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Statement of Requirement for the R-Cloud Explosives and Energetics Strategic Capability

Introduction:

The Defence Science and Technology Laboratory (Dstl), which is part of the UK Ministry of Defence (MOD), is refreshing its commercial agreement for Science and Technology (S&T) research contracts, known as R-Cloud (Research Cloud).

MOD places extensive fundamental, experimental and applied research with industry and academic suppliers and wants to broaden access for this supply base, reducing the cost of trading with MOD and enabling agile contracting. R-Cloud complements MOD's other contracting mechanisms and academic and industry suppliers of S&T research are now invited to apply to join MOD's research supplier community within the Explosives and Energetics Strategic Capability.

This statement of requirement relates to suppliers joining R-Cloud within the Explosives and Energetics capability area. R-Cloud provides a low barrier to entry for potential suppliers and offers direct access to MOD's current and future research requirements. Academic and industrial suppliers of Explosives and Energetics research are invited to apply to R-Cloud if you are a supplier of Science and Technology Research and/or Services in this area.

Explosives and Energetics capability area encompasses a broad range of technical areas, these are summarised here:

Statement of Requirement

1 Pyrotechnics

1.1 The requirement seeks to support the design, manufacture and testing of novel pyrotechnic flares, countermeasures and distractants for both air platform protection and specialist user applications. The research may require, but is not limited to:

- a) Novel pyrotechnic and distractants synthesis and formulations.
- b) The application of novel manufacturing techniques, such as additive manufacture to pyrotechnics.
- c) Spectral measurement and characterisation of pyrotechnics.
- d) Development of novel test and evaluation procedures.
- e) Modelling and simulation development.
- f) Novel countermeasure approaches.



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2 Explosive Ordnance Disposal

2.1 Technical research related to the render-safe of Improvised Explosive Devices (IEDs) and conventional munitions (CMD). The research may require, but is not limited to:

- a) Lightweight, recoilless disruptors which are simple to use, and modular (scalable to the target) in design.
- b) Render-safe options for Maritime applications.
- c) Computer modelling of the disruption process.
- d) Unconventional methods and technologies to render-safe a device.
- e) Development of specialist explosive charges.
- f) Development of explosive mitigation systems.
- g) Development of personal protection systems for operators.

This may include, but is not limited to:

- Pure and applied research into: technologies, energetics and materials.

2.2 Research related to capabilities that allow an operator to understand what is inside a container, or behind a barrier and its current state. The research may require, but is not limited to:

- a) Through-barrier imaging technologies (e.g. X-ray, radar).
- b) Through-barrier sensing technologies able to determine the type, material composition and relative location of component parts of a device – via imaging or other means (e.g. magnetic resonance and neutron activation techniques).

This may include, but is not limited to:

- Basic research into techniques and technologies that may be of use to EOD Diagnostics
- Applied research into component, sub-system and system level equipment.

2.3 Technical research may be required to support the remote controlled delivery of diagnostic and render-safe equipment to an IED. The research may require, but is not limited to:

- a) Robotic platforms , including UAVs and ROVs, capable of delivering a payload to a target (render-safe or diagnostics).
- b) Open source software standards for C2I.
- c) Appliqué tools for EOD operators.
- d) Reducing the cognitive burden on operators.
- e) Land, Air and Maritime based capabilities.
- f) Integration of equipment onto platforms.

This may include, but is not limited to:

- Upgrades for current UK MOD platforms, which may feature Artificial Intelligence or Machine Learning.
- Software and hardware tools.
- Tools for simulation.



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2.4 Technical research may be required to support the synthesis of home-made explosives and new and novel conventional explosives, for the purpose of assessment of render safe procedures. The research may require, but is not limited to:

- a) New approaches to the discovery of energetic molecules.
- b) New synthesis pathways and methods, which are more cost effective or safer.
- c) The application of robotics and/or automation, including AI and ML, at all stages of the molecules discovery and synthesis process.
- d) New chemical engineering approaches, at lab and pilot scale.

3 Explosives and propellants

3.1 Technical research and/ or services may be required to support the synthesis and testing of propellants and explosives, both 'home-made' and conventional, including novel compositions. The research may require, but is not limited to:

- a) New approaches to the discovery of energetic molecules.
- b) New synthesis pathways and methods, which are more cost effective or safer.
- c) The application of robotics and/or automation, including AI and ML, at all stages of the molecules discovery and synthesis process.
- d) New chemical engineering approaches, at lab and pilot scale including, but not limited to, flow reactors for on-demand manufacture.
- e) Test and evaluation of viability of compositions, including geometry effects and critical diameter.
- f) Test and evaluation of blast and/ or thrust properties.

4 Explosives detection and forensic analysis

4.1 The ability to detect and identify explosive material, explosive precursor materials and narcotics. The research may require, but is not limited to:

- a) The accurate detection of bulk or trace levels of explosives and associated substances including drugs, ideally providing identification or type classification.
- b) The identification of explosives and substances of interest from bulk or trace samples.
- c) Broad range explosive detection and identification that can be easily and rapidly adapted in response to novel or changing threats.

The research may require, but is not limited to:

- Optical spectroscopy techniques including hyperspectral imaging.
- Subsystems development for spectroscopic systems, including photonics developments (including but not limited to lasers and detectors).
- Spectrometry techniques including ion mobility, mass, acoustic and thermal.
- Subsystems for mass spectrometry, including vacuum technologies, ionisation and separation.
- Chromatography.
- Chemical tests for explosives detection.
- Novel explosives detection technologies.



