

# RSO DNLEU PhD call: Guidance for submission and evaluation criteria

The Radioactive Waste Management Research Support Office (RWM RSO) is requesting applications for two PhD studentships to improve understanding of the long-term behaviour of alternative backfill for Depleted, Natural and Low-Enriched Uranium (DNLEU) disposal.

The aim of the RWM RSO PhD programme is to develop a portfolio of PhD projects focused on key RWM research priorities. The specific aims of the programme are to:

* Develop key skills required for RWM’s research mission over the coming decades, and to help deliver the next generation of geological disposal scientists, engineers and other researchers;
* Expand all aspects of the geological disposal research community throughout the UK;
* Encourage collaboration and communication between RWM and the academic community.

The two PhD studentships in the DNLEU theme will form part of the RWM RSO PhD studentship scheme. As such, we are looking to start these projects in October 2021. Students funded by RWM through the RSO have access to a growing geological disposal research community, training, and networking opportunities. Each project proposal is expected to cost less than £120,000 and RWM is, where possible, seeking co-funding from universities or third parties (either anticipated or confirmed) and/or in-kind contributions. Universities and researchers that have not previously received funding from RWM are particularly encouraged to apply. The contractual arrangements for the PhD studentships will be administered by RWM.

# Call structure

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| **Request for proposal sent on:** | **13th April 2021** |
| **Clarifications period closes on:** | **14th May 2021** |
| **Request for proposal closes on:** | **1st June 2021** |

All clarification questions (including commercial, technical, terms and conditions, and requests for flexibility in the deadline) should be sent before the **clarification period** is closed on **Friday 14th May** and addressed to the RSO via [rso-gdf@manchester.ac.uk](mailto:rso-gdf@manchester.ac.uk).

Any clarification questions or proposed changes to the scope of the project and/or grant agreement terms will only be considered during the Clarification period stated above and will not be accepted after proposal submission.

Proposals will be accepted until **12:00 on Tuesday 1st June 2021** as Word documents and supporting materials emailed to the RSO inbox: rso-gdf@manchester.ac.uk. Applications will be assessed by a panel led by RWM.

# Research brief

**Understanding the Long-Term Behaviour of Alternative Backfill for DNLEU Disposal**

### Introduction

Depleted, natural and low-enriched uranium (DNLEU) is classed as Low Heat Generating Waste (LHGW) in the UK. Thirteen percent of the UK ‘Baseline Inventory’ destined for geological disposal contains DNLEU (271,968 tonnes) [1]. Since the radioactivity and toxicity of DNLEU increases over time (in contrast with the radioactivity of other inventory wastes), there is a need to understand the long-term behaviour of any engineered barrier system developed to contain it.

Recent work has highlighted that phosphate-based cements are promising candidates for DNLEU container backfill since they could promote the formation of highly insoluble uranophosphate compounds intended to limit migration of uranium through the near-field [2,3]. Investigation of phosphate-based cement is also recommended as an outcome of RWM’s Uranium IPT report [4] and is highlighted in the 2020 Science and Technology plan (Task B3.1.2) [5] as an option for post-closure management of DNLEU. An ongoing disposability consideration, the proposed approach utilising phosphate based cements could deliver a significant cost and hazard reduction though removing the need for uranium treatment.

### Scope

The RWM RSO invites proposals that will help RWM improve its understanding of: (i) the long-term evolution of phosphate cement materials within repository environments and (ii) to further understand the behaviour of uranium and its daughters in phosphate-rich environments. Specific areas of interest include, but are not limited to:

* Degradation of phosphate-based cements by groundwater.
  + Interactions and degradation of phosphate based cement by soluble sulphates and chloride ions from the groundwater.
  + Hydrothermally aging studies of phosphate-based cements.
  + Interface processes between cement-based materials, representative host rocks (including Lower Strength Sedimentary Rocks (LSSR)) and the effect on the physical transport properties
* Behaviour of uranium oxides in phosphate-saturated cement leachates
  + Including analysis of variant DNLEU source term (e.g. UO2, UO3) on U behaviour in these systems under representative resaturation conditions.
  + Analysis of the longevity and stability of U-phosphate minerals under post-closure conditions.
* Sorption to and / or transport of uranium and daughters through variably aged, phosphate-bearing cements
* Geochemical modelling in fulfilment of the above

This project could span multiple studentships, thus we invite proposals that may only fulfil partial scope. For example, the project could be split between the uranium chemistry (i.e. solubility, speciation and sorption of wastes and reaction products) and the cement evolution (chemical and physical alteration, microstructural change and transport dynamics).

