

# NWS RSO post-doctoral call in “Understanding the Mechanisms of Zirconolite Leaching”: guidance for submission and evaluation criteria

Nuclear Waste Services (NWS), via their Research Support Office (NWS RSO) is requesting applications for a Post-Doctoral Research Associate (PDRA) project “***Understanding the Mechanisms of Zirconolite Leaching***” in the Materials Science area.

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

* Develop the high-level skills required for the NWS research mission over the coming decades, and to help deliver the next generation of geological disposal researchers.
* Expand the academic geological disposal research community throughout the UK and internationally.
* Encourage collaboration and communication between NWS and the academic community.

The research project in Materials Science is expected to have a duration of 24 months, and the target start date is July 2024. The project proposal indicative budget is £350,000. The assessment and contractual arrangements for the project will be administered by Nuclear Waste Services. The NWS RSO is seeking proposals from academic lead investigators for a PDRA based project within their group. The lead investigator and will be responsible for recruiting a suitable candidate by the target award start date.

# Call Structure

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| Request for proposal sent on: | 27th May 2024 |
| Clarifications period closes on: | 27th May 2024 |
| Request for proposal closes on: | 24th June 2024 |

All clarification questions (including commercial, technical and terms and conditions) must be sent before the clarification period is closed and addressed to the NWS RSO via [rso-gdf@manchester.ac.uk](mailto:rso-gdf@manchester.ac.uk).

Any clarification questions 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 as .pdf documents and supporting materials emailed to the RSO inbox: [rso-gdf@manchester.ac.uk](mailto:rso-gdf@manchester.ac.uk). Exchanges between academics and NWS staff during the tender period is strongly discouraged. Applications will be assessed by a Nuclear Waste Services (NWS) panel of key stakeholders.

**Materials Science – Understanding the Mechanisms of Zirconolite Leaching**

Applicants are sought for a research project on developing mechanistic understanding of zirconolite leaching, with specific emphasis on the determination of congruent or incongruent dissolution processes. The lead investigator must be based at a UK university. The project is expected to be funded for 24 months. Proposals will be assessed and awarded by NWS and the NWS RSO will administer the tender process on behalf of NWS. The successful project will be associated within the NWS RSO ‘Materials Science’ theme.

It is the policy of the UK Government to manage higher activity radioactive wastes through a deep geological disposal facility (GDF). While not yet declared as waste, GDF planning assumes that the disposal inventory will include the UK’s civil plutonium (Pu). The likely options are that Pu would be disposed of either as an immobilised ceramic wasteform or, in the case of its potential future use in Mixed Oxide (MOX) fuel, in the form of spent MOX fuel assemblies [[1]](#footnote-1) [[2]](#footnote-2).One of the ceramic wasteform options under consideration for immobilisation is based on a zirconolite mineral formulation[[3]](#footnote-3).

To evaluate whether Pu disposal through its incorporation into zirconolite ceramic materials is practical requires the development of GDF concepts compatible with these materials. Any such concepts will need to be underpinned by a suitable safety case. An important component in safety case development for Higher Heat Generating Wastes (which include Pu) is demonstrating a suitable understanding of how the wastes including zirconolite ceramic materials will interact with groundwaters.

While significant work has been undertaken on zirconolite/groundwater interactions, it would be beneficial to NWS to deliver an improved understanding of the mechanisms by which dissolution of zirconolite ceramic materials occurs (e.g., are dissolution processes congruent or incongruent). The task proposed here will develop, undertake and report on experimental studies that will increase the understanding of the chemical mechanisms at play during the dissolution of zirconolite ceramic materials. In addition, advancements in understanding relating to the development of alternation layers, the mechanisms by which they form and the degree of surface passivation they provide would also be advantageous. NWS is interested in proposals for research which build on current understanding of leaching of zirconolite ceramic materials and is requesting that the academic community propose a solutions led experimental approach in any proposals.

In addition, NWS would welcome proposals presented in two stages, with the opportunity for NWS input incorporated through a gateway review after the completion of stage 1. For example,

* **Stage 1:** Zirconolite dissolution should be investigated using a well characterised, single-phase endmember zirconolite (e.g. CaZrTi2O7) to investigate and understand the dissolution mechanism. A well characterised, single-phase zirconolite test material is required to remove complications associated with compositional complexity and/or minor phase /impurity dissolution.
* **Gateway Review:** A gateway review with key NWS stakeholders should be undertaken to review the outputs of Stage 1 and define the approach to Stage 2.
* **Stage 2:** A second stage of work will be required to build on the Stage 1 studies using a well-characterised, single-phase uranium doped zirconolite (doping should be targeted at 0.3 formula units). Two options should be outlined and costed for Stage 2, with the option selected being dependent on the outcomes of Stage 1.
  1. If the dissolution mechanisms **can be** successfully elicited in Stage 1, a proposal for confirming whether the same mechanism is present in samples containing uranium as a redox sensitive Pu surrogate. This should be undertaken GDF relevant conditions (e.g., anoxic / reducing conditions).
  2. If the dissolution mechanisms **cannot be** successfully elicited in Stage 1, an alternative scope of work using the uranium doped zirconolite should be proposed which matures the NWS understanding of ceramic wasteform dissolution mechanisms.

Successful proposals will demonstrate an established academic record of research and publication in ceramic wasteform or related studies. Successful proposals will also demonstrate access to suitable samples (or sample fabrication capabilities) and experimental / analytical capacities to undertake all proposed work (either in-house or though collaborative arrangements). Ideally applicants will be able to demonstrate experience in the design, fabrication, characterisation and leaching of ceramic products, while clearly identifying the challenges these activities present.

