Title:  Hydrogen Ventilation in a Geological Disposal Facility

Type of award  PhD Research Studentship

Department  Mechanical Engineering

Scholarship Details  Enhanced stipend up to £18,000 p.a. subject to eligibility criteria and award.

Duration  4 years

Eligibility  Home UK

Start Date  From 5 April 2022

PhD Topic Background/Description
One of the biggest engineering challenges in safeguarding the UK from the legacy of half a century of nuclear power generation may be found in the design of long-term storage for spent fuel. Plans are being developed for a Geological Disposal Facility, deep underground, where spent fuel can safely be allowed to decay. During this process, small quantities of hydrogen gas may be released. While not especially dangerous in small quantities, any long-term accumulation of a flammable gas could be dangerous, so understanding how quickly gasses might accumulate and in what concentration is essential to ensure that adequate ventilation is designed into the facility, and to understand the risk in the event of a failure of mechanical ventilation.

To address these questions of design and risk, in this project a scientific study into slow leakage flows will be carried out in a desktop-scale laboratory model, using density differences between fresh and salt water as a scale representation of the buoyancy of hydrogen gas leaking into air. In the Hele-Shaw laboratory we use non-invasive techniques, usually marking a fluid with dye and video-recording the flows for quantitative analysis. For this study of leakage over long timescales, the measurements will need to be automated. Leaking gas will mix with its surroundings, though how quickly is not yet known, and this strongly affects the combustibility of hydrogen accumulations and hence the risks associated with ventilation failure.

Furthermore, the vault environment will be filled with heat sources that will cause its atmosphere to become density-stratified, and this raises further challenges over predicting the rate of mixing of ascending hydrogen gas. A network of sensors to detect hydrogen need to be positioned within the vault so that a leaking package of spent fuel can be identified and removed. Back-tracing the leakage flow is a challenging inverse problem that draws together modelling, sensitivity analysis and experimental calibration. This project will suit a student with
a practical mindset for designing and building their own automated experiment, and who also has an interest in developing models to deepen their understanding of an extremely important engineering problem.

**Candidate Requirements**

Applicants must hold/achieve a minimum of a master’s degree (or international equivalent) in a relevant discipline: Aerospace Engineering, Physical Sciences, Mechanical Engineering, Chemical/Process Engineering, Applied Mathematics.

Please note, acceptance will also depend on evidence of readiness to pursue a research degree.

If English is not your first language, you need to meet this profile level:

**Profile E**

Further information about [English language requirements and profile levels](#).

**Basic skills and knowledge required**

Experience in programming in a compiled language relevant to the design of numerically intensive simulation is essential.

**Informal enquiries**

Please email Dr Andrew Lawrie ([Andrew.Lawrie@bristol.ac.uk](mailto:Andrew.Lawrie@bristol.ac.uk))

For general enquiries, please email [came-pgr-admissions@bristol.ac.uk](mailto:came-pgr-admissions@bristol.ac.uk)

**Application Details**

To apply for this studentship, submit a PhD application using our [online application system](http://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.