Institute for Sustainability; University of Bath

Project Title:	Modelling and optimization of tritium inventory in the cryogenic distillation isotope separation system of a future fusion power station
Lead Supervisor and co-supervisors:	Dr Alf Hill, Prof John Chew, Prof Steve Parker & Prof Semali Perera
Industrial Partner:	UK Atomic Energy Authority

Project Summary

Nuclear fusion promises to deliver clean zero carbon electrical power while being safer than nuclear fission and producing less nuclear waste. Plasma and fusion technology has made great strides forward in recent years, Iter construction continues and new commercial demonstration reactor called STEP has recently started. However, the conversion of deuterium and tritium is not expected to improve much beyond the present 2% and this means that efficient and reliable isotope separation systems will be needed for separation, purification and recycle of the gas mixture after the reactor. Cryogenic distillation is a well-established technique for separation of isotopes but there are many challenges to be overcome in order to design the future systems. The transport properties of liquid hydrogen isotopologues (H2, HD, HT, D2, DT & T2) is not well understood and prediction of vital distillation performance parameters such as flooding point, liquid holdup and minimum wetting rate is uncertain. Conventional methods for prediction are empirical correlations are only proven for more conventional fluids and it is not clear how well they apply to hydrogen systems.

In this project you will use fluid mechanics based approaches to improve these empirical predictions. You will work closely with tritium scientists and distillation operators at JET and use real plant data in order to further improve the predictions. Recent data is available from JET which you will use to tune simulations in AspenPlus and then you will put it all together to propose distillation systems suitable for future large scale reactors. The outcome of this project will be improved prediction of distillation performance, tuned models of the existing distillation processes and new design proposals for the future isotope separation system for a commercial scale nuclear fusion reactor.

Pending the signing of contracts, the project is co-supervised by researchers at the UK Atomic Energy Authority located in Culham, Oxfordshire and there will be many opportunities to visit and work at the site.

Sustainability issues addressed

The project objectives directly contribute towards a commercial scale nuclear fusion power station for which efficient and reliable isotopologue separations systems are an essential component. Expansion of zero carbon electrical power is an essential enabling piece towards zero carbon heating, transport and indeed chemicals manufacture via simultaneous electrification of chemicals manufacturing.

Eligibility criteria and selection process

Application:

Formal applications should be made via the University of Bath's online application form for a PhD in the department of Chemical Engineering. Please ensure that you state the full project title and lead supervisor name on the application form.

http://www.bath.ac.uk/guides/how-to-apply-for-doctoral-study/

Funding Eligibility:

This studentship is for 3.5 years' duration and includes Home tuition fees, a stipend (£17,668 per annum, 2022/23 rate) and a budget for research expenses and training.

Information may be found on our fee status guidance webpage, on the GOV.UK website and on the UKCISA website.