The research timetable and proposed outputs should include a quality plan, a suitable number of detailed technical reports (e.g., reports covering the outputs of Stage 1, Stage 2 and a final summary report) and a full data pack containing results for NWS record keeping.

**Proposals Evaluation Criteria**

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

1. **Confirm that the project would start in July 2024 and be completed by July 2026.**

Applicants are requested to confirm the project will be able to start in July 2024 and be completed within 24 months.

**Applicant to confirm project will be able to start in July 2024: Yes/ No**

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

* Acceptance of the attached NWS 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 NWS reserves the right to withdraw the award of the grant.

**Applicant to confirm acceptance of NWS Terms and Conditions: Yes/ No**

1. **Evaluation criteria:**

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| ***Scoring criteria*** | ***Score*** | ***Weighting (out of 100%)*** | ***Description and guidance notes*** |
| **Research Excellence** | /4 | 35% | * The response will clearly define the scope and main deliverables from the project. * Describe how the work is novel and/or builds upon previous work or experience of the supervisory team and why this research in this proposal is the best method. * Describe how your proposal will make things better and advance knowledge; either by mitigating risk or finding a new or different way of doing things. * A demonstrable understanding of the technical and research background of the challenge area. * The suitability of the methodology to achieve the project’s aims. * The ambition, novel approaches and transformative aspects or potential outcomes that the proposed research might achieve. |
| **Fit to Scheme** | /4 | 20% | * Refer to specific NWS challenges that exist now or are likely to become issues in the future.      * Alignment to the brief or justification as to how the proposal meets NWS challenges. * Describe how the proposed research relates to those challenges and how they will tackle them/ increase understanding of them/ contribute to or produce an alternative tool or technique for dealing with them. |
| **Project Management** | /4 | 15% | * Include an approximate breakdown of costs to the nearest £1k showing how the funding will be split between labour, equipment, and consumables etc.:   + Fees (including overheads, permanent staff costs, estate costs)   + Research training support (e.g., travel and subsistence, conference registration fees, training courses)   + Equipment and consumables (equipment >£1K should be itemised)   + Include an estimate of when (month) expenditure will be required. * Incorporate a project plan/Gannt chart showing the durations of the key phases of the work and identifying key milestones and deliverables. * Identify any major risks to the research and associated mitigation that can be considered against these risks. * Demonstrate value for money for any equipment (costing more than >£1K) required to deliver the research, including in-kind access to equipment where appropriate. * Itemise any leverage associated with the research. This can include use of existing facilities, in-kind support from other areas/projects, use of NNUF or other national infrastructure. * Demonstrate that any proposed active work has been discussed in advance with the relevant facility owners/ operators and is feasible within the bounds of the proposal. |
| Skills and capability generation |  | 10% | * Identify the specific skill set that will be developed by the proposed work and demonstrate how & where that fits into the long-term NWS mission. * Identify “peripheral” skills/knowledge e.g., communication skills, networking, exposure to the nuclear sector that will be developed during the PhD research project and explain why these are now/will in the future be relevant to NWS mission. * Show how skills will be developed/retained within the wider supervisory team, e.g., networking, exposure to the nuclear sector. This will include the student, the Principal Investigator (PI), industrial supervisor and any other industry experts who will be engaged throughout the project. |
| Knowledge Exchange and Impact | /4 | 10% | * + Describe what will be done by the researcher and academic PI to ensure that the learning from the project is incorporated into the overall body of knowledge.   + Is visible to, and accessible by, interested parties within NWS, for example, are unlikely to have access to academic journals.   + Is visible to, and accessible by, the wider community (e.g., other academics, industry supply chain).   + Describe how the work will be made accessible to and/or could be applied by those working within the NWS or the supply chain.   + Identify other industries who might benefit from this knowledge |
| Cost | /4 | 10% | * As a guide the total indicative budget value is estimated at £350,000 * Provide a cost for the full duration of the project, including all costs i.e., labour, equipment, and consumables. * Identify any cost saving that could be made to reduce cost. * Price analysis will be carried out to ensure like for like costs capture the full project scope, deliverables, and milestones |
| **Total Score** |  |  |  |

***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

***Score Weighting:***

Research excellence = 35%

Fit to scheme = 20%

PM = 15%

Skills and capability generation = 10%

Knowledge capture = 10%

Cost = 10%

**Security and Publication Restrictions**

To be agreed with the Funder prior to contract award and commencement of project.

**T&Cs**

Terms and Conditions link is included within the webpage submission to support the application.

1. [assets.publishing.service.gov.uk/media/5c9e3e0140f0b625e1cbd851/Progress\_on\_Plutonium.pdf](https://assets.publishing.service.gov.uk/media/5c9e3e0140f0b625e1cbd851/Progress_on_Plutonium.pdf) [↑](#footnote-ref-1)
2. [NDA Strategy 2021 (publishing.service.gov.uk)](https://assets.publishing.service.gov.uk/media/605cb82fd3bf7f2f112f0f84/NDA_Strategy_2021_A.pdf) [↑](#footnote-ref-2)
3. Hyatt, N.C., “*Safe management of the UK separated plutonium inventory: a challenge of materials degradation*”, *npj Mater Degrad*, **4**, 28 (2020). https://doi.org/10.1038/s41529-020-00132-7 [↑](#footnote-ref-3)