High-fidelity modelling of clad ballooning during a loss-of-coolant accident

Supervisors: Dr Michael Bluck (Mechanical Engineering) and Dr Mark Wenman (Materials)

Applications are invited for a PhD research studentship in the field of high-fidelity modelling of clad ballooning in nuclear reactor loss-of-coolant accidents. The post is supported by a bursary and fees (at the UK/EU student rate) provided by the EPSRC and the National Nuclear Laboratory (NNL). Candidates should fulfil the eligibility criteria for the award. Please check your suitability at the following web site: https://epsrc.ukri.org/skills/students/guidance-on-epsrc-studentships/eligibility/

The loss-of-coolant accident (LOCA) is generally the limiting design-basis accident in a LWR. In the event of such an accident, the fission chain reaction is automatically shutdown, however there remains ‘decay heat’ generation, perhaps 7% of operating power, for some hours following the accident. Removal of this decay heat requires that sufficient coolant can be brought into the core, and that the core, during this time, retains a "coolable geometry". This is not guaranteed - excessively hot, internally pressurised fuel pins can deform - so called ‘clad ballooning’ - and possibly form blockages to the flow.

A major focus of the reactor safety case is therefore to ensure that the consequences of a LOCA are manageable. To do so, we must understand and model both the complex mechanical behaviour of the fuel and outer cladding, and the coolant flow over the fuel pins. Indeed, these effects are strongly interdependent.

The aim is to develop a state-of-the-art computer code system to predict the 3-D clad ballooning behaviour of rods in a light water reactor (LWR) fuel bundle during a loss-of-coolant accident (LOCA). The code system will involve the dynamic coupling of a state-of-the-art 3-D fuel rod performance code with a state-of-the-art 3-D thermal-hydraulics code, will be validated using experimental data, and will be demonstrated for an LWR fuel assembly.

The position is a collaboration between the Nuclear Engineering Group within the Mechanical Engineering Department and the Engineering Alloys Group within the Department of Materials. This PhD is funded by the UKRI/EPSRC and the UK National Nuclear Laboratory (NNL).

You will be an enthusiastic and self-motivated person who meets the academic requirements for enrolment for the PhD degree at Imperial College London. You will have a 1st class or 2:1 honours degree in mechanical engineering or a related subject, and an enquiring and rigorous approach to research together with a strong intellect and disciplined work habits. An interest in fracture mechanics is essential. Good team-working, observational and communication skills are essential.

To find out more about research at Imperial College London in this area, go to:
http://www3.imperial.ac.uk/mechanicalengineering
http://www3.imperial.ac.uk/materials
For information on how to apply, go to:

http://www.imperial.ac.uk/mechanical-engineering/study/phd/how-to-apply/

Interested applicants should send an up-to-date curriculum vitae to Dr Michael Bluck, m.bluck@imperial.ac.uk. Suitable candidates will be required to complete an electronic application form at Imperial College London in order for their qualifications to be addressed by College Registry.

Closing date: until post filled

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