Fully-funded Nuclear Engineering Doctorate: Control of algae in fuel storage ponds

Academic supervisors: Prof Jon Lloyd (SEAES), Drs Jon Pittman and David Sigee (FLS)

Industrial supervisor: Dr Genevieve Boshoff (NNL)

Nuclear fuel and associated waste that results from the degradation of fuel cladding (referred to as sludge) is stored in a variety of facilities at Sellafield site. There is a requirement to recover the stored fuel and associated sludge in order to reduce the hazard associated with the facilities and in order to progress decommissioning of the site. Some of the storage facilities (open fuel storage ponds) are exposed to the environment and hence there is a deposition of organic material and nutrients, as a result the fuel ponds experience periodic extended algal blooms. Algal blooms significantly reduce visibility within the ponds and hence impact on fuel and sludge recovery operations, which require good visibility. Delays in waste retrieval due to algal blooms could considerably extend decommissioning timescales, hence increasing overall decommissioning costs and increasing the hazard associated with the storage facility. Algal blooms also result in the accumulation of contaminated organic matter (dead and decaying algae) which can add to the overall sludge waste volume and the burden on effluent treatment plants. There is therefore an interest in developing an understanding of algal systems and the application of methods to control or eliminate algal growth.

A variety of algal control techniques have been considered and assessed for application in nuclear fuel storage facilities with varying degrees of success. One promising approach currently being assessed for plant trials is the use of biocides. In order to support the successful implementation of such technology it will be necessary to:

- Identify the microbial communities causing the problem in key facilities.
- Develop a test system, utilising appropriate strains.
- Establish factors triggering/controlling algal/microbial growth.
- Understand the effectiveness of algal control techniques (initially focussing on biocides) for different strains of algae.
- Understand the optimum dosing arrangements (e.g. optimum dose concentration, frequency and timing).
- Explore alternative technologies (should biocide dosing be unsustainable, or require complementary techniques).

This study will provide information to evaluate and optimise algal control approaches, with an aim to inform the deployment strategy within the fuel storage ponds. In some cases, algal biomass may not dominate the biomass blooms, and here we will assess the appropriate method of control. The information derived from the Eng Doc would complement experience developed from ongoing plant trials.

We seek a motivated graduate in biochemical engineering, chemical engineering or biotechnology/biology. The successful applicant will be based in the Nuclear Engineering Development Facilities in Cumbria and also work closely with the academic supervisors, with access to Manchester's state of the art laboratories in the Faculty of Life Science, and the Williamson Research Centre for Molecular Environmental Science. They will also work closely with effluent and biotechnology specialists from the UK's National Nuclear Laboratory (through industrial supervision and through working with the Effluent and Environmental Science Team), representatives from Sellafield Ltd Effluent Centre of Expertise and those from Sellafield Ltd decommissioning projects.

For further details contact: jon.lloyd@manchester.ac.uk