**£JC3504 Robot Technology Assessment 2**

**Autonomous Martian Sample Collector (AMSC)**

**1. Overview and Objectives**

Humanity's pursuit of Mars exploration continues to advance, and the collection and analysis of Martian surface samples are essential to understanding the planet's geological evolution, the search for life, and potentially supporting future human habitation. Mars presents a range of extreme environmental challenges: complex terrain, intense temperature variation, and a communication delay of approximately 30 minutes with Earth, rendering remote control infeasible. This creates a pressing need for highly autonomous ground-based sampling robotic systems.

This call addresses that challenge, focusing on the design and development of the next generation of autonomous Martian sample collection robots. The call is supported by the strategic technology and investment partner SA.

SA has recently developed a breakthrough micro nuclear battery, with the following features:

* Continuous energy supply for up to 100 years without recharge or replacement;
* Maximum output of 40W;
* For safety reasons, each robot may carry only one battery.

This funding call invites UK universities and their industrial partners to design a fully functional prototype of an autonomous ground robot for Martian sample collection, powered by the SA battery. Proposals must demonstrate the ability to navigate diverse terrain, collect geological samples, and return them to the landing site – all without real-time remote control.

⚠️ This is a **Call for Proposals**. Applicants are required to respond to a defined set of questions, outlining a **technically feasible, integrated, and validated system design**.

The call prioritises:

* Technical feasibility and environmental adaptability;
* Autonomy within power and safety constraints;
* Societal importance;
* Value to both the applicant institutions and the investment partner SA.

Creative, interdisciplinary approaches are encouraged, with consideration of the project's broader educational, societal, and commercial potential.

**2. Mission Requirements**

Projects must address the following core objectives and technical criteria:

* The robot must autonomously depart from the Martian landing site, collect geological samples from designated areas, and return them to the landing site;
* It must operate efficiently within the power limit of 40W over a continuous mission period of **at least 90 Martian sols**;
* All control, sensing and decision-making must be performed locally – no remote operation allowed (30-minute communication delay);
* The system must navigate diverse terrains, including craters, rock fields, dunes and slopes;
* The system must prioritise collection of **larger and more diverse geological samples**;
* All components must be designed to withstand Mars' extreme environmental conditions, such as low pressure, dust storms, radiation and temperature fluctuations;
* **Adequate physical protection must be provided for the nuclear battery**, ensuring resistance to impact, fall or structural damage, to mitigate explosion risks;
* SA will supply battery interface specifications and safety requirements at the project initiation stage.

Proposals should present a systems-level response to these constraints, including energy management strategies, perception and control logic, sampling mechanisms and overall safety considerations.

**3. Proposal Questions and Guidance**

Respond to each of the following ten questions in your proposal. Each question includes a character or word limit and guidance to assist applicants, especially those with limited proposal writing experience. Use diagrams, charts, and references where appropriate.

**1. Project Summary (max. 500 words)**  
*Aim: To provide a clear overview of the proposal’s scope, purpose, and impact.*  
Clearly summarise the project’s goal, methods, and anticipated outcomes.

* What is the core mission?
* What is your proposed technical approach?
* What impact or innovation will this deliver?

Your Answer:

**2. Technical Approach (max. 3000 words)**  
*Aim: To assess the technical feasibility and completeness of the proposed robotic system.*  
Provide a detailed explanation of your system design. Where appropriate, please include **illustrations, block diagrams, annotated schematics, system architecture charts, or control flow visuals** to help convey the functionality of your robot and its subsystems.

* Describe your robot's mechanical structure, mobility system, sensors, and power strategy;
* Explain autonomy architecture: navigation, terrain mapping, decision-making;
* Describe the sampling system and environmental resilience;
* Include energy budgeting, local control algorithms, and fallback systems;
* and more.

Your Answer:

**3. Innovation and Uniqueness (max. 1000 words)**  
*Aim: To evaluate the novelty and originality of the proposed solution.*  
Identify the originality of your solution.

* What makes your approach novel?
* How does it differ from existing Martian missions (e.g., Perseverance)?
* Does it incorporate new algorithms, materials, or configurations?
* and more.

