NDA PhD Bursary Call 2018:

Developing and Maintaining Skills and Innovation Relevant to Nuclear Decommissioning and Clean-up

The NDA is requesting applications to its bursary scheme, to support the NDA mission to deliver safe, sustainable and publicly acceptable solutions to the challenge of decommissioning and clean-up of the UK's civil nuclear legacy. This year, up to £500,000 is available and Universities and Research Institutes are invited to make proposals in the following thematic areas:

A) Characterisation

1) In-Situ Analysis, specifically:

    a. Improved techniques for the surveillance and characterisation of plant, structures, waste, land and effluents for radiological and chemical contamination

    b. Remote (field sensing) for contaminated land, buildings, effluents and waste packages

    c. Improved detectors for more rapid analysis, more flexible deployment, improved information content etc.

2) Rapid and Automated Analytical Techniques, specifically:

    a. More rapid analysis methodology to support automation especially in labour-intensive areas of sample preparation and radionuclide separations to improve analysis cost, turnaround and improved supply-chain capacity.

        A key focus is on improved analysis/assay capabilities for alpha and beta radionuclides.

B) Waste Packaging & Storage

1) Development of in-cell technologies that will allow us to monitor the necessary functional performance and contents of metallic and concrete waste containers and waste packages during long-term storage (e.g. chloride deposition, condensation events, container corrosion, package dimensional stability and stress measurement, wasteform degradation, gas evolution and pressurisation monitoring).

2) Studies to underpin the performance of non-stainless steel metallic containers (e.g. carbon steels, cast irons) during long-term storage, and the effectiveness of coatings under conditions of storage, up to a period of 500 years.

3) Developments of methods to more efficiently apply the waste hierarchy principles of reuse and recycle. This may include efficient methods of sorting and segregation of wastes, decontamination, and reuse or recycling processes. Typically consider contaminated waste materials such as metals, concrete and soil.

4) Development of alternative treatment technologies that offer improvements in feed envelope, process control, volume reduction or wasteform stability over the existing baseline technology of OPC based cement encapsulation. This may include:

    a. Performance assessment of non-cementitious products.

    b. Problematic wastes or wastes where an optimised solution has yet to be identified such as organic wastes e.g. oils, solvents, decontaminants etc.

    c. Small volume wastes which may benefit from incorporation into existing processes or from small, mobile processing options.

C) Land Quality

1) Development of the understanding of the migration of radioactive and chemotoxic contaminants from buried concrete structures, including mechanisms of mobilisation of these into the environment such as diffusion & desorption; effective characterisation methods; and the generation of modelling and assessment tools to support the production of more robust Environmental Safety Cases.

2) Development of effective stakeholder communication tools for the representation of uncertainty and assessment of variability in determining the long term safety of radioactive waste disposals and management of contaminated land.

3) Expansion of the performance envelope of the latest generation of sampling equipment and analytical instruments to address the radioactive contaminants found at NDA sites, and to allow characterisation of groundwater conditions (including anoxic groundwater at geological repository depths 200-1000mbgl).

4) Novel investigation techniques for radioactive discharge pipelines from nuclear sites, including: methods for determination and application of fingerprints (using easily measured gamma emitters and the relationships between radionuclides of interest and easily measurable physical parameters (pH, eH, etc.) to determine the presence of and quantify more difficult to detect radionuclides; innovative remotely operated vehicle designs to characterise pipelines, within the operating constraints of nuclear sites, to optimise the cost/benefit of sampling.

D) Decommissioning

1) Technologies and techniques for the recovery, characterisation and in-situ treatment of wastes.

2) Development of dry decontamination.

3) Decommissioning tools and techniques for manual or remote deployment.

4) Monitoring of decommissioned facilities.

5) Treatment or remediation of contaminated buildings.

E) Spent Fuel & Nuclear Material

1) Research to determine the fundamental mechanisms of the corrosion and corrosion inhibition of irradiation sensitised AGR fuel cladding under pond storage conditions. This should, for example, consider the potential impact of stress and the microstructure on corrosion mechanisms and corrosion inhibition by agents such as hydroxide or boron in the presence of potential impurities such as chloride or sulphate in the water.

2) Research into the behaviours of irradiation sensitised AGR fuel cladding under moist and dry storage conditions, including the potential impact of stress and the microstructure of the cladding; notably behaviours which could compromise future containment or mechanical strength. This might consider the impact of surface oxides, potential storage gas compositions and impurities including the influence of variables such as temperature, humidity, radiation dose rate and free or 'fixed' moisture presence.

3) Research to demonstrate methods which could replicate the metallurgy of neutron irradiated stainless steel to provide representative simulant materials which could be used to examine the behaviour of neutron irradiated sensitised stainless steel in various wet, moist, or dry storage environments. The simulant material should enable experimentation without the requirement for heavy shielding and remote handling. The approaches might consider alternative forms of irradiation, such as proton or heavy ion irradiation, or techniques to develop bespoke microstructurally engineered simulants of neutron irradiation sensitised metallurgies.

