Vitrification is the technology of choice world-wide for management of high-level wastes (HLW) from used fuel reprocessing. Vitrification converts HLW solvent extraction raffinates and other wastes into glass waste forms by heating the waste with silica bearing materials to form a silicate melt. The melt is poured into stainless steel canisters where it solidifies into the final glass waste form. The composition of the melt must meet a number of competing property requirements related to the processability, product quality, and regulatory/contractual requirements. Formulation of glass composition entails the development of optimal glass compositions by balancing all the requirements that must be met. For the glass waste form to be successful, its chemical durability must remain stable over geological timescales, typically 1 million years. In addition, the stability of the waste form must be predictable over those timescales requiring a demonstrable rigorous, complex and iterative scientific approach called Long-term Behaviour Science. The methodology relies on closely coupled theory, experiments, and modelling. In this short course, we describe the process of vitrification as it is applied world-wide; demonstrate the glass formulation process; and supply an overview of the long-term behaviour science being applied to glass waste forms.

Specifically, this course will overview:

- The current status of HLW management within the primary nuclear fuel reprocessing nations.
- A survey of vitrification technologies deployed world-wide with reasoning behind their deployment of those technologies
- State-of-the-art glass formulation techniques deployed to obtain optimal HLW glass compositions.
- On-going research into the long-term behaviour of glass in the disposal environment.