

Hot Isostatic Pressing for Plutonium Immobilisation

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The UK has approximately 140 tonnes of civil separated plutonium dioxide (PuO₂) powder following completion of reprocessing operations. The management strategy for this inventory has recently been reviewed and, to reduce the long-term safety and security burden associated with it, UK Government policy has changed to immobilisation as the preferred way forward to put the material beyond reach. UKNNL has been supporting this mission by developing one of the credible options for Pu immobilisation, Hot Isostatic Pressing (HIP) technology, over more than two decades from inactive development to plutonium active sample fabrication and demonstration plant installation. The advantages of HIP and zirconolite are that together they produce a very robust ceramic material that is specifically designed for immobilising radioactive materials, with high loadings and very low leach rates. It is, however, less technologically mature than alternative options and requires development and demonstration. In 2020, a small-scale glove box capability was installed in Central Laboratory to allow plutonium zirconolite pellets to be fabricated and analysed. The subsequent samples produced have validated the Pu-zirconolite system with UK PuO₂ and successfully shown the system's chemical flexibility with respect to incorporation of neutron absorbers and variations of PuO₂ feed characteristics, such as age and chloride content. The current focus of work is commissioning the 'HIP100' facility; a laboratory-scale alpha-active HIP facility within UKNNL Central Laboratory. When complete in 2027 it will be the UK's first HIP capability able to manufacture PuO₂ containing products.