Title: Real-time material degradation monitoring and assessment of waste containers using correlative non-contact non-destructive evaluation

Type of award: PhD Research Studentship
Department: Mechanical Engineering

Scholarship Details: Minimum £17,668 p.a. (2022/23 rate) subject to eligibility criteria and award

Duration: 3.5 years
Eligibility: Home (UK)
Start Date: December 2022

PhD Topic Background/Description
Nuclear power is an essential part of our sustainable electricity supply. As we move towards a net zero future the call on nuclear will be grow. A significant and well-known downside of nuclear power is the waste material and its safe storage. This PhD project focuses on safe and sustainable storage for future generations. In-situ measurements will be crucial for precise real time understanding of the waste containers structural condition to ensure safe storage. Non-destructive methods and improved accuracy, precision, and limits of detection together with uncertainty quantification will pave the way for reducing management costs of facilities while maintaining low risk levels. The aim of PhD is to devise remote strain and temperature measurement techniques to feed into a real time structural integrity (SI) assessment methodology to evaluate the condition of waste packages and/or spent fuel racks. The outcome is a demonstration that integrity safety cases can be based on the inspection capabilities devised in PhD. The main challenge is to detect and characterise small defects at an early stage (less than ~5 mm) so that mitigation measures could be designed accordingly. The research question is can imaging techniques be used to gather quantitative information from small defects located on the surface and sub-surface of the material. The PhD project will develop a new means of deriving degradation in the welds and packaging based on non-contact high fidelity imaging procedures to reveal flaw surface dimensions to be used in probabilistic approaches to predict remnant life. The project will involve using state of the art techniques such a digital image correlation (DIC) and high fidelity infra-red thermography (IRT), as well as applying ex-situ ultrasonic modelling and testing to generate correlations between flaw surface dimensions and depths.

This project is challenging and ambitious and is intended to gain more understanding of the mechanical behaviour of materials and particularly joining procedures in extreme conditions. We are looking for a talented, enthusiastic researcher to join our diverse team. The successful candidate will be based in the Solid Mechanics Research Group a world-leading research team at the University of Bristol.
supervisory team offers the skills and expertise required to support the PhD project: Dr Larrosa has expertise in the mechanics of failure of welded structures and in the mechanical characterisation of materials subject to degradation mechanisms with particular relevance to the nuclear industry; Prof. Barton is an internationally leading expert in experimental mechanics and mechanical testing; All the resources and expertise in terms of material preparation, mechanical testing, thermography, digital image correlation analysis and modelling are available within the research team facilities.

**Candidate Requirements**

Applicants must hold/achieve a minimum of a 2:1 MEng, MPhys or an MSc (or international equivalent) in physics or engineering with a preference for mechanics. They must be in post by March 2023

**Basic skills and knowledge required**

The project is experimental it will involve design, manufacture, and testing of welded components. Knowledge of mechanics, thermodynamics especially heat transfer is required. Experience in the basic mechanics of materials is essential. Experience of using tools such as MATLAB, Python and FEA is highly desirable. During the project these skills will be developed and enhanced. The project will develop new expertise in mechanical testing, imaging, and modelling.

**Scholarship Details**

Scholarship covers full PhD tuition fees and a **tax-free** stipend at the current RCUK rate (£17,668 p.a. 2022/23).

**Informal enquiries**

For questions about the research topic, please contact Dr Nicolas Larrosa or Prof Janice Barton.

For general enquiries, please email came-pgr-admissions@bristol.ac.uk

**Application Details**

To apply for this studentship, submit a PhD application using our online application system [www.bristol.ac.uk/pg-howtoapply]

Please ensure that in the Funding section you tick “I would like to be considered for a funding award from the Mechanical Engineering Department” and specify the title of the scholarship in the “other” box below with the name of the supervisor.

Interested candidates should apply as soon as possible.