Your Answer:

**4. System Integration Plan (max. 800 words)**  
*Aim: To understand how individual components will be integrated and tested as a coherent system.*  
Show how components will function together.

* What is the integration strategy?
* How will modules be tested and validated?
* Will you use simulations or physical prototypes?

Your Answer:

**5. Path to Scientific and Technical Impact (max. 600 words)**  
*Aim: To demonstrate how the project will advance UK capability in robotics, AI, and space technologies.*  
Explain how this project contributes to the UK’s scientific and engineering leadership. For example:

* Will it produce data, tools, or frameworks?
* Will it influence standards, education or further research?

Your Answer:

**6. Project Management and Risk Assessment (max. 1000 words)**  
*Aim: To evaluate the robustness of the work plan and risk mitigation strategies.*  
Demonstrate how the project will be delivered. For example:

* Timeline, milestones and task assignments;
* Identify key risks and your mitigation plan.

Your Answer:

**7. Societal Importance (max. 800 words)**  
*Aim: To highlight the project’s relevance to societal issues, public understanding, and responsible innovation.*  
Reflect on why the project matters for society. For example:

* What broader societal questions does this work touch on?
* Does it promote public understanding of space, nuclear power, robotics, or exploration ethics?
* Can it serve as a model of responsible innovation?

Your Answer:

**8. Commercial Potential and Business Development (max. 800 words)**  
*Aim: To assess the commercial viability of the project and its relevance to industry.*  
Evaluate the project’s potential beyond academia. For example:

* Can your technology become a product or service?
* Is there relevance to extreme-Earth applications (e.g., mining, search and rescue)?
* Are there plans for commercialisation, IP, or investment?

Your Answer:

**9. Strategic Value to SA (max. 800 words)**  
*Aim: To determine how the project benefits the technology and funding partner.*  
Describe how the project supports SA’s strategic aims. For example:

* Will the project validate SA’s battery in realistic environments?
* Could this enhance SA’s branding or open new markets?
* Is there potential for IP sharing or ongoing technical collaboration?

Your Answer:

**10. Author Contributions and Team Roles (max. 600 words)**  
*Aim: To ensure transparency in proposal authorship and contribution.*  
Provide a list of all individuals directly involved in preparing this proposal, including their affiliations and specific contributions to the writing process.

* Who are the contributing authors or team members?
* What section(s) did each person lead or support?
* Were any external advisors or industrial collaborators involved in shaping the content?
* Include a brief note on team coordination and internal review, if applicable.

Your Answer:

**5. Assessment Criteria**

Applications will be reviewed and scored independently by an expert panel. Each question will be evaluated according to specific criteria on a **1 to 5 scale**:

|  |  |  |
| --- | --- | --- |
| Score | Meaning | Credit (%) |
| 5 | Outstanding | 90% - 100% |
| 4 | Strong | 70% - 89% |
| 3 | Satisfactory | 50% - 69% |
| 2 | Weak | 30% - 49% |
| 1 | Inadequate | 0% - 29% |

Each proposal will be assessed across the following ten categories, corresponding directly to the proposal questions. Reviewers will evaluate both the content and clarity of responses, as well as the depth of contribution where applicable. Note that Question 10 will assess the transparency and completeness of authorship declarations, ensuring fairness and credit assignment in collaborative applications.

1. **Project Summary** (10%): Clarity of the proposed goal and its relevance to the call objectives.
2. **Technical Approach** (30%): Depth, feasibility, and completeness of the design.
3. **Innovation and Uniqueness** (10%): Originality, novelty and technological value.
4. **System Integration Plan** (10%): Coherence and practicality of integration/testing plan.
5. **Scientific/Technical Impact** (10%): Potential to contribute to UK research and engineering leadership.
6. **Project Management** (5%): Delivery credibility and risk preparedness.
7. **Societal Importance** (10%): Contribution to public understanding, ethical awareness, or social relevance.
8. **Commercial Potential** (10%): Opportunities for real-world deployment or commercial follow-up.
9. **Strategic Value to SA** (5%): Benefit to the battery provider and alignment with their development aims.
10. **Author Contributions and Team Roles** (0%): This section will not be scored, but will be reviewed to ensure transparency, accuracy and fairness in reporting individual contributions to the proposal.