4) Research into potential methods of treating damaged and degraded spent fuel materials, e.g. from ceramic, oxide or metal fuels, following exposure to water or air, to stabilise and immobilise them in a form suitable for long-term storage and/or final disposal.

5) Research into methods of improving performance of containment packages for intact or damaged, degraded spent (oxide and/or metal fuels) to facilitate long-term interim storage and/or final disposal.

Such improvements might, for example, include 'gettering' or recombination of radiolysis products from moisture or cover gas impurities; residual moisture capture; or provisions to limit container pressure while maintaining radionuclide containment.

6) Research into novel techniques which could support detection, (3D) mapping or tracing of very low level radionuclide releases in spent fuel storage ponds (typically containing hydroxide dosed water). The techniques might be used to monitor and confirm the levels of ongoing releases from historic sources such as 'plate out' on storage equipment; to provide 'near real time' mapping of radionuclide contaminants (typically, but not exclusively, caesium) in the pond water; to enable rapid detection and location of any incipient new sources of contaminant. Techniques might include remote scanning, in-situ sampling and analysis, use of low/zero maintenance tell-tale instrumentation or materials which could show low level contaminant concentration changes.

7) Research into potential novel approaches which may detect at an early stage the onset of general or local conditions which might promote corrosion of cladding or other fuel containment in fuel storage ponds. The approaches may, for example, involve real time measurement mapping of minute concentration changes of aggressive ions, or other species, or use corrosion electrochemistry measurements which may signal potential changes in the corrosion risk at an early stage.

8) Investigate effect of age, heat, impurities, self-irradiation and can materials on PuO_2 to support capability to make decisions on compatibility of individual Pu can contents for reuse

9) Non-destructive testing, other than ultrasonic techniques, to assess the integrity of steel Pu storage cans, specifically in relation to internal corrosion (e.g. pin-hole formation from the interior to the exterior). This could involve the development of a risk based approach to repackaging rather than having to use a conservative approach and repack when design life has been reached.

10) Research into potential approaches to reuse of plutonium so that the vast majority of UK plutonium can be converted into fuel qualified for use in new reactors.

11) Research into immobilisation technologies (e.g. process simplification) for all types of plutonium materials including oxide powder, MOX manufacturing scraps and residues.

12) Research into alternative approaches to geological disposal for the management of surplus uranic stocks.

F) Open Criteria

This category will be left open for civil nuclear decommissioning related proposals that might be of interest to the NDA and are not encompassed by the above themes. When constructing proposals for this theme, respondents should ensure their idea aligns with the NDA mission (see NDA Strategy 2016) and demonstrate this in their proposals. In particular, the NDA would be interested to receive proposals based on:

1) The development or application of robotic and autonomous systems for use in nuclear decommissioning.
2) The characterisation and interim end-states of aqueous effluents.

G) Collaboration with US research organisations

This year, respondents will have the opportunity to include an element of collaboration with research institutions in the United States in their research proposals on topics of mutual interest to NDA and DOE. The PI for the proposal should be a UK academic and he/she will need to have an established relationship with the US academic/research institution with whom the collaboration is proposed. The proposal should include separate costs for any secondments and/or work in the US, and any associated supervision costs. It should also indicate how overseas working would be managed. It should indicate whether the collaboration is essential or desirable to the proposal and the associated benefit of the collaboration. If work in the proposal is deemed relevant to US nuclear decommissioning challenges, the US DoE may fund part of the proposal.

N.B. Inclusion of a US collaboration element is not mandatory for bursary proposals, and applications without this element will not be "marked down".

Details and further information

Funding will be available to UK academic institutions for PhD projects and to SMEs seeking 'top-up' funding for CASE awards and EngDocs in relevant areas. Only project proposals with a total cost to NDA of less than £100,000 will be considered (excluding cost of any collaboration with US research organisations). Eligible projects will include PhD projects involving universities or subcontractors where the bursary is used as a grant top-up in order to access national facilities for research involving the

handling of radioactive materials. NDA does not stipulate how this money is to be spent and will not penalise proposals that utilise some of the bursary funding to increase the stipend to the PhD candidate.

To comply with the Government's protective security procedures all employees/contractors will be subject to an Industry Assurance check and a level of National Security vetting. Proposals will be assessed by a group of nuclear industry specialists. Contractual arrangements will be administered by the National Nuclear Laboratory (NNL) on behalf of the NDA.

Proposals must be submitted using the application form available on the NNL website **www.nnl.co.uk** and need to be submitted online at **www.nnl.co.uk** by 15:00 on the **9th October 2017**. Further information on the scheme the assessment criteria and selection process is also available by contacting the administrator, Dr Mark Bankhead directly at the following email address (**mark.bankhead@nnl.co.uk**) and within the documents posted on the NNL website.