your price proposal and during subsequent price negotiation, to enable the Authority to fulfil its obligation to assure VFM. The Authority approaches all contract pricing on the basis of the NAPNOC principle (No Acceptable Price, No Contract). The Authority reserves the right to not enter into any contract that is unacceptably priced or unaffordable. | | | | | |