**The Modelling of Nuclear Thermal Hydraulics Phenomena**

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**ABSTRACT**

The commitment to the net zero economy has seen a resurgence of interest in nuclear power generation in many countries, including the UK. This has led to interesting developments in reactor design. The needs for a more flexible response in power supply and a more efficient construction processes have motivated vendors to invest in the development of designs of small and modular reactors. While most reactors currently in operation are based on water cooling cycles, the need to operate at higher temperatures have led to generation IV designs based on a variety of coolant cycles, including liquid metals, liquid salts, hight temperature gas and supercritical water.

The existing, mainly pressurized water and advanced gas cooled, and the proposed new reactor designs involve a wide range of thermal hydraulics phenomena, which are critical to reactor safe and efficient operation. Some of these phenomena are common to most reactor designs, while others are reactor specific. They include forced, natural and mixed convection, conjugate heat transfer, thermal transients, boiling and condensation, melting and solidification, and heat convection with high and low Prandtl number fluids. In all cases it is essential to have a sound understanding of these thermal hydraulics phenomena and to be able to reliably simulate them and accurately quantify their effects. These requirements pose severe computational modelling challenges, which research groups have been trying to address for decades.

This lecture will provide an overview of the contributions of the University of Manchester Thermo-Fluids research group on this topic. It will consider mainly modelling contributions and will cover topics in forced, natural and mixed convection, conjugate heat transfer, heat transfer in low and high Prandtl number fluids and solidification in liquid metal reactors. The emphasis will be mainly on the modelling of the effects of turbulence on convective heat transfer and on the development of reliable and cost-effective modelling strategies for this sector.