### References

[1] RWM (2016) Inventory for geological disposal

[2] W. J. Montague (2014) “The Suitability of Magnesium Phosphate Cement for Uranium Metal Encapsulation”-PhD thesis. Imperial college

[3] A. Covill, N. C. Hyatt, J. Hill & N. C. Collier (2013) “Development of magnesium phosphate cements for encapsulation of radioactive waste” Advances in Applied Ceramics, 110:3, 151-156.

[4] RWM/NDA (2016) Geological Disposal- Investigating the Implications of Managing Depleted, Natural and Low Enriched Uranium through Geological Disposal.

[5] RWM, Geological Disposal: Science and Technology Plan, 2020

[6] M.J Rigali, P.V. Brady and R.C. Moore (2016) “Radionuclide removal by apatite” American Mineralogist. 101:12

**Proposals acceptance and evaluation**

The details requested from applicants and how these will be evaluated are as follows:

1. **Confirm that the PhD project would start October 2021 and complete in 4 years (not evaluated)**

Applicants are requested to confirm the project will be able to start in October 2021 and be completed within 4 years.

1. **Acceptance of the attached terms and conditions of the grant is mandatory:**

* Acceptance of the attached RWM terms and conditions is mandatory. A completed grant agreement isn’t needed with the application, but will be required if funding is awarded.
* If the grant agreement is not signed on award, then funding will not be issued.
* If after the grant award the grant agreement is not signed within 30 days, then RWM reserves the right to withdraw the award of the grant.

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| **PASS/FAIL** |  |

1. **Evaluation criteria:**

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| ***Scoring criteria*** | ***Score*** | ***Weighting (out of 100%)*** | ***Description and guidance notes*** |
| Please provide a clear proposal demonstrating alignment to the brief, or in the case of fulfilment of partial scope, please outline clearly the aspects of the brief to be fulfilled.  Please define the necessary timescales, including a project work plan and/or Gannt chart. If experimental work will be undertaken, a clear strategy for delivering, analysing and synthesising appropriate data should be detailed. | /4 | 50% | Responses should include:  - A demonstrable understanding of the challenge area and complexities within that, referring to the research brief;  - A project plan / Gannt chart showing key phases of work, milestones and deliverables including completing within required period of time;  - Clearly defined input / time / resources that would be required from RWM, excluding industrial supervision, to support or enable the project, such as security clearance, sample access or site visit to a licensed site;  - Identify any major risks to the research and mitigation that can be considered against these risks, including any risks of the research to be extended past agreed period of time;  - Identify any use of external facilities, such as NNUF or other national / international infrastructure and demonstrate that proposed activity has been discussed in advance with the relevant facility owners and is feasible within the bounds of the proposal. |
| Please show how the supervisory team has the required expertise in the relevant areas. | /4 | 10% | Expertise required in material science and radiochemistry, evidenced by e.g. journal papers, reports. This section will be assessed in relation to career stage and experience.  The inclusion of early career researchers, and / or researchers new to radioactive waste disposal, in the supervisory team is encouraged. |
| Skills and capability generation. | /4 | 10% | Identify the skills that will be developed by the proposed work and why they are relevant to the future of RWM.  Show how skills will be developed within the wider supervisory team. |
| Please provide a costed proposal, identifying additional ‘in-kind’ contributions which you can bring to the PhD project. | /4 | 30% | Identify cost breakdown between Tuition Fees, Stipend and Research & Training Grant, providing details of the estimates. Provide information on any secured or applied for funds or in-kind contributions to enhance the PhD. |

***Scoring criteria:***

0= No response or response does not meet any requirements

1= Marginal response with significant drawbacks or omissions

2= Acceptable response, meeting most criteria with only minor drawbacks or omissions

3= Good response which meets all requirements

4= Excellent response which meets and exceeds requirements