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- Vapour generation and vapour sampling techniques including pre-concentration.
- Antibody/immunoassay development/synthesis.
- Sample processing and handling.
- Molecular recognition.
- Nanoparticles and nano-photonics.
- Anomaly detection and chemometrics.
- Inductively Coupled Plasma techniques.
- Surface sampling methods.
- Functionalised materials.
- Chemical printing.
- Novel molecular sensors.
- Novel microscopy techniques.
- Novel chemical analysis techniques.
- Techniques to provide enhanced selectivity.
- Multicomponent spectral analysis.
- Sensor fusion, including AI and ML.
- The application of robotics, including AI and ML, to explosive detection and analysis.

4.2 Techniques to analyse target materials in support of future developments in the detection and identification of explosives, explosive precursors, drugs and other targets pertinent to defence and security tasks. The research may require, but is not limited to:

- a) Characterisation of the fundamental chemical properties of explosive materials and the products from explosive syntheses.
- b) Characterisation of the fundamental chemical properties of explosive precursors and drugs.
- c) Development of chemical analysis techniques that enable the characterisation, identification and/or attribution of other target materials.
- d) Fluid dynamics modelling in support of detection.
- e) Development of advanced computational processing, integration and analysis techniques for rapid, automated data assessment.

The research may include, but is not limited to:

- Sample processing and sample handling of threat materials in the vapour, liquid and solid phase.
- Chemical analysis of bulk and trace threat materials including headspace characterisation.
- Chemical analysis instrumentation, software and method development.
- Novel microscopy techniques.
- Data analysis and software development.

4.3 Technical research may be required to develop standards which support the test and evaluation of explosives (and related materials including drugs) detection and identification equipment and techniques. The research may require, but is not limited to:

- a) Development of realistic, accurate and reproducible explosive bulk and particulate trace standards and associated techniques.



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- b) Development of techniques to characterise bulk and trace particle standards and compare them with realistic trace contamination.
- c) Tools to reproducibly assess explosive trace sampling effectiveness.
- d) Development of reproducible vapour generation capabilities to provide standard vapour concentrations for equipment test and evaluation.

The research may include but is not limited to:

- Chemical ink-jet printing.
- Vapour generation.
- Chemical analysis of bulk and trace threat materials including headspace characterisation.
- Trace sample collection and trace swabbing materials.
- Storage and presentation packaging and methods

5 Biomimetics and working animals

5.1 Technical research and analysis may be required to support the development and deployment of working animals in a counter-terrorism and security role. This will include, but is not limited to, research into:

- a) Development and deployment of working animals
- b) Assessment of the detection capability of dogs and other animals against a broad array of explosive and non-explosive substances (e.g. weapons, drugs, firearms, human remains).
- c) Animal learning, welfare, performance, decision making, olfaction, animal-human interaction, and search behaviours, particularly for dogs.
- d) The development, provision and use of animal models for animal learning, olfaction, decision making and search behaviour.
- e) Tools and learning resources to improve animal welfare and performance, including equipment and software to aid in the use of working animals.
- f) Optimum deployment strategies for working animals including operational analysis
- g) Development of explosive and non-explosive aids for training animal detection capability including laboratory analysis of materials.
- h) Fluid dynamic modelling in support of explosive detection.

This research may require but is not limited to:

- Zoology, including animal behaviour and welfare, experimental psychology, veterinary, physiological and neurological science.
- Psychology and human sciences.
- Chemical analysis of material composition and headspace including explosives.

5.2 Technical research may be required to support the detection of explosives or other substances using biological systems and sensors, including innovative means to detect explosives in vapour phase. The research may require, but is not limited to:

- a) Real-time sensitive and selective identification of explosives.
- b) Broad range target detection that can be adapted in response to novel or changing threats.



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The research may include but is not limited to:

- Development of biomimetic systems for detection of explosives and other substances.
- Development of recognition elements and assay design for detection of explosives and other substances (including but not limited to protein, nucleic acid, synthetic sensing elements).
- Research and development of olfaction-based systems for explosive detection (including but not limited to whole animal, whole cell and molecular interactions).
- Sample processing and sample handling of explosives in the vapour, liquid and solid phase.
- Platform development for explosive sampling and sample processing using biological detection techniques.
- Development of AI/ ML for olfactory signal processing.

5.3 Technical research may be required to support the development of training techniques for working animals. The research may require, but is not limited to:

- a) Animal learning, welfare, performance, decision making, sensing (particularly olfaction), animal-human interaction, and search behaviours, particularly for dogs;
- b) The development and use of animal models for animal learning, olfaction, decision-making and search behaviour;
- c) Tools and learning resources to improve animal welfare and performance, including equipment and software to aid in the use of working animals;
- d) Optimal deployment strategies for working animals, including operational analysis;
- e) The development of equipment to use in combination with animals;
- f) The development of analytical techniques to enable fusion and interpretation of data from animals and other sources;
- g) Development of computational models to predict animal responses.

The research may include, but is not limited to:

- Zoology, including animal behaviour and welfare, experimental psychology, veterinary, physiological and neurological science.
- Genetics.
- Psychology and human sciences.
- Operational analysis.
- Engineering and electronics.
- Software development.
- Modelling.
- Machine learning and artificial intelligence.